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"The Incentive Costs of Internalizing Externalities"

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The Incentive Costs of Internalizing Externalities[*]

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Abstract

We present a dynamic agency model in which changes in the structure of a firm affect its value due to altered incentives. There may be disadvantages in merging two firms even when such a merger allows the internalization of externalities between the two firms. Merging, by making unprofitable certain decisions, increases the cost of inducing managers to exert effort. This incentive cost arises as a natural consequence of the manager's firm-specific human capital.

1. Introduction

Mergers between competing firms sometimes create value by internalizing externalities. We argue here that this internalization may also decrease managers' incentives through its impact on their human capital, offsetting the increased value. To fix ideas, consider the effects of a merger between the American television networks CBS and ABC. There is strong "late-night" competition between CBS, ABC, and the third major network, NBC. Two of the networks, CBS and NBC compete via entertainment shows (*The Late Show* with David Letterman and *The Tonight Show* with Jay Leno, respectively), while ABC broadcasts a "highbrow" news program *Nightline* featuring Ted Koppel. It is commonly believed that the entertainment programs are substantially more profitable than the news program, and as a consequence, there are recurrent rumors that the news program might be replaced by a program that is more entertainment oriented.[1] Replacing or reorienting the program would likely have several effects. First, the combined profit of the three networks would probably decrease, since the reduction in variety offered is likely to result in a smaller number of viewers of all networks combined. Second, the producer of *Nightline* would see a decline in the value of his human capital. He currently has a relationship with a large number of people who can be called upon to provide expertise for a wide variety of topics that might be covered on the program. Those relationships have dramatically lower value should ABC make a strategic change and reorient the news program to include more entertainment content.

The possible destruction of some of his human capital may provide the producer of *Nightline* an incentive, above and beyond any direct financial incentives, to make that program a success. The incentive is operative whenever it is optimal for the network to reorient *Nightline* after sufficiently low ratings. The threat of reorientation thus reduces the cost to ABC of inducing any given effort level from the producer.

We turn now to the effect of a merger of ABC with one of the other networks, say CBS. There is an obvious advantage of such a merger, namely the internalization of externalities. In the absence of any merger, by maximizing its stand-alone profits, each network ignores any cannibalization of the other network's audience. After a merger, cannibalization is taken into account, and any decision will maximize the joint profits of the two networks. For example, if ABC reoriented *Nightline*, ABC might well see its profits increase, but at least some of the increase in profits would likely come from the rival networks. If the combined profit of ABC and CBS was *reduced* by such a reorientation, a merged firm would take this into account and not reorient *Nightline*. But in this case, the producer of *Nightline* need not worry (or not worry as much) about

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[1]Indeed, in February-March 2002, ABC tried to lure David Letterman from CBS. A detailed discussion can be found in the articles "How ABC's Full-Court Press Almost Landed Letterman" and "Doubted as Business, Valued as Asset, Network News Will Be Hard to Displace", both in *The New York Times*, March 18, 2002, page C1.

a decrease in the value of his human capital in the event that the program performs poorly. The implicit (credible) threat that the program will be reoriented following poor performance has vanished, and consequently, direct financial incentives must be increased to induce the premerger effort level.

More generally, the optimality of any business plan for a firm will depend upon many aspects of a firm. Changes in the structure of a firm (such as a merger) will affect the optimality of various business plans. Because changes in the business plan alter the effectiveness of workers' human capital within the firm, such changes in the structure of the firm affect the optimal contracts within the firm. We illustrate and discuss the incentive effects that accompany such redeployment in the context of a merger between firms that allows for the internalization of externalities. We should also emphasize that while we focus on negative incentive effects, positive incentive effects are also possible.

We present the model in the next section and demonstrate the differences in the optimal contracts under different organizational structures. In section 3, we discuss related literature and then conclude, in section 4, with a general discussion.

