ERASMUS UNIVERSITY ROTTERDAM

Erasmus School of Economics

A Game Theoretic Approach to Disciplining Advisers

Bachelor Thesis

Yao-ming Eng (319415)

Supervised by Prof. Dr. O.H. Swank

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Abstract

Decision makers in large companies and organisations are often constrained in time to become fully informed before making a decision. It is often the case that they rely on advice given by their advisers who do the analysis. However, a problem of reliability may arise when an adviser does not possess the same preferences as the decision maker. This paper studies how a trigger strategy can be used to discipline an adviser into giving advice according to the decision maker's preferences. Furthermore, it is also explained when it is profitable for the decision maker to use such a strategy. As an extension to the main conclusions, it is shown that it is possible that decision makers choose to follow an adviser with different preferences rather than an adviser with similar, but not the same, preferences.

1. Introduction

As Chief Executive Officer or government policy maker, or any executive function in general, a large part of daily activities involves the making of decisions. A typical CEO has to make decisions which cover a range of different areas, such as advertising, suppliers, staffing and purchasing. Moreover, the CEO is responsible for virtually any decision made within the company. Nowadays, however, it has become practically impossible for leaders of large organisations and governments to collect the right information, and weigh the costs and benefits by themselves before making a decision due sheer lack of time and expertise. Instead, executives and political leaders often rely on advisers or experts to become familiar with the project and listen to their advice on what would be the best outcome. However, one could wonder according to whose preferences and benefit this advice is.

The answer to this question is likely to be found in the selection procedure of the adviser. For example, Calvert (1985, p. 532) argued that decision makers who are predisposed to a certain belief, often look for information from sources which are known to share the same predisposition. This conclusion is shared by Dur and Swank (2005, p. 191) who found that the optimal adviser from a policy maker's point of view is one whose preferences are either exactly the same or similar in the predisposition, the so called Ally Principle. This would imply that the advice on the best outcome is often more or less given according to the decision maker's preferences. However, this is only true because the adviser holds a similar perception. But the question is then whether an adviser with a different predisposition can be of any use to the decision maker since there is an inherent problem of asymmetric information; the adviser is the only person familiar with the project.

According to Che and Kartik (2009, p. 819) heterogeneous preferences between an adviser and a decision maker can lead to a welfare loss for the decision maker when effort is not a choice variable. This is due to strategic withholding of information by the adviser. This is no surprise since the model used in their paper is in essence a one shot game in which reputation plays no role. As a result the adviser has no incentive to give advice in the interest of the decision maker. This paper contributes to this topic area by introducing repeated interaction between a decision maker and an adviser. It will be shown that by using a game theoretic approach, i.e. a trigger strategy, it is possible to discipline an adviser with a different predisposition into following the decision maker's exact preferences. Moreover, it is shown that a decision maker may even prefer an adviser with a different predisposition over an adviser with similar preferences.

The organisation of the paper is as follows. In the remainder of this section, some comments will be made on the communication taking place between the decision maker and the adviser. Section 2 will present the basic game in which a decision maker interacts with an adviser in order to make a decision on a project. In Section 3, a description of the problem and the solution will be given, whilst Section 4 presents the equilibria findings in which a trigger strategy has the ability to discipline an adviser if he is patient enough. In Section 4 it will also be explained what the decision maker will do if an adviser is not patient enough. Section 5 presents an extension to the main conclusion in which the Ally Principle will be challenged. Section 6 will conclude the paper.

Before going deeper into the actual contents of the paper, it is necessary to note three characteristics of the communication taking place. First, the model used in this paper is a cheap talk game, i.e. the messages sent by the adviser does not directly affect the payoffs. This form of game was first studied by Crawford and Sobel (1982). In their paper the better-informed agent, the Sender, sends a possibly noisy signal to another agent, the Receiver. The Receiver then makes a decision which affects the welfare of both based on the information contained in the signal. The Sender's message and the Receiver's decision together form a Bayesian equilibrium. Second, for simplification effort will not be a choice variable in this model. Third, the decision maker who receives the messages is both rational and naive in different ways. On the one hand, he is naive in the sense that he will blindly follow the recommendations made by the adviser. This is leads to a situation which simply resembles delegation as, where the decision maker holds the formal authority and the adviser the real authority. On the other hand, the decision maker is rational, because he is only willing to do so if he knows it will be more profitable to listen to the advice than to ignore it.

