The behaviour of biased and unbiased advisers

in a repeated cheap talk model with multiple advisers

A. Kuiper[1]

Abstract

A problem with consulting an adviser is that the decision maker lacks information about the preference of the adviser. Advisers can be either good or bad, where the preferences of good advisers correspond to the preferences of the decision maker. Several studies found that good (bad) advisers act less (more) in line with the interests of the decision maker when they face reputational concerns. I show that these results still hold when a decision maker consults multiple advisers instead of one adviser. However, both advisers (good and bad) are inclined to act more in line with the interests of the decision maker in a setting with multiple advisers than in a setting with one adviser.

Master thesis – Economics of Management and Organization

ERASMUS UNIVERSITY ROTTERDAM

Erasmus School of Economics

Department of Economics

Supervisor: Prof. dr. B. Visser

March 2016

ERASMUS UNIVERSITEIT ROTTERDAM
ERASMUS SCHOOL OF ECONOMICS

[1] Student ID: 344860

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1. Introduction

The implications of many decisions are hard to forecast. Hence, a decision maker collects information about a project before making a decision. He could collect this information by himself, but also by consulting an adviser. As in many cases a decision maker lacks time and as an adviser has more expertise, it might be beneficial for the decision maker to consult an adviser. However, it is often the case that experts of a certain topic have particular interests in the outcome of a decision (Milgrom and Roberts, 1986). The bias this brings about could be problematic as it might result in less information transmission, i.e. the adviser does not always send his private information to the decision maker. Several studies state that this problem should not be exaggerated when the advisers care about their reputation (Kreps and Wilson, 1982; Milgrom and Roberts, 1986). The advisers might act more in line with the interests of the decision maker because of reputational concerns. However, there are also studies showing the opposite effect. For instance, Ely and Välimäki (2003), Morris (2001) and Wrasai and Swank (2007) showed in their theoretical models that reputational concerns could be harmful. They show that a good adviser might act less in line with the preferences of the decision maker when he cares about his reputation than in the reverse situation of not caring about his reputation.

To illustrate the idea of the above mentioned studies, consider the following example based on an example that Morris (2001) mentions. A policy maker has to make a decision about the implementation of a policy adjustment that positively discriminates women. The policy maker consults a social scientist that has more information about the consequences of this possible policy adjustment. The social scientist could be a sexist that is biased towards the rejection of this policy adjustment. Consider the case in which the social scientist is not a sexist (good/unbiased adviser), but that he found out that this adjustment is unbeneficial to society. In that situation, he would recommend the policy maker to not implement the policy adjustment when he does not care about his reputation. However, when the social scientist cares enough about his reputation and also wants to be taken seriously in the future, he could have an incentive to lie and tell the policy maker to adjust the policy. Morris (2001) calls this effect *political correctness*. The reason for this is that he does not want to be considered a sexist. When he recommends the policy maker to not implement the policy adjustment, the probability that he is a sexist increases from the point of view of the policy maker. On the other hand, when the social scientist would be a sexist (bad/biased adviser) and cares about his reputation, he could have an incentive to recommend the policy maker to adjust the policy when he knows that this is a good idea for society. Morris (2001) calls this the *discipline effect*.

The studies of Ely and Välimäki (2003), Morris (2001) and Wrasai and Swank (2007) are all based on a theoretical model in which the decision maker was able to consult one adviser only. The opportunity to consult multiple experts might affect the corresponding outcomes. The literature regarding multiple advisers shows that the possibility of consulting multiple advisers tends to have a positive effect on the extent to which information transmission is possible (Battaglini, 2002; Battaglini, 2004; Krishna and Morgan, 2001; Ottaviani and Sorensen, 2001).

In this thesis, I investigate what the effect is on the outcomes of Morris (2001) when I allow the decision maker to consult multiple advisers. I examine whether both good and bad advisers act either less or more in line with the interests of the decision maker when the decision maker consults multiple advisers instead of one adviser. To be more precise, I investigate what will happen to the political correctness and the discipline effect when I allow the decision maker to consult two advisers instead of one.

The model that I use is an extension of the theoretical cheap talk model of Morris (2001). This model is a two-period model in which the adviser has more information about the state of the world than the decision maker. In the second period the advisers do not have reputational concerns, whereas in first period they have. In contrast with Morris (2001), in my model the decision maker has the opportunity to consult two advisers besides the option to consult one adviser. I examine whether the so-called *political correctness* and *discipline effect* still exist and if so, how strong these effects are in the following three situations: (1) the situation in which the decision maker consults one adviser, (2) the situation in which the decision maker consults two advisers that give their advice simultaneously and (3) the situation in which the decision maker consults two advisers that give their advice sequentially. Moreover, I examine the effect of consulting two advisers instead of one adviser on the welfare of the decision maker.

Overall, my results show that the decision maker can benefit from consulting multiple advisers. The total expected welfare of the decision maker is higher when the decision maker consults two advisers instead of one. Furthermore, I found that the political correctness and discipline effect are still present when the decision maker consults two advisers. However, it is likely that more information transmission takes place when the decision maker consults two advisers. (1) Consulting two advisers that give their advice simultaneously instead of one adviser heightens the possibility of information transmission. In the case of two advisers that give their advice simultaneously, both good and bad advisers are more often inclined to tell the truth. This means that the political correctness effect reduces, whereas the discipline effect increases. The outcomes also depend on the quality of the information that the advisers have received. The higher the quality of the information, the more likely it is that the good and bad advisers tell the truth. The reason for this is that the decision maker learns more about the types of the advisers by comparing their advices. The higher the quality of the information, the more information the advices reveal about the types of the advisers. (2) Consulting two advisers that give their advice sequentially could either be less or more beneficial than consulting one adviser or two advisers (simultaneous). This depends on the specific values of several variables in the model.

The structure of this thesis is as follows. *Chapter 2* discusses the relevant literature regarding information transmission between advisers and a decision maker. Specific attention is paid to the concepts reputational concerns and multiple advisers. *Chapter 3* describes the model with its assumptions. In *Chapter 4*, I determine the adviser's utility functions of the first period for lying and truth-telling in the different situations (one adviser, two advisers (sequentially) and two advisers (simultaneous)). These utility functions are used in *Chapter 5,* where I compare the values for which the advisers are indifferent between lying and truth-telling in the situations mentioned. In this chapter, I also determine the effects of two advisers instead of one adviser on the welfare of the decision maker. *Chapter 6* concludes with a summary of the main results, a discussion and recommendations for future research.

2. Related literature

The relationship between a decision maker and an adviser has been the object of several studies. In their seminal study, Crawford and Sobel (1982) found that information transmission is only possible when the interests of the sender (adviser) and the receiver (decision maker) lie relatively close to each other. They made use of a cheap talk model with one sender and one receiver. To continue, it is often the case that experts have interests in the outcome of a decision (Milgrom and Roberts, 1986). As a result, the advisers do not always send their private signal to the decision maker. This bias could be problematic, as it might result in less information transmission. In this chapter, I discuss two factors that might affect the possibility of information transmission: reputational concerns and multiple advisers. Subsequently, as part of the concept of multiple advisers, I discuss the different effects of simultaneous and respectively sequential advising on the possibility of information transmission.