2. Dynamic Agency

We first describe a dynamic principal-agent relationship in which the owner ignores any externalities. The manager exerts either high (H) or low (L) effort in each of two periods. At the end of each period, there is a binary signal stochastically related to that period's effort. The signal in period t is denoted y_t and we interpret it as indicating the *success*, s, or *failure*, f, of that period's project. At the end of the first period, and knowing the realization of y_1, the owner either maintains the current business plan (i.e., continue with the status quo) or introduces a new one. We refer to the former choice as the *passive action* and the second as the *active action* (we also say that the owner is passive or active). The generic action is denoted $\alpha \in \{a, p\}$, with p denoting the passive action, and a the active action. The manager knows whether the owner is active or passive when making his second period effort choice. The manager has firm-specific human capital, the value of which is affected by the owner's strategy.[2] Specifically, we assume the manager is more effective under the current business plan than under the new business plan.[3] The probabilities of success in the first period, ρ_e, and in the second period, ρ_e^p and ρ_p^a, are independent and given by:

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[2] "Business-plan specific human capital" might be a better term since the value of the manager's human capital depends not only on the firm, but also on the firm's strategy.

[3] Part of the manager's human capital is his knowledge of the current business practices, which may diminish drastically for some changes in strategy. A manager of a manufacturing firm who has a personal relationship with all the major customers of the firm will be less valuable if the firm decides to have all sales done on the web, or if the firm decides to outsource the marketing of the product.

	Period 1	Period 2	
e	ρ_e	passive, ρ_e^p	active, ρ_e^a
low effort	0.3	0.3	0.1
high effort	0.9	0.9	0.7

While not necessary for the analysis, it is convenient to think of the returns as accruing over time. Under this interpretation, the action of the owner at the end of the first period affects first, as well as second, period returns. For example, the choice to be active (introduce a new business plan) may require immediate asset reallocations by the owner. We assume the new business plan increases first period returns if the first signal is a failure. At the same time, the new business is riskier in that the payoffs are more extreme in the second period than under the original business plan.

	Period 1 returns		Period 2 returns		Total returns $\pi\left(y_1 y_2 \mid \alpha\right)$	
outcomes $(y_1,\, y_2)$	passive	active	passive	active	passive	active
failure, failure	0	50	50	0	50	50
success, failure	300	170	50	25	350	195
failure, success	0	50	350	400	350	450
success, success	300	175	350	425	650	600

Finally, both agents are risk neutral, with the manager's disutility of high effort in any period given by 120.

As in the standard moral hazard model, the effort level chosen by the manager is non-contractible. However, the outcome of each project (whether it was a failure or success) is observable to both the owner and manager and verifiable to third parties. Crucially, we assume that the owner's action at the interim stage is both ex post as well as ex ante non-contractible.[4] This is similar to Aghion, Dewatripont, and Rey (2001), and differs from the Grossman-Hart-Moore models of incomplete contracts, where certain actions are ex-ante non-contractible, but ex-post contractible. This implies that in any contract, wages can only be a function of the realizations of the signals in the two periods, y_1 and y_2; wages cannot depend on the action of the owner.

The manager's compensation (or wage) is denoted by $w(y_1 y_2)$. The manager has *limited liability*, so $w(y_1 y_2) \geq 0$ for all y_1 and y_2. The owner's payoff is

$$\pi(y_1 y_2 \mid \alpha) - w(y_1 y_2),$$

and the payoff of the manager is

$$w(y_1 y_2) - c(e_1) - c(e_2),$$

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[4]This requires that the final payoffs to the firm are non-verifiable.

where $e_t \in \{L, H\}$ is the effort in period t, and $c(L) = 0$ and $c(H) = 120$.

We now calculate the owner's optimal take-it-or-leave-it offer $w(y_1 y_2)$ to her manager.

It is straightforward to show that the owner optimally pays the manager just enough to induce him to exert high effort in both projects. Moreover, the owner will take the passive action, p, in the event of success of the first project, and the active action, a, in the event of failure.