2. The Model

The basic game used in this paper was constructed by Swank and Letterie (1997) to examine advice and interaction between policy makers and policy advisers. This framework is capable of capturing common observed themes in organisations, such as managers looking for information from employees or boards consulting experts. The model consists of two players: a decision maker (P) and an adviser (A). The decision maker (P) has to make a decision about a project $X = \{0,1\}$, where $X = 1$ represents implementation of the project and $X = 0$ represents keeping status quo. The payoffs to P are as follows:

$$U_P(X = 1) = p + \mu \qquad (1)$$

$$U_P(X = 0) = 0 \qquad (2)$$

In the utility function, p stands for the predisposition of the decision maker towards the project. This implies that if $p > 0$, P has a bias towards implementing the project. By the same logic, if $p < 0$, P has a bias against the project, i.e. keeping status quo. The μ is a stochastic term, uniformly distributed on $[-h,h]$. Using this information, it is clear that the decision maker, P, should implement the project if and only if $\mu > -p$. However, there is one assumption which complicates the decision-making process: P does not observe μ. Further assumptions are that $p + h > 0$ and $p - h < 0$, implying that the decision maker may make an incorrect decision without further information about μ.[1] Note that without further information about μ, P will make the decision in accordance with his predisposition, i.e. $X = 1$ if $p > 0$ and $X = 0$ if $p < 0$.

Before making the decision, the decision maker has the possibility to consult an adviser. This adviser, A, has the ability to observe μ. Furthermore, A is an interested party with the following utility functions:

$$U_A(X = 1) = a + \mu \qquad (3)$$

$$U_A(X = 0) = 0 \qquad (4)$$

Like in the case of the decision maker, a stands for the predisposition of the adviser towards the project. After observing μ, A can send a message m to the decision maker about the value of the project. In this basic model, the assumption is that A can send two types of messages: a good message, $m = m^g$, recommending the implementation of the project and a bad message, $m = m^b$, recommending keeping status quo. Furthermore, the assumption is that information is "soft" prior to the decision, meaning that it cannot be verified by the decision maker before the decision is made. This is in contrast to "hard" information, in which a decision maker can verify the received message.

[1] Note that if $p + h \leq 0$ or $p - h \geq 0$, the decision maker will always make a correct decision, since μ will either be always smaller than $-p$ or larger than $-p$

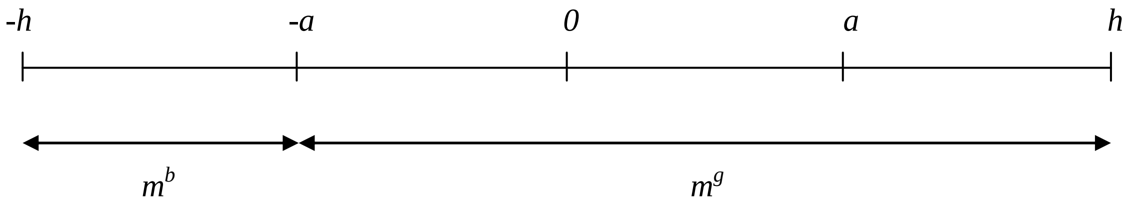
A summary of the basic DM-A game is as follows:

Players:	P and A
Timing of the Game:	- Nature draws μ
	- A observes μ, P does not
	- P makes decision on project $X = \{0,1\}$
Payoffs:	Decision Maker: $U_P\,(X = 1) = p + \mu$; $U_P\,(X = 0) = 0$
	Adviser: $U_A\,(X = 1) = a + \mu$; $U_A\,(X = 0) = 0$

2.1 The Communication Constraint

For the adviser, it is optimal to send $m = m^g$ if and only if $\mu > -a$ and to send $m = m^b$ if and only if $\mu < -a$.

Figure 1: A's Optimal Messages



Suppose the adviser sends $m = m^g$. Given the fact that $\mu > -a$, the expected value of μ is: $E\,(\mu \mid \mu > -a) = ½(h - a)$. By the same logic, if the adviser sends $m = m^b$, the expected value of μ is: $E\,(\mu \mid \mu < -a) = -½(h + a)$.