Reputational concerns

Several studies state that the problem of less information transmission following from biased advisers should not be exaggerated, because reputational concerns exist (Kreps and Wilson, 1982; Milgrom and Roberts, 1982). They mention that the adviser might act more in line with the preferences of the decision maker when the players meet each other in multiple periods. Reputational concerns might therefore increase the commitment power, which enables information transmission. Also, Suurmond, Swank and Visser (2004) showed that reputational concerns might have good implications. With their model, in which advisers want to be seen as high-ability experts, they found that good advisers exert more effort to be able to distinguish themselves from low-ability experts. Contrary to their model in which reputational concerns are based on ability, in my model the reputational concerns of the advisers are preference-based.

There are also studies showing that reputational concerns might be harmful for the decision maker. Ely and Välimäki (2003), Morris (2001) and Wrasai and Swank (2004) for instance showed with their theoretical models that reputational concerns could be harmful. Their results show that a good adviser might act less in line with the preferences of the decision maker because of reputational concerns. The reason for this is that a good adviser does not want to be perceived as a bad adviser. Therefore, in the two-period model of Morris (2001), a good adviser does not always tell the truth in the first period in order to increase his influence on the decision made in the second period (*political correctness*). On the other hand, bad advisers act more in line with the decision maker because of reputational concerns (*discipline effect*). Morris (2001) finds that no information transmission takes place in the first period when the second period is sufficiently important.

To conclude, the effect of reputational concerns on the extent to which information transmission is possible is ambiguous. In the models of Ely and Välimäki (2003), Morris (2001) and Wrasai and Swank (2004) the decision maker was only able to consult one adviser. I extent the model of Morris (2001) by adding the possibility for the decision maker to consult two advisers.

Multiple advisers

The literature regarding multiple advisers shows that the possibility to consult multiple advisers could influence the extent to which information transmission is possible. The effect of consulting multiple advisers on information transmission has been investigated by several researchers. Krishna and Morgan (2001) study the situation where the decision maker can consult two perfectly informed advisers that give their advice sequentially. They show that the decision maker should not consult both advisers when both advisers are similarly biased. In that case, it is never beneficial to consult both. On the other hand, when the advisers are opposingly biased, the decision maker benefits from consulting both experts. Hence, consulting multiple advisers could be preferred above consulting one adviser. However, when advisers send a message only once, there does not exist an equilibrium in which full information revelation occurs. Battaglini (2002) showed that full information transmission is possible when the policy space is multidimensional and the advisers are perfectly informed. This is even the case when the differences in interests of the advisers are relatively large. When the advisers are not perfectly informed in a multidimensional setting, full information transmission is impossible (Battaglini, 2004). In my model, I only examine a unidimensional setting. The studies mentioned above show that consulting multiple advisers has an effect on the possibility of information transmission. However, to the best of my knowledge, the effect of the possibility to consult multiple advisers on the strategy of the good (unbiased) and the bad (biased) reputational concerned adviser has not been studied yet.

Furthermore, the way in which the advisers send their information to the decision maker (sequential or simultaneous) can influence the possibility of information transmission. In the models of Scharfstein and Stein (1990) and Ottaviani and Sorensen (2001) advisers could show herding behaviour when giving their advice sequentially. A difference between their models and my model is that they consider reputation to be ability-based whereas in my model reputation is preference-based. Furthermore, in the model of Scharfstein and Stein (1990), the state of the world is not revealed after the first period, whereas in my model this is revealed. These differences might lead to different outcomes. Austen-Smith (1993) and Krishna-Morgan (2001) both study a model with two experts. Austen-Smith (1993) found that sequential advising should be preferred above simultaneous advising. Opposingly, Krishna and Morgan (2001) found that simultaneous advising should be preferred above sequential advising, as full revelation of information is only possible with simultaneous advising. Differences between their models are that in the model of Austen-Smith (1993) the state and the signals that the advisers send could be either 0 or 1, whereas in the model of Krishna and Morgan (2001) more outcomes for the state are possible. Furthermore, in the model of Austen-Smith (1993), advisers have imperfect information about the state of the world, whereas this information is perfect in the model of Krishna and Morgan (2001). Hence, these studies show that the way in which the advisers send their messages influences the extent to which information transmission is possible. As a result, I investigate both the situation of simultaneous and sequential advising.

3. Model

I consider a two-period model which is based on the model of Morris (2001). It is a dynamic game with incomplete information. In the first period, a decision maker has to take an action $a_1 \in [0,1]$. The optimal action depends on the state of the world. The state of the world could be either high ($\omega_1 = 1$) or low ($\omega_1 = 0$). The probability that the state is high is equal to $\frac{1}{2}$. When the state of the world is high, a high value of a_1 is beneficial to the decision maker. When the state of the world is low, a low value of a_1 is beneficial to the decision maker. The decision maker does not know the state of the world. He only knows that the probability that the state is high is equal to $\frac{1}{2}$. The decision maker can consult advisers for two subsequent periods to learn about the state of the world. The advisers receive a signal about the state of the world, $s_1 \in \{0,1\}$. The signal s=1 refers to a high state, whereas the signal s=0 refers to a low state. I examine the case in which advisers receive a noisy signal; the probability that the advisers receive the right signal is equal to γ, $Prob(s=1 \mid \omega_1=1) = Prob(s=0 \mid \omega_1=0) = \gamma$ with $½ < \gamma < 1$. The advisers differ in their preferences. The advisers can be either good (unbiased) or bad (biased). Hence, the type space of the advisers in this model is two-dimensional, as it depends on the observed signal about the state of the world (s=0 or s=1) and on the preferences of the advisers (good or bad). Henceforth, when I use the word "types", I only refer to the preferences of the good advisers (good and bad) and not to the observed signal. The ex-ante probability that an adviser is of the good type is equal to λ_1. Good advisers have the same preferences as the decision maker. Their total utility function is the following:

$-x_1(a_1-\omega_1)^2 - x_2(a_2-\omega_2)^2$ with $x_1>0$, $x_2>0$

Bad advisers are biased towards a high action; they always want the highest possible value of a_t regardless of the signal they receive. The total utility of bad advisers in this two-period model is equal to $Y_1a_1 + Y_2a_2$ with $y_1>0$, $y_2>0$.[2] After receiving a signal, the adviser(s) send(s) a message to the decision maker about the state of the world, $m_1 \in \{0,1\}$. When the adviser sends message m=1, he advises the decision maker to take a high action. When he sends the message m=0, he advises to take a low action. Finally, the decision maker chooses a certain action. After that decision, the state of the world will be revealed and the decision maker updates his belief about the type of the adviser(s), $\lambda_2 = \Pr(good_i | \lambda_1, m_i, m_{-i}, \omega_1)$. The second period is similar to the first period. The decision maker has to decide which action to take with respect to

[2] I assume that x_1 and x_2 are the same for all bad advisers and that y_1 and y_2 are the same for all good advisers.

a new project. I analyze the situations in which the decision maker consults one adviser, two advisers (sequentially) and two advisers (simultaneously).