In order to induce the manager to exert high effort in the second project, the owner optimally offers the minimum possible compensation in case the project turns out to be a failure. That is, $w(ff) = w(sf) = 0$. For the manager to exert high effort in the second project, wages in the event of success in the second period, $w(y_1 s)$, have to satisfy the following incentive constraints:

$$\rho_H^p w(ss) - c(H) \geq \rho_L^p w(ss) \tag{1}$$

and

$$\rho_H^a w(fs) - c(H) \geq \rho_L^a w(fs). \tag{2}$$

To provide optimal incentives for the first agency problem, the owner offers, in the event of failure in the first period, the minimum possible wage consistent with the incentive constraint of the second agency problem,

$$w(fs) = \frac{c(H)}{\rho_H^a - \rho_L^a} = \frac{120}{0.7 - 0.1} = 200.$$

It remains to determine the wage payment if both signals are successful. The wage $w(ss)$ will be chosen so as to satisfy the following incentive constraint (for the first agency problem) with equality:[5]

$$\rho_H \rho_H^p w(ss) + (1 - \rho_H) \rho_H^a w(fs) - c(H) \tag{3}$$
$$\geq \rho_L \rho_H^p w(ss) + (1 - \rho_L) \rho_H^a w(fs).$$

This wage is thus given by

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\begin{aligned}
w(ss) &= \frac{c(H)}{(\rho_H - \rho_L) \rho_H^p} + \frac{\rho_H^a}{\rho_H^p} w(fs) \\
&= 3400/9 \approx 377.78.
\end{aligned}
$$

It is useful to calculate the optimal wage contract *assuming* the owner is passive after any realization of the first period signal. We denote this wage by $\hat{w}$. As above, it is immediate that

$$\hat{w}(ff) = \hat{w}(sf) = 0$$

[5]Since the manager will exert high effort in the second period irrespective of the realization of the first period signal, the disutility of second period high effort can be ignored.

and
$$\hat{w}\left(fs\right) = \frac{c(H)}{\rho_H^p - \rho_L^p} = \frac{120}{0.9 - 0.3} = 200.$$

Turning to the wage $\hat{w}\left(ss\right)$, we have

$$\hat{w}(ss) = \frac{c(H)}{\left(\rho_H - \rho_L\right)\rho_H^p} + w(fs) = \frac{3800}{9} \approx 422.22.$$

Note that (second period) high effort is less effective with an active owner. If a first period signal of f results in the owner being active, the opportunity cost of low effort in the first period is not only an increase in the probability of a first period signal of f, but also a reduction in the effectiveness of second period effort, and so a further reduction in expected wages. On the other hand, if the owner is necessarily passive, this further reduction in expected wages from first period low effort does not occur, and so the wage after ss must be increased to obtain the same incentive effect.

For future reference, the expected payoff to the owner under the wage w is

$$\begin{aligned} & \rho_H \left\{ \rho_H^p \left(\pi\left(ss|p\right) - w\left(ss\right) \right) + \left(1 - \rho_H^p\right) \left(\pi\left(sf|p\right) - w\left(sf\right) \right) \right\} \\ & + \left(1 - \rho_H\right) \left\{ \rho_H^a \left(\pi\left(fs|a\right) - w\left(fs\right) \right) + \left(1 - \rho_H^a\right) \left(\pi\left(ff|a\right) - w\left(ff\right) \right) \right\} \\ = & \ 271, \end{aligned}$$

while the expected payoff for a necessarily passive owner, i.e., the expected payoff under $\hat{w}$, is 230.

2.1. Internalizing the externality

The choice of business plan by the owner has implications for economic agents other than the manager. For example, a rival firm may be hurt by a new business plan. Again, to keep things simple we assume that active choice imposes a negative externality of 200 on another firm. Under separate ownership, the owner ignores this externality, and, as described above, offers the wage contract w to the manager, and after a negative first period signal chooses the active action.

We now consider the impact of joint ownership (where the two firms have the same owner) on both the manager and the owner of the firm. Note that, as in Grossman and Hart (1986), the ownership structure does not affect the set of variables that can be contracted upon. Ownership only changes the identity of the individual who has residual rights of control.

Joint ownership implies that the negative externality the active action imposes on the other firm will be internalized. Intuitively, the active action is less attractive under joint ownership than under separate ownership. For the problem at hand, this will imply that joint ownership cannot replicate the outcome under separate ownership.