These values of μ give rise to a constraint for which the decision maker will listen to the adviser. Namely, in order for P to listen to A's advice, it requires:

(i) If $p < 0$ $\quad p + ½(h - a) > 0$

(ii) If $p > 0$ $\quad p - ½(h + a) \leq 0$

Solving both equations for a, a communication constraint is constructed for which the decision maker will follow the adviser's advice:

$$2p - h \leq a < 2p + h \tag{5}$$

If this communication constraint is violated, P will ignore A's advice. This situation will give the following payoffs:

$$U_P = p;\ U_A = a \tag{6}$$

3. Repetition and Trigger Strategy

Suppose we have a situation in which $p > 0$ and $a < 0$.[2] This could, for example, describe a right-wing minister and a left-wing adviser. The minister is biased towards implementing the project whereas the adviser is strongly biased against the project. Now assume the communication constraint explained in the previous section is violated. This means that under normal circumstances P will ignore A's advice and always implement the project according to his predisposition without observing μ. However, in some cases A has good information on why the project should not be implemented and P could use this information. In the model, this intelligence is described as $\mu < -p$.

Typically, a decision maker does not consult his adviser only once, but every time he has to make a decision. As a consequence, this leads to the DM-A game being played repeatedly. The decision maker could discipline the adviser into sending messages according to his preferences, i.e. $m = m^g$ if $\mu > -p$ and $m = m^b$ if $\mu < -p$, by using a trigger strategy. This would imply that P will follow A's advice as long as this advice is good. As soon as A gives bad advice, P will ignore his advice forever and make the decision according to his own predisposition.

It is important to mention that there is a distinction between two scenarios: a scenario in which the term μ can and cannot be observed by P after choosing $X = 0$. In the latter case, it is impossible for the decision maker to detect whether the adviser has defected. An example for this could be a new government policy. Suppose the adviser sends $m = m^b$ after observing μ and P follows this advice by deciding not to go through with the policy. By not implementing the project, the decision maker will never find out whether the adviser gave good or bad advice. Because detection is impossible in this case, the threat will not be credible and a trigger

[2] The reverse situation where $p < 0$ and $a > 0$ is solved in the same fashion (see the derivation in section 4.2)

strategy cannot be used.[3] In the other case, an investment decision on the stock exchange is an example where μ can be observed after choosing $X = 0$. Even after not going through with the investment, the decision maker can still infer whether it would have been a good investment and determine whether he received good or bad advice. Since detection is possible, the threat is credible, giving possibility of a trigger strategy. The assumption throughout the paper is that the stochastic term μ can always be observed no matter whether the project is implemented or not.

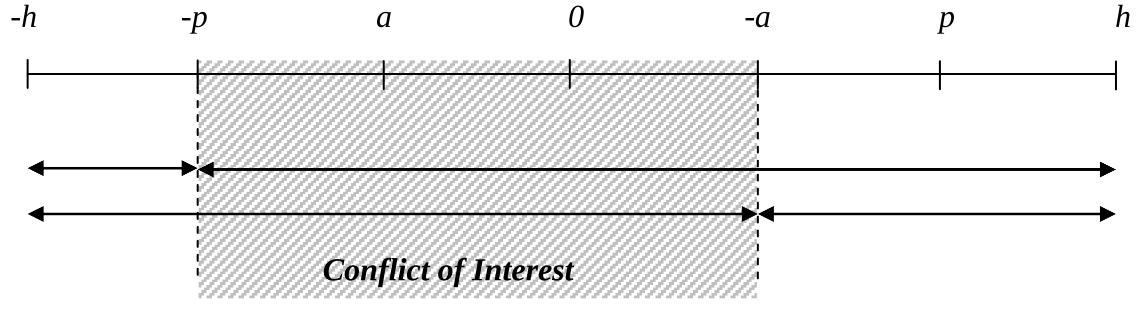
4. Equilibria

The idea behind the trigger strategy is that the adviser will be willing to cooperate, i.e. give good advice, if it is worthwhile to do so. Whether it is worthwhile to do so depends on how much the adviser cares about the future. Let δ denote the discount factor, i.e. the degree A cares about the future. The game will be repeated infinitely. Note that the solution will also hold for a game with an uncertain end period.

4.1 Situation $p > 0$ and $a < 0$

Due to the difference in the predisposition of the decision maker and the adviser, there is a conflict of interest. P wants A to send a good message, $m = m^g$, if and only if $\mu > -p$ and send a bad message, $m = m^b$, if and only if $\mu < -p$. The adviser, on the other hand, wants the project to be implemented if and only if $\mu > -a$, and keep status quo if and only if $\mu < -a$ (See Figure 2).