To summarize, the time sequence is as follows:

Period 1

Project 1

1. Nature chooses $\omega_1 \in \{0,1\}$
2. Decision maker hires adviser(s) for two periods
3. Adviser(s) receive(s) a private signal about the state of the world ($s_1 \in \{0,1\}$)
4. Adviser(s) send(s) a message to the decision maker ($m_1 \in \{0,1\}$)
5. Decision maker decides to take a certain action ($a_1 \in [0,1]$)
6. The state of the world ω_1 is revealed
7. Decision maker updates his belief about the type of adviser(s) (λ_2)

Period 2

Project 2

1. Nature chooses $\omega_2 \in \{0,1\}$
2. Adviser(s) receive(s) a private signal about the state of the world ($s_2 \in \{0,1\}$)
3. Adviser(s) send(s) a message to the decision maker ($m_2 \in \{0,1\}$)
4. Decision maker decides to take a certain action ($a_2 \in [0,1]$)
5. Payoffs are realized

Besides the example of the policy maker and the social scientist, this model is also applicable in other settings that involve an adviser and a decision maker. Examples are the relationships between a client and a lawyer, a car owner and a car mechanic, a manager and a management consultant and a financial adviser and an investor.

In this cheap talk model, a babbling equilibrium always exists. In a babbling equilibrium, the messages that the advisers send are uncorrelated with their preferences (good or bad adviser) and the signals ($s=0$ or $s=1$) that they observe. As a result, the decision maker does not learn anything from the messages that he receives in this period. In this study, I examine whether a perfect Bayes equilibrium is possible in which the decision maker can extract information about the state of the world from the messages he receives. In the second period, there always exists a unique informative (i.e., non-babbling) equilibrium in which good advisers always tell the truth and bad advisers always announce message 1. The reason for this is that the advisers do not care about their reputation in the second period. My main interest is to find out what the effect is of consulting multiple advisers on the political correctness and the discipline effect that Morris (2001) showed. For this, I examine under which conditions informative (i.e., non-babbling) equilibria can exist in the first period for the situations of one adviser, two advisers (simultaneous) and two advisers (sequential). I examine when good and bad advisers have an incentive to either tell the truth or to lie about their signal.

For a perfect Bayes equilibrium in this game, the following conditions must be met with respect to the strategies and the updated beliefs: (1) the beliefs are consistent and are updated by Bayes' rule given the strategies of good and bad advisers, (2) the actions of the players (decision maker and advisers) are the best response to their beliefs about the type of each adviser and the strategies of good and bad advisers.

4. Total payoff functions

In this chapter, I determine the conditions under which informative (i.e., non-babbling) equilibria can exist in the first period. To find these conditions, I firstly determine the possible strategies for the good and respectively bad advisers. After that, I determine their corresponding total payoffs of deviating from and sticking to these strategies. I determine these conditions for the situations of one adviser, two advisers (simultaneous) and two advisers (sequential).

The total first period payoffs of the advisers consist of the payoffs of the first period plus the expected payoffs of the second period. I start this analysis by determining the expected payoffs for the second period of having a good reputation for all different situations (s*ection 4.1*). Subsequently, I determine the total payoffs of lying and truth-telling in the first period for the different situations (*section 4.2*). In Chapter 5, I will use the total payoffs that are determined in section 4.2 to compare the conditions under which informative equilibria can exist in the three different situations. Calculations underlying the payoff functions can be found in the Appendix.

4.1 Second period: expected benefits of reputation

In this section, the expected payoffs for the second period are determined. Firstly, I determine the strategies of the good and bad advisers in the second period (section 4.1.1). After that, I calculate the expected benefits for the advisers from having a good reputation when the decision maker consults one adviser (section 4.1.2) subsequently when he consults two advisers (section 4.1.3).

4.1.1 Strategies in the second period

In the second period, there always exists a unique informative equilibrium. As the second period is the last period, an adviser does not have an incentive to build a reputation. Because a good adviser wants the action to be closely in line with the state of the world, he always tells the truth. As a bad adviser wants the highest possible action, he always sends message 1. This is the same for the situations in which the decision maker consults one adviser, two advisers (simultaneous) and two advisers (sequential). The corresponding strategy is summarized in the following table:

Table 1

	s_1=0	s_1=1
Good adviser	0	1
Bad adviser	1	1

The decision maker knows the strategies of the different types of advisers. Hence, he takes their strategies and his beliefs about the types of the advisers (λ_2) into account while deciding which action to take in the second period (a_2). The action (a_2) that the decision maker takes differs for the situations in which the decision maker consults one or two advisers. It does not differ whether the advisers give their advice simultaneously or sequentially. The strategies of good and respectively bad advisers are the same in the situations of simultaneous and sequential advising. Hence, in the second period, I determine the expected benefits from having a good reputation when the decision maker consults one and two advisers.

To determine the expected value of having a good reputation, I first have to determine the action that the decision maker takes given the strategies of the advisers and the possible messages that the adviser sends. This is because the decision maker is the last player in this game. With information on the action that the decision maker takes, the expected values for the adviser can be determined.

4.1.2 One adviser

This situation corresponds to the situation in Morris (2001). To complete the analysis, I recalled his outcomes.

Decision maker. In the second period, the decision maker receives message 0 or 1. The decision maker learns the type of the adviser and the signal that the adviser had received when he announces message 0, as only good advisers that have received signal 0 send this message. Hence, the action that the decision maker takes is equal to the probability that the state of the world (ω_2) is 1 given that the message is 0. Therefore, the action is equal to (1-γ).

When the adviser sends message 1, the decision maker does not know the type of the adviser and the signal that this adviser has received. The action that the decision maker takes is equal to the probability that the state of the world (ω_2) is 1 given that the message is 1. Hence, the action is equal to $\frac{\gamma\lambda_2-\lambda_2+1}{2-\lambda_2}$.[3]

Adviser. Hence, the action that the decision maker takes in this case, depends on the reputation of the adviser (λ_2) and the probability that the adviser receives the right signal (γ). If the values of λ_2 and γ increase, a_2 increases as well. Both good and bad advisers benefit from having a good reputation.

The total expected values of having a good reputation in the second period for the different types of advisers are the following:

- *Good advisers*[4]

$$v_G[\lambda_2] = -x_2\left(\frac{1}{2}\gamma\left(\frac{1-\lambda_2+\lambda_2\gamma}{2-\lambda_2} - 1\right)^2 + \frac{1}{2}(1-\gamma)\left(\frac{1-\lambda_2+\lambda_2\gamma}{2-\lambda_2}\right)^2 + \frac{1}{2}(1-\gamma)\gamma^2 + \frac{1}{2}\gamma(1-\gamma)^2\right)$$

- *Bad advisers*[5]

$$v_B[\lambda_2] = y_2\left(\frac{1-\lambda_2+\lambda_2\gamma}{2-\lambda_2}\right)$$

4.1.3 Two advisers (simultaneous and sequential)

When two advisers give their advice, four possible combinations of messages ($m_{2,i}$, $m_{2,-i}$) are possible: (0,0), (0,1), (1,0) and (1,1).

Decision maker. When at least one adviser sends message 0, the decision maker learns the type and the received signal of this adviser. The decision maker does not know for sure whether an adviser that has announced message 1 is of the bad type, as it is in this situation possible that the advisers have received different signals. Therefore, the action that the decision maker takes depends on his beliefs about the signals he received. These beliefs depend on the reputation of the advisers.