Suppose the owner offers the manager the wage contract w. After a negative first period signal, the owner must decide between the passive and active actions. Denote by V the value of the second firm when the owner is passive. This value V is assumed to be independent of the ownership structure.[6] The expected payoff from the active choice (which is what the owner would do in the absence of the externality) is then given by

$$\rho_H^a(\pi\,(fs|a) - w\,(fs)) + (1 - \rho_H^a)\,(\pi\,(ff|a) - w\,(ff)) + V - 200 = V - 10,$$

while the expected payoff from being passive is

$$\rho_H^p(\pi\,(fs|p) - w\,(fs)) + \left(1 - \rho_H^p\right)(\pi\,(ff|p) - w\,(ff)) + V = V + 140$$

(the payment of 200 after fs is sufficient to obtain high effort in the second period, irrespective of the action choice of the owner).

Thus, the manager faced with a wage contract of w does not exert high effort in the first period (since $w\,(ss) < \hat{w}\,(ss)$). Consequently, the owner offers the manager the wage contract $\hat{w}$, always chooses the passive action, and (since there is no externality from passive behavior) the expected payoff is

$$230 + V.$$

Under separate ownership, the firm imposes a negative externality on the other firm if and only if the first period signal is negative. The expected value of the externality is thus $(1 - \rho_H)(-200) = -20$. The combined value of the two firms under separate ownership is then given by

$$271 + V - 20 = 251 + V,$$

and so the internalization of the externality results in a lower total value.

The prospect of the active (instead of the passive) action in the event of failure motivates the manager to exert high effort as it reduces the rent the manager can ensure himself in the continuing relationship with the owner. In this sense, the active action acts as a disciplining device. However, the active action is no longer credible under joint ownership. It follows that the manager must be paid more under joint ownership (if the owner wants him to exert high effort) — which more than outweighs the potential gain from joint ownership.

Observe that the merger does not obtain although it is "efficient" in that the sum of the managers' and owners' payoffs is higher under joint ownership than under separate ownership. This inefficiency arises because of non-contractibilities.

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[6]This assumption can easily be relaxed. For instance, our conclusion would be unchanged if both firms are symmetric. In this case, V would be higher under separate ownership than under joint ownership.

3. Related Literature

Our paper is in the tradition of the literature on the boundaries of the firms; see Williamson (1975, 1985), Klein, Crawford, and Alchian (1978), Grossman and Hart (1986), and Hart and Moore (1986). Hart (1995) provides a nice survey of this literature. The main insight of the modern property rights approach, pioneered by Grossman and Hart (1986), is that property rights (and hence ownership) matter when contracts are incomplete. In more recent work on relational contracts, Halonen (1995) and Baker, Gibbons, and Murphy (2002) show that this insight continues to hold even in a repeated game setting. While we also consider a dynamic agency problem, in our setting, the owner's decision (following the first agency problem) constitutes a state variable which alters the continuation game that players subsequently play. Thus, in our model, players are engaged in a *dynamic game*, in contrast with most previous literature, which typically employed repeated games. This distinction is important because the phenomenon under study arises precisely from the change in the continuation game induced by the owner's behavior.

It should be noted that the conflict between the owner and the manager in our model is *not* the result of a holdup problem, unlike much of the related literature.[7] We also depart from much of the property rights literature by focussing on the link between agency problems and firm boundaries.

In recent work, Hart and Holmstrom (2002) present a model in which workers have preferences over firm policies and managers care about workers' interests. In their model, integration may not be optimal since workers' and managers' preferences are, by assumption, more difficult to align in an integrated firm. Hart and Holmstrom incorporate nonstandard variables in the utility functions of the actors; in contrast, managers and owners have preferences only over money and the disutility of effort as in the standard moral hazard problem in our model. A second distinction is that, unlike Hart and Holmstrom, agency problems are at the heart of our paper.

Our paper is also related to the recent finance literature on internal capital markets (see, for example, Stein (1997), Scharfstein and Stein (2000), and in particular Brusco and Panunzi (2001)). This literature shows that "winner picking" among different investment projects in a conglomerate firm may reduce managers' incentives to exert effort.[8] As in our paper, there may be a reallocation of assets after the outcome of the agency problem is observed. The paper closest to our model is Brusco and Panunzi

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[7]It has recently been argued that there has been an over-emphasis on the holdup problem in understanding organizational structure: "It seems to us that the theory of the firm, and especially work on what determines the boundaries of the firm, has become too narrowly focused on the hold-up problem and the role of asset specificity" (Holmstrom and Roberts (1998)).