Figure 2: Conflict of Interests when $p > 0$ and $a < 0$



[3] This problem does not occur in the reverse scenario of $p < 0$ and $a > 0$, since a deviation implies implementation of the project. In that case, the decision maker can always detect whether the adviser has deviated

Notice that there is no conflict if μ > -a and μ < -p, since they both prefer the same decision in these situations. However, if -p < μ < -a, the decision maker would want the project to be implemented, whilst the adviser would like to keep status quo.

From figure 2, it is also possible to determine at which point the adviser has the strongest incentive to deviate. This point occurs when μ is furthest removed from his own predisposition –a, i.e. when μ = -p (at this value of μ, the decision maker is indifferent between implementing the project and status quo). If the adviser is willing to give good advice by sending $m = m^g$ at this point, then he will be also willing to do so over the whole range of –p < μ < -a where the incentive to deviate is not as strong.

Suppose nature draws μ = -p in period 0. If A would send $m = m^g$ at this point his utility would be the following:

$$U_A{}^g = a + \mu = a - p \tag{7}$$

By giving good advice if μ = -p in period 0, the decision maker will continue to listen to his advice for all periods afterwards, yielding the following payoff:

$$U_A{}^g = a - p + \frac{1}{2h}(h + p)\left[a + \frac{1}{2}(h - p)\right]\frac{\delta}{1 - \delta} \; where \; 0 < \delta < 1 \tag{8}$$

If A would send $m = m^b$ if μ = -p, A would get the one time utility of zero in period 0. The decision maker detects the deviation in the next period and as a consequence will not listen to the adviser from that period onwards. His payoff will be as follows:

$$U_A{}^b = 0 + a\,\frac{\delta}{1 - \delta} \; where \; 0 < \delta < 1 \tag{9}$$

A trigger strategy can now easily be constructed. The adviser, A, will give good advice if the payoff from doing so is larger than giving bad advice:

$$a - p + \frac{1}{2h}(h + p)\left[a + \frac{1}{2}(h - p)\right]\frac{\delta}{1 - \delta} > 0 + a\frac{\delta}{1 - \delta} \tag{10}$$

$$\delta^* > \frac{p - a}{p - 2a + \frac{1}{2h}(h + p)[a + \frac{1}{2}(h - p)]} \tag{11}$$

The value δ^* is a threshold discount factor for which the adviser will act in accordance with the preferences of the decision maker. If the discount factor δ is sufficiently high, A will send

$m = m^g$ if $-p < \mu < -a$. Note that the threshold δ^* decreases as the payoff the adviser receives from giving good advice increases, while keeping everything else constant.

Furthermore, by taking partial derivatives we find the following results:

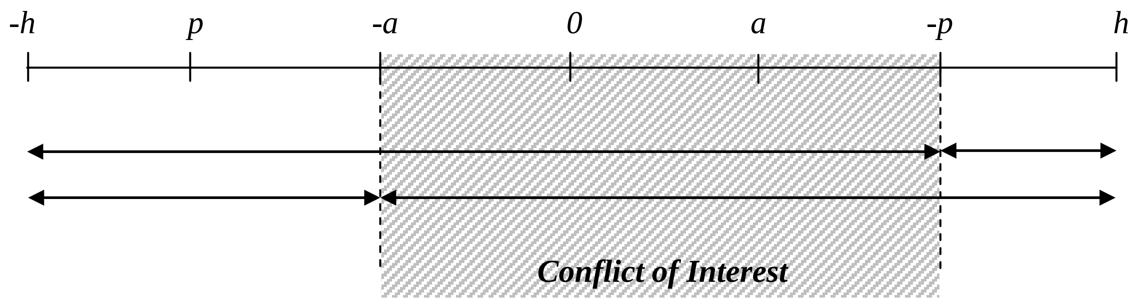
$$\frac{\partial \delta^*}{\partial p} > 0; \ \frac{\partial \delta^*}{\partial a} > 0; \ \frac{\partial \delta^*}{\partial h} < 0$$

The threshold discount factor δ^* is a positive function of predispositions p and a, and a negative function of h.