[3] See appendix 1.1.1
[4] See appendix 1.2.1
[5] See appendix 1.3.1

The actions $a_2(m_{2,I}, m_{2,-i})$ that the decision maker takes are as follows:[6]

- $a_2(0,0) = \frac{\gamma^2-2\gamma+1}{2\gamma^2-2\gamma+1}$
- $a_2(0,1) = \frac{(1-\lambda_{2,-i})(1-\gamma)^2 + \gamma(1-\gamma)}{(1-\lambda_{2,-i})*(2\gamma^2-2\gamma+1)+ 2\gamma(1-\gamma)}$
- $a_2(1,0) = \frac{(1-\lambda_{2,i})(1-\gamma)^2 + \gamma(1-\gamma)}{(1-\lambda_{2,i})*(2\gamma^2-2\gamma+1)+ 2\gamma(1-\gamma)}$
- $a_2(1,1) = \frac{\gamma^2 + (1-\lambda_{2,i})\gamma(1-\gamma)+ (1-\lambda_{2,-i})\gamma(1-\gamma)+(1-\lambda_{2,i})(1-\lambda_{2,-i})(1-\gamma)^2}{\gamma^2+ (1-\gamma)^2+ (1-\lambda_{2,i})2\gamma(1-\gamma)+ (1-\lambda_{2,-i})2\gamma(1-\gamma)+ (1-\lambda_{2,i})(1-\lambda_{2,-i})(\gamma^2+ (1-\gamma)^2)}$

Advisers. Similar to the case of one adviser, when the decision maker has not received message 0, the action that the decision maker takes depends on the reputation of the advisers (λ_2) and the probability that advisers receive the right signal (γ). The values of $a_2(1,0)$ and $a_2(1,1)$ increase when the values of λ_2 and γ increase.

The total expected values of having a good reputation in the second period for the different types of advisers are as follows:

- *Good advisers*[7]

$v_G [\lambda_2] = -x_2 * (\frac{1}{2}*[(\gamma^2 + (2\gamma(1-\gamma)(1-\lambda_{2,-i})*\frac{1}{2})) *(a_2(1,1)-1)^2 + ((1-\gamma)^2 + 2\gamma(1-\gamma)(1-\lambda_{2,-i})* \frac{1}{2}) a_2(1,1)^2] + \frac{1}{2} *[(2\gamma(1-\gamma)\lambda_{2,-i}*\frac{1}{2})* (a_2(1,0)-1)^2 + (2\gamma(1-\gamma)\lambda_{2,-i}*\frac{1}{2})*a_2(1,0)^2) + \frac{1}{2} [(2\gamma(1-\gamma) *\frac{1}{2} + (1- \lambda_{2,-i})* (1-\gamma)^2) * (a_2(0,1)-1)^2 + (2\gamma(1-\gamma) *\frac{1}{2} + (1-\lambda_{2,-i})* \gamma^2) * a_2(0,1)^2] + \frac{1}{2} * [\lambda_{2,-i}*(1-\gamma)^2 *(a_2(0,0)-1)^2) + \lambda_{2,-i}*(\gamma)^2*a_2(0,0)^2]$

- *Bad advisers*[8]

$v_B [\lambda_2] = Y_2 ((1 - \frac{1}{2}\lambda_{2,-i})a_2(1,1) + \frac{1}{2}\lambda_{2,-i}*a_2(1,0)$

Summary

To summarize, in Section 4.1, I determined the second period expected payoffs of having a good reputation for both the situations of consulting one adviser and two advisers. The payoffs for all different situations will be used in the next section to determine the conditions under which the first-period strategies of the advisers can be in equilibrium.

[6] See appendix 1.1.2
[7] See appendix 1.2.2
[8] See appendix 1.3.2

4.2 First period: total payoff functions

In this section, I determine the conditions under which informative equilibria can exist in the first period. I determine the strategies that the advisers follow in the first period (*section 4.2.1*). Furthermore, I determine the conditions under which these strategies can be equilibrium strategies. In order to do so, I determine the advisers' total payoffs of sticking to and deviating from their strategies in the first period. Again, I consider the different situations of one adviser (*section 4.2.2*), two advisers simultaneous (*section 4.2.3*) and two advisers sequential (*section 4.2.4*).

4.2.1 Strategies in the first period

The game in the first period is nearly identical to the game in the second period. The only difference is that the advisers care about building a reputation in the first period, whereas they do not care about this in the second period. They know that the actions that the decision maker takes in the second period depend on his belief about the type of the advisers. As shown in section 4.1, the expected payoffs for the second period increase when the value of λ_2 increases. The total payoffs for the advisers are the joint payoffs of the first and second period. Each period might have a different weight. The total payoffs for a good adviser in the first period are equal to $-x_1(a_1 - \omega_1)^2 + v_G[\lambda_2]$ and the total payoffs for the bad adviser in the first period are equal to $Y_1a_1 + v_B[\lambda_2]$.

In the first period, there are multiple informative equilibria possible. To identify informative equilibria, I focus on the situation in which the good adviser always tells the truth. For the decision maker, the most informative equilibrium would be one in which the good and the bad advisers always tell the truth. However, this equilibrium cannot exist.[9] The reason for this is that it is not the best response for a bad adviser to also always tell the truth when the good adviser does so. When both advisers always tell the truth, there is perfect pooling. In that case, the decision maker does not learn anything about the types of the advisers by their messages; his prior beliefs about the types of the advisers are identical to his posterior beliefs. When all the advisers tell the truth, the action that the decision maker takes increases when he receives message 1. As the bad adviser wants the action to be the highest as possible, he has, regardless of his signal, an incentive to announce message 1 when this does not influence his reputation. Hence, an equilibrium in which good and bad advisers always tell the truth is not possible. The bad adviser has an incentive to announce message 1 more often than the good adviser. If this would

[9] This is identical to Morris (2001).

not be the case, reputational benefits to announce message 1 are present. Hence, in that case, it would be optimal to announce 1 for the bad adviser, as it increases his current and future payoffs.

When a good adviser always tells the truth, a bad adviser that observes signal 1 will always announce message 1 and a bad adviser that observes signal 0 will announce message 1 with probability v and message 0 with probability (1-v).

The value of v is unique and depends on the values of the variables γ, λ_1, Y_1 and Y_2. Henceforth, I focus on the situation in which the good adviser always tells the truth and the bad adviser always sends message 1 (v=1). In other words, a bad adviser always lies when he observes signal 0. This set of strategies of the good and bad advisers corresponds to the equilibrium strategies of the advisers in the second period (without reputational concerns).

When the sets of strategies in equilibrium of the first and second period are different, advisers have an incentive to behave differently when they care about their reputation than when they do not do so. Hence, political correctness is present when the good adviser has an incentive to deviate from his strategy of always telling the truth when he cares about his reputation. The discipline effect is present when the bad adviser has an incentive to deviate from his strategy of always announcing message 1 when he cares about his reputation. In other words, political correctness and the discipline effect are present when the set of strategies in equilibrium in the first period differs from the set of equilibrium strategies in the second period. To examine the effect of consulting multiple advisers on the extent to which political correctness and the discipline effect exist, I analyse the values of the variables γ, λ_1, Y_1 and Y_2 for which the good adviser always tells the truth and the bad adviser always announces message 1. Moreover, in Chapter 5, I compare the differences in the values of these parameters between the cases of one adviser, two advisers (simultaneous) and two advisers (sequential). In addition, in Sections 5.1.1 and 5.1.2 I compare the values of v in the situations of one adviser, two advisers (simultaneous) and two advisers (sequential) in the case that v=1 cannot be the equilibrium strategy.