[8]Meyer, Milgrom, and Roberts (1992) present an early model showing why winner picking may have adverse incentive effects (namely, by encouraging influence activities at the expense of productive effort).

(2001), in which after a successful realization of the project there is a chance that some of the returns are allocated to other projects, and consequently, the nonpecuniary benefit accruing to the manager is diminished. This is reminiscent of the owner's decision to reallocate assets in our model. As in Hart and Holmstrom, these finance papers incorporate variables in the utility function in addition to those in the standard moral hazard model (money and effort). In contrast, in our model, there are no psychic benefits.

The idea that a principal's inability to commit to some future action has negative incentive consequences plays a central role in Dewatripont and Maskin (1995). In particular, an investor (creditor) would like to commit not to refinance a bad project (so as to ensure that the better-informed entrepreneur does not choose such a project in the first place). However, such commitment by the investor may not be credible since, at the time of financing, some of the investment costs are already sunk and so it may be efficient to continue the bad project. The authors show that a decentralized credit market in which no single creditor has sufficient funds to fully finance the project, the moral hazard problem can be ameliorated.

It has been observed before that structural changes that improve efficiency ex post may reduce efficiency overall in a dynamic setting due to adverse effects on ex ante incentives (see, e.g., Cremer (1995), Olsen and Torsvik (1995), Meyer, Olsen, and Torsvik (1996), Olsen (1996), and Meyer and Vickers (1997)). The closest to our work is Olsen (1996), who shows that (vertical) integration may not be profitable even though it facilitates the realization of complementarity gains: by changing the set of ex post efficient actions, integration can aggravate the ratchet effect. In contrast, in our model the agent (manager) has no private information. Here, what makes the integration potentially disadvantageous is that agency costs increase following a merger due to a reduction of the manager's business-plan specific human capital.

4. Discussion

1. We analyzed a model in the value of a manager's human capital is affected by changes in the deployment of the firm's assets. Because of the link between firm organization and the value of managers' human capital, the internalization of externalities affects ex ante incentives by altering the set of actions that will be taken ex post. If the internalization of externalities is not contractible, organizational structure can have ex ante incentive effects by affecting the extent to which externalities will be internalized ex post. While we have focussed on incentive *costs*, these incentive effects can in general be either positive or negative. In our model, a certain (disciplining) action that imposes a negative externality on both the rival firm and the manager is optimal for the owner in the event of failure under separate ownership, but not under joint ownership. In contrast, a positive incentive effect of internalizing externalities would have resulted

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if we had assumed that the active action (which reduces the manager's rent in the ongoing relationship) imposes a *positive* externality on the rival firm, and is taken only under joint ownership in the event of failure of the first period project. More generally, the incentive effects of internalizing externalities could be either positive or negative depending on (i) whether the active action imposes a positive or negative externality on the rival firm, (ii) whether the active action increases or reduces the manager's rent in his ongoing relationship with the owner, and (iii) whether the internalization of externalities affects the action taken by the owner in the event of failure or in the event of success of the first period project.

2. It is not just mergers that can affect the value of managers' human capital, and consequently, their incentives; a similar issue may arise between two divisions within a single firm. Consider a situation with a single firm with two divisions, each with a two level managerial structure. Replace the owners of the two firms in our model with top level managers, each with a low level manager as in our model. Suppose that these top level managers have an effort choice, and to induce efficient effort, the managers must be given an equity share of their division, and that the structure of the payoffs when the managers take these efficient effort choices is as in our model.

When there are two separate top managers, the cost of providing incentives for the low level managers is as in our analysis. However, if one institutes a different firm structure with a single top manager, it becomes more costly to induce efficient effort choices for the low level manager. The reason is precisely as in our model: a single top manager will (by assumption) necessarily have his compensation tied to the performance of each of the divisions that he controls. But in this case, for any decision he contemplates within one division, he will internalize the externalities of that decision on the other division. By the same logic as in our analysis above, the set of actions that might credibly be taken by managers may be smaller with a single top manager than with separate managers for the divisions.