4.2 Situation p < 0 and a > 0

If we would assume the reverse situation of $p < 0$ and $a > 0$, the trigger strategy can be found in the same fashion as in subsection 4.1. Figure 3 provides a graphical representation of the problem at hand.

Figure 3: Conflict of Interests when p < 0 and a > 0



Also in this situation it is the case that when $\mu = -p$, A will have the strongest incentive to deviate by sending $m = m^g$.

Suppose nature draws $\mu = -p$ in period 0. If A would send $m = m^b$ at this point his utility would be equal to zero, since the project would not be implemented. Because this is considered good advice, the decision maker will continue to listen to the adviser for all following periods. This gives the adviser the following payoff:

$$U_A{}^b = 0 + \frac{1}{2h}(h+p)\left[a + \frac{1}{2}(h-p)\right]\frac{\delta}{1-\delta} \ where\ 0 < \delta < 1 \quad (12)$$

If A would send $m = m^g$ at this point, he would receive the following payoff in period 0:

$$U_A{}^g = a + \mu = a - p \tag{13}$$

The decision maker detects this deviation and will ignore his advice from period 1 onwards. Note that ignoring the adviser's advice implies that *P* will never implement the project since his predisposition is negative. As a consequence, *A*'s payoff will be zero for all other periods afterwards.

The trigger strategy will then be constructed as follows:

$$0 + \frac{1}{2h}(h + p)\left[a + \frac{1}{2}(h - p)\right]\frac{\delta}{1 - \delta} > a - p + 0\frac{\delta}{1 - \delta} \tag{14}$$

$$\delta^* > \frac{a - p}{a - p + \frac{1}{2h}(h + p)[a + \frac{1}{2}(h - p)]} \tag{15}$$

Taking partial derivatives we find:

$$\frac{\partial \delta^*}{\partial p} < 0;\ \frac{\partial \delta^*}{\partial a} > 0;\ \frac{\partial \delta^*}{\partial h} > 0$$

In this situation, the threshold discount factor δ^* is a negative function of *p* and a positive function *a* and *h*.

4.3 *When δ^* is not met*

In subsections 4.1 and 4.2 it has been determined what the discount factor should be in order to have the adviser behave exactly in accordance with the decision maker's preferences. If the discount factor is not high enough to meet this threshold, it implies that the adviser has an incentive to act according to his own preferences. As a consequence, the trigger strategy would not be stable and *P* should ignore the advice he receives and make the decision on implementation of the project according to his own predisposition. However, it is possible that *A*'s discount factor lies only slightly below the threshold. If this would be the case, it might still be profitable for *P* to listen to the adviser even though *A* does not always act according to *P*'s preferences. In other words, the decision maker could be less strict about having the adviser always giving good advice.

Figure 4: Not meeting δ^*

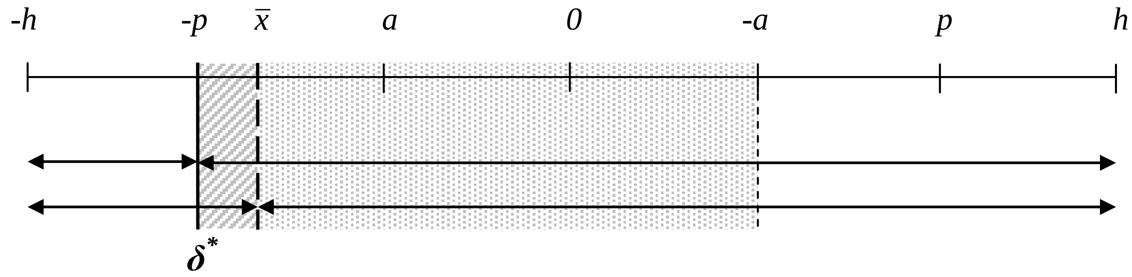


Figure 4 illustrates a situation where $p > 0$ and $a < 0$ in which the threshold is not met. In the previous subsections it was explained that at $\mu = -p$, the adviser would have the strongest incentive to deviate. Now suppose that A would indeed find it profitable to deviate at $\mu = -p$. This implies that the original threshold discount value would not be met, i.e. an unstable trigger strategy. However, it is possible that A would be willing to cooperate at an arbitrary point $\mu = \bar{x}$ in the conflicting interests area. In other words, the adviser, A, would give good advice, i.e. $m = m^g$, if $\bar{x} < \mu < -a$ and bad advice, i.e. $m = m^b$, if $-p < \mu < \bar{x}$. A trigger strategy could then easily be constructed based on $\mu = \bar{x}$.[4] Notice that the adviser can signal a bad message on certain range, even though the decision maker would have wanted the project to be implemented. The real question is then whether the decision maker would find it profitable to use a trigger strategy and listen to the adviser, even when the adviser will not follow his exact preferences.