The strategies that I examine are given in the following table:

Table 2

	s_1=0	s_1=1
Good adviser	0	1
Bad adviser	1	1

Good adviser. A good adviser could have an incentive to deviate from the strategy of always telling the truth when he receives signal 1, as announcing message 0 brings along reputational benefits. A good adviser always sends message 0 when he receives signal 0, as this improves his current and future payoffs. When the good adviser receives signal 1, it is not always beneficial for him to announce 1. The expected second-period benefits for a good adviser will increase by announcing 0, whereas at the same time the expected benefits for the first period decrease (trade-off between the first and second period). Hence, truth-telling in the case of receiving signal 1 could be an equilibrium when the good adviser cares relatively less about the second period; the value of x_2 is relatively low compared to the value of x_1. If the latter is not the case, the good adviser has an incentive to deviate and lie about the signal he received in order to be taken more seriously in the second period (*political correctness*).

Bad adviser. A bad adviser could have an incentive to deviate from this strategy by announcing message 0 when he receives signal 0. He is more inclined to deviate from the strategy of always announcing 1 when he has received signal 0 than after receiving signal 1. The reason for this is that the expected reputation ($E(\lambda_2)$) for the bad adviser after announcing message 1 is higher after receiving signal 1 than after receiving signal 0. The probability that the state of the world is equal to 1 is higher when the adviser has received signal 1.

In the following sections, I determine the payoffs of the good and bad advisers of sticking to and deviating from their strategy. For the good adviser, I determine the payoff functions of sending message 0 (lying) or 1 (truth-telling) after observing signal 1. For the bad adviser, I determine the payoff functions of sending message 0 (truth-telling) or 1 (lying) after observing signal 0. I determine these payoffs for subsequently the situations of one adviser, two advisers (simultaneous) and two advisers (sequential). To determine the total payoffs of the good and bad advisers, I first have to determine the actions that the decision maker takes given the strategies of the advisers and the possible messages that the advisers send. In addition, I determine the updated beliefs of the decision maker about the types of the advisers. After the state of the world is revealed in the first period, the decision maker updates these beliefs. With the information about the optimal action and the updated beliefs of the decision maker, as well as the expected value of having a good reputation, the total utility of the adviser can be determined.

4.2.2 One adviser

Decision maker. The decision maker receives message 0 or 1. The decision maker believes that the adviser that sends message 0 is of the good type and has received signal 0. Hence, the action that the decision maker takes is equal to (1-γ). When the adviser sends message 1, the decision maker is uncertain about the type of the adviser and the signal he has received. When the adviser sends message 1, the action that the decision maker takes is $\frac{\gamma\lambda_1-\lambda_1+1}{2-\lambda_1}$.[10]

When the decision maker believes that bad advisers always send message 1 and good advisers always tell the truth, his posterior beliefs about the types of the advisers are equal to:[11]

$\wedge(\lambda_1, 0, \omega_1) = 1$

$\wedge(\lambda_1, 1, 1) = \frac{\gamma\lambda_1}{\gamma\lambda_1+(1-\lambda_1)}$

$\wedge(\lambda_1, 1, 0) = \frac{(1-\gamma)\lambda_1}{(1-\gamma)\lambda_1+(1-\lambda_1)}$

When $\lambda_1 \in (0,1)$, the following holds:

$\wedge(\lambda_1, 0, \omega_1) > \wedge(\lambda_1, 1, 1) > \wedge(\lambda_1, 1, 0)$

Good adviser. As mentioned before, the good adviser only has an incentive to deviate from his strategy of truth-telling when he receives signal 1. When bad advisers only announce message 1, the decision maker believes that the adviser that announces message 0 is of the good type. Thus, when the good adviser that received signal 1 announced message 0, the decision maker believes that he is of the good type.

[10] See appendix 2.1.1

[11] See appendix 2.2.1

The good adviser has an incentive to deviate from his strategy of truth-telling, when his total payoff of deviating (lying) is higher than his total payoff of sticking to his strategy (truth-telling). Hence, when the good adviser received signal 1, the total payoffs of lying and truth-telling are the following:[12]

- U_G(Truth-telling: s_1=1, m_1=1) = $-x_1(\gamma(\frac{\gamma\lambda_1-1}{(2-\lambda_1)})^2 + (1-\gamma)(\frac{\gamma\lambda_1-\lambda_1+1}{(2-\lambda_1)})^2)$ $-x_2(\frac{1}{2}\gamma(\frac{1-\lambda_2\gamma}{2-\lambda_2})^2 + \frac{1}{2}(1-\gamma)(\frac{1-\lambda_2+\lambda_2\gamma}{2-\lambda_2})^2 + \frac{1}{2}(1-\gamma)\gamma^2 + \frac{1}{2}\gamma(1-\gamma)^2)$

  with $E(\lambda_2) = \gamma * \frac{\gamma\lambda_1}{\gamma\lambda_1+(1-\lambda_1)} + (1-\gamma) * \frac{(1-\gamma)\lambda_1}{(1-\gamma)\lambda_1+(1-\lambda_1)}$
- U_G(Lying: s_1=1, m_1=0) = $-x_1((\gamma)^3+(1-\gamma)^3) - x_2*(\gamma(1-\gamma))$

Bad adviser. The bad adviser could also have an incentive to deviate from the strategy of always announcing message 1 when he cares relatively much about the second period. As mentioned before, he only deviates from his strategy when he receives signal 0. When the bad adviser receives signal 0, the total payoffs of truth-telling and lying are the following: [13]

- U_B(Truth-telling: s_1= 0, m_1 = 0) = $Y_1(1-\gamma) + Y_2\gamma$
- U_B(Lying: s_1=0, m_1 = 1) = $Y_1(\frac{\gamma\lambda_1-\lambda_1+1}{(2-\lambda_1)}) + Y_2(\frac{\gamma\lambda_2-\lambda_2+1}{(2-\lambda_2)})$

  with $E(\lambda_2) = (1-\gamma) * \frac{\gamma\lambda_1}{\gamma\lambda_1+(1-\lambda_1)} + \gamma * \frac{(1-\gamma)\lambda_1}{(1-\gamma)\lambda_1+(1-\lambda_1)}$

These utility functions will be used in Chapter 5 to compare the point where the advisers have an incentive to deviate from truth-telling for the different situations.