While we can translate our model to this case of multiple divisions within the firm, there is an important difference between the two cases. If the top level decision maker is a manager rather than an owner, the question of renegotiation arises. At the point where the top manager is to take the active action, the owner will *not* want him to take this action, since the owner cares about the negative externality this action imposes on the other division. This contrasts with the merger case in which the top level decision maker is the owner, and consequently is unaffected by the external effects of the active action. If the active action is contractible ex post, it will not be taken, and hence the potential disciplinary effect of the existence of the active action disappears. The only way that there can remain a disciplinary effect of the active action is if that action is *not* ex post contractible. In many situations this is likely to be the case. Consider, for example, the Buick and Oldsmobile divisions of General Motors. The top manager of the Buick division may understand well that design changes he is effecting might

increase demand for Buicks at the expense of the Oldsmobile division. It is difficult to imagine a contract between the owners of General Motors and the head of the Buick division that would eliminate the incentive to encroach on Oldsmobile's customer base, while still providing the Buick head incentives to increase sales in general.

3. The possibility that a decrease in business plan-specific human capital creates an incentive for the manager to exert effort raises the question of whether a similar incentive effect could be achieved by firing the manager after project failure. Firing the manager would seem to be the ultimate in decreasing the value of his human capital. However, even if the project fails, the manager may still have substantial firm-specific human capital that the firm would be reluctant to lose. Hence, the firm and the manager would find it in their interest to write a new contract following termination, and consequently contracts that threaten termination are not renegotiation-proof.

4. For organizational structure to have any effect on decisions, it must be the case that some actions cannot be contracted on. We discuss briefly the issue of noncontractibility and the role it plays in our model.

A central issue is whether the manager(s) and the owner(s) can renegotiate at the interim stage to take the efficient action, namely the passive action (independently of the outcome of the project). We assume that such renegotiation is infeasible since the owner's action is *ex post non-verifiable* (which implies that it is neither ex ante nor ex post contractible). It follows that ex post efficiency may not be obtainable.[9] Our assumption of non-contractibility is motivated by the observation that, in many circumstances, it is intrinsically hard to describe the "right" action in sufficient detail to distinguish it from many seemingly similar actions with quite different payoff consequences. If it is intrinsically hard to describe the desired action, contracting to induce that action may be impossible even after the state of the world is realized. Moreover, in many contexts, it seems plausible that the owner of the firm (or the agent responsible for taking the action) may not only choose from a large array of similar actions but that she may have *private information* about the payoff consequences of the different actions. This should limit, or even eliminate, any scope for contracts. It is for simplicity that we assume that *no* contract can be written about the owner's action.[10]

Note that our assumption is different from (but, as we see it, complementary to) what is commonly assumed in the literature on property rights and the theory of the

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[9]As is well known, ex post inefficiency in certain states of the world may provide ex ante incentives. In our model, this is the case under separate ownership: it is the ex post inefficient (active) action—in the event of failure—which motivates the manager ex ante. Under joint ownership, the inefficient action is no longer credible, and the manager has to be motivated by a larger monetary compensation in the event of success.

[10]Note that our assumption on contractibility is similar to standard moral hazard models in which the agent's effort is neither ex ante nor ex post contractible. In a recent paper, Aghion, Dewatripont, and Rey (2001) also explore the assumption of ex ante and ex post non-contractibility. However, they consider the case where control over a non-contractible action is transferable.

firm. Following Grossman and Hart (1986), much of the literature focusses on the hold-up problem and (ex post) renegotiation. Consequently, the literature typically assumes that certain actions are *ex ante non-contractible* but *ex post contractible.* It follows that, in contrast to our model, ex post efficiency can easily be achieved via renegotiation. The Grossman-Hart assumption of ex ante non-contractibility and ex post contractibility is often motivated by reference to the idea that the (ex post efficient) action may be difficult and/or costly to describe ex ante, possibly due to unforeseen contingencies. However, once the state of the world is realized, the efficient action is easily describable and verifiable.

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