For P it is beneficial to listen to the adviser if the utility he gains from doing so is larger than the utility he gains from ignoring the advice. If P listens to the advice, it can be determined that A will give good advice, i.e. send $m = m^g$, with probability $\frac{1}{2h}(h+\bar{x})$ and give bad advice, i.e. $m = m^b$, with probability $\frac{1}{2h}(h-\bar{x})$. Notice that when A sends $m = m^g$, the expected value of μ will be the following expression: $E(\mu \mid \mu > \bar{x}) = ½(h + \bar{x})$. Therefore, the total expected utility the decision maker gains from using a trigger strategy and listening to the adviser will be:

$$EU_P = \frac{1}{2h}(h+\bar{x})\left[p+\frac{1}{2}(h+\bar{x})\right]+\frac{1}{2h}(h-\bar{x})(0) = \frac{1}{2h}(h+\bar{x})\left[p+\frac{1}{2}(h+\bar{x})\right] \tag{16}$$

[4] The trigger strategy is constructed in exactly the same method as in section 4.1. The only difference is that $-p$ is then replaced by $\bar{x}$, resulting in $\delta^* > \frac{-\bar{x}-a}{\frac{1}{2}(h+\bar{x})\left[p+\frac{1}{2}(h-\bar{x})\right]-2a-\bar{x}}$

As given in equation (6), the utility the decision maker will gain from ignoring the advice will be p.[5] Given these pay-offs, it would be profitable for P to construct a trigger strategy and listen to A's advice, if and only if:

$$\frac{1}{2h}(h+\bar{x})\left[p+\frac{1}{2}(h+\bar{x})\right] > p \tag{17}$$

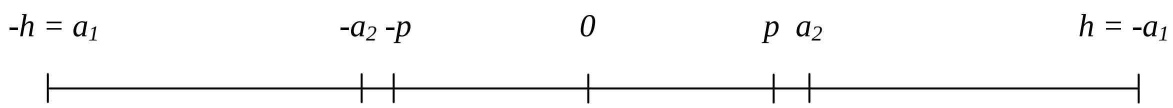
If this is not the case, the decision maker would be better off to ignore the advice and implement the project according to his own predisposition.

5. Extension

In the previous section the assumption was that there was only one adviser the decision maker could listen to. This means that if the discount factor is not sufficiently high enough, the decision maker would make his decision according to his own predisposition. If instead there was an additional adviser the decision maker could turn to, an interesting observation can be made.

In this game there are two advisers the decision maker can turn to. Let us assume that the first adviser, A_1, has a predisposition equal to $-h$. Under normal circumstances, this adviser would always send $m = m^b$ no matter what the value of μ is. The communication constraint is in this case violated. The second adviser, A_2, has a predisposition which is very close to, but not equal to the predisposition of the decision maker. This scenario is illustrated in figure 5.

Figure 5: Two Advisers



The Ally Principle states that the decision maker would rely on advisers whose preferences are similar to their own preferences. In this situation, it would mean that P would always rely on adviser A_2, and always ignore the advice coming from A_1, this to the dissatisfac-

[5] Naturally, in the reverse scenario of $p < 0$ and $a > 0$, the utility the decision maker would gain from ignoring advice is zero. Equation (16) remains the same in this scenario.

tion of A_1. However, as observed in the previous section, it is possible to discipline an adviser so that he sends messages in accordance with the preferences of the decision maker. In this scenario, the decision maker could make an agreement with adviser A_1 where it states that if he would give good advice, he would continue to listen to his advice and otherwise go back to relying on adviser A_2. Note that the reverse situation is not possible. The decision maker, P, cannot threaten A_1 by stating that he would rely on A_2 otherwise, since their communication constraint is violated.