4.2.3 Two advisers (simultaneous)

Decision maker. Four possible combinations of messages are possible; (0,0), (0,1), (1,0) and (1,1). When an adviser sends message 0, the decision maker learns the type of this adviser and the signal he had received, as only good advisers that have observed signal 0 send message 0. In this case, the advisers could have received different signals. Hence, when an adviser sends message 1, he could still be of the good type. The actions that the decision maker takes are summarized in table 3. These values depend on the beliefs of the decision maker about the signals that the advisers had received and his corresponding beliefs about the state of the world (ω_1).[14]

[12] See appendix 2.3.1
[13] See appendix 2.4.1
[14] See appendix 2.1.2

Table 3

$\Pr(\omega_1 = 1 \mid m_{1,i} = 0, m_{1,-i} = 0)$ = $a_1(0,0)$	$\frac{(1-\gamma)^2}{\gamma^2+(1-\gamma)^2}$
$\Pr(\omega_1 = 1 \mid m_{1,i} = 0, m_{1,-i} = 1)$ = $a_1(0,1)$	$\frac{(1-\lambda_1)(1-\gamma)^2 + \gamma(1-\gamma)}{(1-\lambda_1)*(\gamma^2 + (1-\gamma)^2)+ 2\gamma(1-\gamma)}$
$\Pr(\omega_1 = 1 \mid m_{1,i} = 1, m_{1,-i} = 0)$= $a_1(1,0)$	$\frac{(1-\lambda_1)(1-\gamma)^2 + \gamma(1-\gamma)}{(1-\lambda_1)*(\gamma^2 + (1-\gamma)^2)+ 2\gamma(1-\gamma)}$
$\Pr(\omega_1 = 1 \mid m_{1,i} = 1, m_{1,-i} = 1)$= $a_1(1,1)$	$\frac{\gamma^2 +2\,(1-\lambda_1)\gamma(1-\gamma)+(1-\lambda_1)^2(1-\gamma)^2}{\gamma^2+ (1-\gamma)^2+ 4(1-\lambda_1)\gamma(1-\gamma)+ (1-\lambda_1)^2(\gamma^2+ (1-\gamma)^2)}$

The posterior beliefs of the decision maker about the types of the advisers correspond to the posterior beliefs in the case one adviser. This is because the decision maker observes the state of the world (ω_1). The posterior beliefs are as follows:[15]

Table 4

$\wedge(\lambda_1, m_i, m_{-i},\omega_1)$	$\lambda_{2,i}$	$\lambda_{2,-i}$
$\wedge(\lambda_1, 1, 1,1)$	$\frac{\gamma\lambda_1}{\gamma\lambda_1+(1-\lambda_1)}$	$\frac{\gamma\lambda_1}{\gamma\lambda_1+(1-\lambda_1)}$
$\wedge(\lambda_1, 1, 1,0)$	$\frac{(1-\gamma)\lambda_1}{(1-\gamma)\lambda_1+(1-\lambda_1)}$	$\frac{(1-\gamma)\lambda_1}{(1-\gamma)\lambda_1+(1-\lambda_1)}$
$\wedge(\lambda_1, 1, 0,1)$	$\frac{\gamma\lambda_1}{\gamma\lambda_1+(1-\lambda_1)}$	1
$\wedge(\lambda_1, 1, 0,0)$	$\frac{(1-\gamma)\lambda_1}{(1-\gamma)\lambda_1+(1-\lambda_1)}$	1
$\wedge(\lambda_1, 0, 1,1)$	1	$\frac{\gamma\lambda_1}{\gamma\lambda_1+(1-\lambda_1)}$

[15] See appendix 2.2.2

$\wedge(\lambda_1, 0, 1,0)$	1	$\frac{(1-\gamma)\lambda_1}{(1-\gamma)\lambda_1+(1-\lambda_1)}$
$\wedge(\lambda_1, 0, 0,1)$	1	1
$\wedge(\lambda_1, 0, 0,0)$	1	1

Good adviser. The total payoffs of lying and truth-telling for the good adviser when he received signal 1 are as follows:[16]

- U_G(Truth-telling: $s_1=1$, $m_1=1$) = $-x_1((\gamma^2*(a_1(1,1)-1)^2 + (1-\gamma)^2*a_1(1,1)^2 + 2\gamma(1-\gamma)(\lambda_{1,}*(\frac{1}{2}(a_1(1,0)-1)^2 + \frac{1}{2}(a_1(1,0))^2 + (1-\lambda_1)(\frac{1}{2}(a_1(1,1)-1)^2 + \frac{1}{2}(a_1(1,1)^2)\,] \; -x_2 * (\frac{1}{2}*[(\gamma^2 + (2\gamma(1-\gamma)(1-\lambda_{2,-i})*\frac{1}{2})) *(a_2(1,1)-1)^2 + ((1-\gamma)^2 + 2\gamma(1-\gamma)(1-\lambda_{2,-i})*\frac{1}{2})\, a_2(1,1)^2] + \frac{1}{2}*[(2\gamma(1-\gamma)\lambda_{2,-i}*\frac{1}{2})*(a_2(1,0)-1)^2 + (2\gamma(1-\gamma)\lambda_{2,-i}*\frac{1}{2})*a_2(1,0)^2) + \frac{1}{2}\,[(2\gamma(1-\gamma)*\frac{1}{2} + (1-\lambda_{2,-i})*(1-\gamma)^2)*(a_2(0,1)-1)^2 + (2\gamma(1-\gamma)*\frac{1}{2} + (1-\lambda_{2,-i})*\gamma^2)*a_2(0,1)^2] + \frac{1}{2}*[\lambda_{2,-i}*(1-\gamma)^2 *(a_2(0,0)-1)^2) + \lambda_{2,-i}*(\gamma)^2*a_2(0,0)^2]$

  with $\lambda_{2,I} = \gamma*\frac{\gamma\lambda_1}{\gamma\lambda_1+(1-\lambda_1)} + (1-\gamma)*\frac{(1-\gamma)\lambda_1}{(1-\gamma)\lambda_1+(1-\lambda_1)}$ and $\lambda_{2,-I} = \lambda_1$

- U_G(Lying: $s_1=1$, $m_1=0$) = = $-x_1(\gamma^2(a_1(0,1)-1)^2 + (1-\gamma)^2(a_1(0,1)^2) + (2\gamma(1-\gamma)*(\frac{1}{2}\lambda_1*(a_1(0,0)-1)^2 + \frac{1}{2}\lambda_1*a_1(0,0)^2 + \frac{1}{2}(1-\lambda_1)*(a_1(0,1)-1)^2 + \frac{1}{2}(1-\lambda_1)*a_1(0,1)^2 - x_2 * (\frac{1}{2}*[(\gamma^2 + (2\gamma(1-\gamma)(1-\lambda_{2,-i})*\frac{1}{2})) *(a_2(1,1)-1)^2 + ((1-\gamma)^2 + 2\gamma(1-\gamma)(1-\lambda_{2,-i})*\frac{1}{2})\, a_2(1,1)^2] + \frac{1}{2}*[(2\gamma(1-\gamma)\lambda_{2,-i}*\frac{1}{2})*(a_2(1,0)-1)^2 + (2\gamma(1-\gamma)\lambda_{2,-i}*\frac{1}{2})*a_2(1,0)^2) + \frac{1}{2}\,[(2\gamma(1-\gamma)*\frac{1}{2} + (1-\lambda_{2,-i})*(1-\gamma)^2)*(a_2(0,1)-1)^2 + (2\gamma(1-\gamma)*\frac{1}{2} + (1-\lambda_{2,-i})*\gamma^2)*a_2(0,1)^2] + \frac{1}{2}*[\lambda_{2,-i}*(1-\gamma)^2 *(a_2(0,0)-1)^2) + \lambda_{2,-i}*(\gamma)^2*a_2(0,0)^2]$

  with $\lambda_{2,i} = 1$ and $\lambda_{2,-i} = \lambda_1$

[16] See appendix 2.3.2

Bad adviser. The total payoffs of lying and truth-telling for the bad adviser when he received signal 0 are as follows:[17]

- U_B(Truth-telling: s_1= 0, m_1 = 0)= $Y_1((\lambda_1(2\gamma-2\gamma^2)+(1-\lambda_1))*a_1(0,1) + (\lambda_1*(2\gamma^2-2\gamma+1))*a_1(0,0)) + Y_2*((1-\frac{1}{2}\lambda_{2,-i})a_2(1,1) + \frac{1}{2}\lambda_{2,-i}*a_2(1,0))$

  with $\lambda_{2,i} = 1$ and $\lambda_{2,-i} = \lambda_1$
- U_B(Lying: s_1=0, m_1 = 1) = $Y_1((\lambda_1(2\gamma-2\gamma^2)+1-\lambda_1)*a_1(1,1) + (\lambda_1*(2\gamma^2-2\gamma+1))*a_1(1,0)) + Y_2*((1-\frac{1}{2}\lambda_{2,-i})a_2(1,1) + \frac{1}{2}\lambda_{2,-i}*a_2(1,0))$

  with $\lambda_{2,i} = (1-\gamma)*\frac{\gamma\lambda_1}{\gamma\lambda_1+(1-\lambda_1)} + (\gamma)*\frac{(1-\gamma)\lambda_1}{(1-\gamma)\lambda_1+(1-\lambda_1)}$ and $\lambda_{2,-i} = \lambda_1$

These utility functions will be used in Chapter 5 to compare the point where the advisers have an incentive to deviate from truth-telling for the different situations.

4.2.4 Two advisers (sequential)

The case in which a decision maker consults two advisers that act sequentially is almost identical to the case in which the decision maker consults two advisers that act simultaneously. The difference between these situations is that the second adviser is aware of the message of the first adviser in the situation of advising sequentially. The message of the first adviser contains information about the state of the world (ω_1) and the type of this adviser ($\lambda_{2,-i}$).

In this section, I determine the conditions under which a good adviser always tells the truth and a bad adviser always announces message 1. There are three possible situations in which an adviser has to give his advice: (1) the situation that the adviser has to give his advice at first (henceforth: "first adviser"). (2) The situation that the adviser has to give his advice after the first adviser has announced message 0. (3) The situation that the adviser has to give his advice after the first adviser has announced message 1. Henceforth, "second adviser" refers to an adviser in one of the latter two situations. The good advisers always tell the truth and the bad advisers always announce message 1, if these strategies maximize their payoffs. In the case that these strategies maximize the advisers' payoffs given the action that the decision maker as well as the other adviser take in the above mentioned situations, these strategies are equilibrium strategies. However, when these strategies do not maximize the advisers' payoffs in one of the above mentioned situations, these strategies are not equilibrium strategies. In this section, I analyse

[17] See appendix 2.4.2

in which of the three situations the good respectively the bad advisers deviate the first from their strategy. When an adviser does not have an incentive to deviate from his strategy in this particular situation, the strategy is an equilibrium strategy.

Good adviser. The three situations in which the good adviser might deviate are mentioned above. As the good adviser only deviates from truth-telling when he receives signal 1, the three relevant situations are as follows: (1) the first adviser has observed signal 1, (2) the second adviser has observed signal 1 and m_{-i}=0 and (3) the second adviser has observed signal 1 and m_{-i}=1.

In figures 16, 17 and 18 of Appendix 2.5.1, I compare these three situations. The lines in these figures correspond to the points at which the good adviser is indifferent between lying and truth-telling. These figures show that the second (good) adviser that notices that the first adviser has sent message 0 (situation 2) deviates the first. The reason for this is that the probability that the state of the world is 1 is lower in case 2 than in the case of situation 1 or 3.[18] The second adviser believes that the first adviser is of the good type and had received signal 0 accordingly. As the second adviser has observed signal 1 himself, these signals cancel each other out. Hence, the second adviser believes that the probability that the state of the world is 1 is equal to $\frac{1}{2}$.

Hence, when a good, second adviser that has received signal 1 and observed that the first adviser announced message 0 does not have an incentive to deviate from sending message 1, truth-telling can be an equilibrium strategy. I take the payoff functions of the second good adviser that operates in situation 2 into account in Chapter 5.

Bad adviser. As the bad adviser only deviates from truth-telling when he receives signal 0, there are three situations possible in which the bad adviser might have an incentive to lie: (1) the first adviser has observed signal 0, (2) the second adviser has observed signal 0 and m_{-i}=0 and (3) the second adviser has observed signal 0 and m_{-i}=1.

In figures 19, 20 and 21 of Appendix 2.5.3, I compare these three situations. The lines in these figures correspond to the points at which the bad adviser is indifferent between lying and truth-telling. From these figures, it follows that the second (bad) adviser that notices that the first adviser has sent message

[18] Prob $(s_i = 1, m_{-i} = 1 \,|\omega = 1)$ > Prob $(s_i = 1|\omega = 1)$ > Prob $(s_i = 1, m_{-i} = 0 \,|\omega = 1)$.

0 (situation 2) deviates the first from the strategy of always sending message 1. In other words, the second adviser that observed signal 0 and m_{-i}=0 (situation 2) is more likely to tell the truth than the first adviser that observed signal 0 (situation 1) and the second adviser that observed signal 0 and m_{-i}=1 (situation 3). The reason for this is that the future benefits of telling the truth are relatively large compared to the current benefits of lying.

In the first period, the second (bad) adviser and the decision maker believe that the first adviser has observed signal 0 and that he is of the good type, as he sends message 0. Hence, the probability that the state of the world is equal to 0 is relatively large. When the bad adviser sends message 1, the decision maker's belief about this bad type of adviser (λ_2) is relatively low. The action that the decision maker takes in that case ($a_1(1,0)$), is relatively low as well.

On the other hand, when the bad adviser has announced message 0 in the first period, he will be taken more seriously in the second period. His expected payoff for the second period increases when he announces message 0 in the first period. As the second (bad) adviser believes that the first adviser is of the good type, he believes that the first adviser sends message 0 in the second period with probability $\frac{1}{2}$. When this adviser sends message 0 and the decision maker believes that the second adviser that sends message 1 in the second period is of the good type, the corresponding messages cancel each other out. Therefore, the action that the decision maker takes is equal to $\frac{1}{2}$. Hence, the future benefits of telling the truth are relatively large.

To conclude, when a bad, second adviser that has received signal 0 after observing that the first adviser has announced message 0 does not have an incentive to deviate from sending message 1, truth-telling can be an equilibrium strategy. I take the payoff function of the second bad adviser that operates in situation 2 into account in Chapter 5.

5. Comparison

In Chapter 4, I determined the total expected payoffs of lying and truth-telling for the cases of one adviser, two advisers (simultaneous) and two advisers (sequential), as well as the corresponding actions and posterior beliefs. In this chapter, I use these expected payoffs to determine the value of respectively x_1 and Y_1 for which the good and bad advisers have an incentive to deviate from their strategy. I compare the obtained values for the three different situations. In section 5.1.1, I compare the situation in which the decision maker consults one adviser with the situation in which he consults two advisers that give their advice simultaneously. Afterwards, in section 5.1.2, I compare the situations of advising sequentially and simultaneously. Finally, in section 5.2, I compare the expected welfare of the decision maker when he consults one adviser with the situation when he consults two advisers.