Naturally, this agreement relies on a trigger strategy. The left-hand side of the equation is equal to the situation in which $p > 0$ and $a < 0$ in the previous section, i.e. equation (8).

$$U_{A1}{}^{g} = a_1 - p + \frac{1}{2h}(h+p)\left[a_1 + \frac{1}{2}(h-p)\right]\frac{\delta}{1-\delta} \; where \; 0 < \delta < 1 \tag{16}$$

The right-hand side is different, because in this situation the decision maker has another adviser he could rely on. If A would send $m = m^b$ if $\mu = -p$, A would get the one time utility of zero in period 0. The decision maker detects the deviation and will rely on the advice of A_2 from that period onwards. This has as consequence that P will choose $X = 1$ with probability $\frac{1}{2h}(h + a_2)$ and $X = 0$ with probability $\frac{1}{2h}(h - a_2)$.

$$a_1 - p + \frac{1}{2h}(h+p)\left[a_1 + \frac{1}{2}(h-p)\right]\frac{\delta}{1-\delta} > 0 + \frac{1}{2h}(h + a_2)a_1\frac{\delta}{1-\delta} \tag{18}$$

$$\delta^* > \frac{p - a_1}{p - a_1\left[1 - \frac{1}{2h}(h + a_2)\right] + \frac{1}{2h}(h + p)\left[a_1 + \frac{1}{2}(h - p)\right]} \tag{19}$$

Taking partial derivatives we find:

$$\frac{\partial\delta^*}{\partial p} > 0;\ \frac{\partial\delta^*}{\partial a_1} < 0;\ \frac{\partial\delta^*}{\partial a_2} > 0;\ \frac{\partial\delta^*}{\partial h} < 0$$

The threshold discount factor is a positive function of p and a_2 and a negative function of a_1 and h.

The result implies that if the discount factor is sufficiently high, in contrast to the belief of the Ally Principle, the decision maker will choose to rely on adviser A_1 instead of A_2. In other words, instead of depending on an adviser with similar preferences to his own, P will choose to depend on an adviser with different preferences, because he has the ability to discipline the latter by using a credible threat.

6. Conclusion

This paper studied the use of a trigger strategy in disciplining advisers with an opposite predispositions into giving good advice for decision makers. It is shown that it is possible that an adviser will follow the decision maker's exact preferences using a trigger strategy if and only if the adviser is patient enough, i.e. if the discount factor is high enough. If the adviser is not patient enough, the decision maker still has the possibility to make use of a more lenient trigger strategy. This implies that the decision maker allows for a certain extent of deviation, i.e. giving the opposite advice of what the decision maker would have wanted. However, this trigger strategy will be implemented if and only if it is more profitable for the decision maker to do so rather than to simply ignore any advice and make the decision based on his own predisposition.

Several simplifying assumptions needed to be made in order to reach these results. A key underlying assumption in order for a trigger strategy to be feasible in the model is the ability to observe the stochastic term μ even when the project is not implemented ($X = 0$). In reality, this assumption is plausible in scenarios such as investment projects where the consequences of a decision can still be observed in case of choosing status quo. However, the assumption is less likely to hold in cases such as government policies where choosing status quo will give little to no further information. In those scenarios, a trigger strategy cannot be implemented since detection of deviation is impossible. As a result of this, the adviser will have no incentive to act in the decision maker's best interest.

Furthermore, throughout a large part of the paper the model assumed that the decision maker had only one adviser to his disposal. Naturally, this is highly unlikely to be observed in reality. Gerardi and Yariv (2008) studied a model in which two advisers could be selected. In their paper they found that the optimal adviser selection is one consisting of two advisers who have opposing and more extreme preferences than the decision maker. In the extension section of this paper, another adviser was introduced to see what kind of effect this would have in the model used. It was shown that in contrast to the beliefs of the Ally Principle, it is sometimes optimal for the decision maker to choose an adviser with a completely different predisposition when an adviser with similar preferences is available. This scenario exists because of the possibility of threatening the adviser into following the decision maker's exact preferences.

Other simplifying assumptions relate to effort not being a choice variable and the lack of outside options for the advisers, i.e. a participation constraint. When effort is endogenous, different incentives may come into play. This topic has already been touched upon by Dur and Swank (2005) and Che and Kartik (2009). Furthermore, the analysis in Section 4 focused specifically on the incentive compatibility constraint of the adviser. One can imagine large consequences on the resulting incentive compatibility constraint if the adviser were to have the option to work for another decision maker with a different predisposition. Further research may go deeper on the inclusion of the participation constraint to see how this affects the results of this paper.

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