5.1 Behaviour of advisers

5.1.1 One adviser vs. two advisers (simultaneous)

Proposition 1. *Depending on the probability that the advisers receive the right signal (γ) and the ex-ante probability that the adviser is of the good type (λ_1), it is equally or less likely that a **good adviser** deviates from his strategy of always telling the truth when the decision maker consults two advisers (simultaneously) instead of one adviser. When (1) the value of γ is high and (2) the value of λ_1 is not close to 0 or 1, a good adviser is more likely to tell the truth in the case of two advisers (simultaneous) than in the case of one adviser.*

From figures 1, 2 and 3 it follows that proposition 1 holds. The lines in the figures 1, 2 and 3 indicate where the good adviser is indifferent between lying (sending message 0) and truth-telling (sending message 1) for the situations of one adviser and two advisers (simultaneous) in the case of an imperfect signal. In the area above this line, the good adviser prefers to tell the truth when he receives signal 1; in the area below this line, the good adviser prefers to lie when he receives signal 1. The variable on the x-axis represents the ex-ante probability that an adviser is good (λ_1). The value on the y-axis represents the degree to which the good adviser cares about the first period (x_1). I assumed that the value of x_2 is equal to 1. Figures 1, 2 and 3 only differ in the probability that an adviser receives a signal that corresponds with the state of the world; γ=0,51, γ=0,75 and γ=0,99.

(1) When the value of *γ* is high, a good adviser is more likely to tell the truth in the case of two advisers (simultaneous) than in the case of one adviser. In figures 2 and 3 (γ=0,75; γ=0,99), a difference is visible

between the lines representing the situations of one adviser and two advisers (simultaneous), whereas this difference is not visible in figure 1 (γ=0,51). The line representing the situation of two advisers (simultaneous) lies below the line that represents the situation of one adviser. This means that a good adviser prefers to tell the truth for more values of x_1 in the case of two advisers (simultaneous) than in the case of one adviser. That is because the highest value of x_1 for which a good adviser does not have an incentive to deviate from the strategy of truth-telling is higher when the decision maker consults two advisers (simultaneously) instead of one adviser. The higher the value of γ, the larger the difference between the lines of one and two advisers (simultaneous) in figures 1, 2 and 3 becomes.

A reason for this result is that the message that an adviser sends reveals more about his type in the case of two advisers than in the case of one adviser when the value of γ is high. The current payoff of lying for the good adviser will be lower in the case of two advisers than in the case of one adviser when the good adviser deviates from his strategy, i.e. the difference of the values of $a_1(1,1)$ and $a_1(0,1)$ becomes larger when the value of γ increases. When γ is relatively high, the probability that the other adviser receives a different signal is relatively low[19] and the probability that they both have received the same signal is relatively high.[20] When the advisers send a different message, the decision maker will believe that the adviser that has sent message 0 is of the good type. In that case, the decision maker believes that the probability that the other adviser is of the bad type is relatively high, as the probability that both advisers receive a different signal is relatively low.

(2) Figures 1, 2 and 3 also show that the advisers are equally likely to tell the truth in the cases of one adviser and two advisers (simultaneous) when the value of λ_1 is close to 0 or 1. The reason for this is that the beliefs of the decision maker about the type of the adviser will not change that much when the reputation of the adviser is either very low or very high.

Hence, the so-called political correctness effect decreases when the decision maker consults two advisers (simultaneously) compared to the situation in which he consults only one adviser.

[19] Probability that they receive a different signal: $2\gamma(1-\gamma)$

[20] Probability that they receive the same signal: $\gamma^2+(1-\gamma)^2$

Figure 1

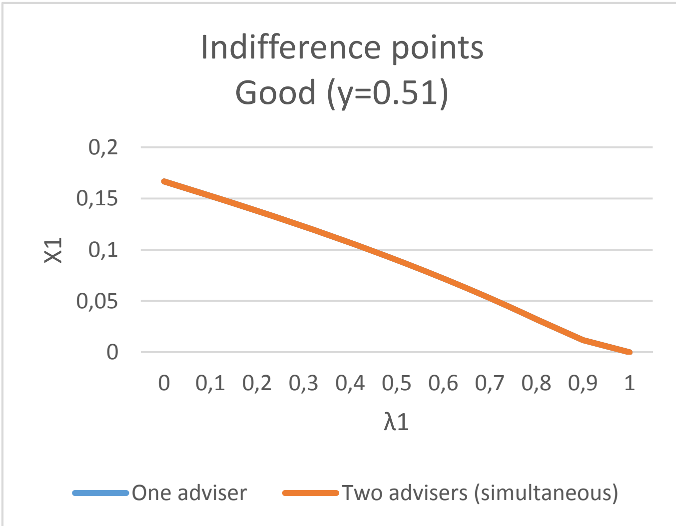


Figure 2

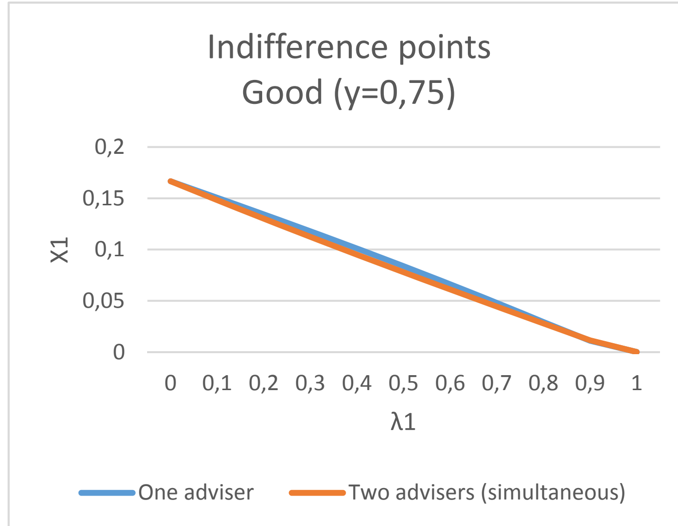
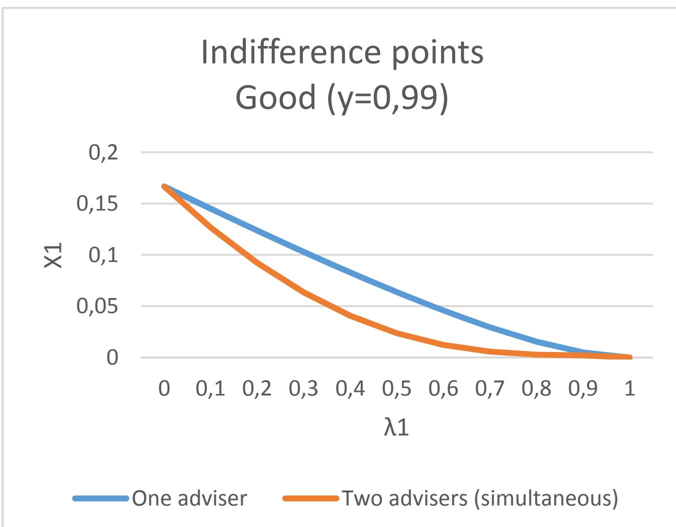


Figure 3



The lines in the figures 1, 2 and 3 indicate when the good adviser is indifferent between lying and truth-telling for the situations of one adviser and two advisers (simultaneous) in the case of an imperfect signal. In the area above this line, the good adviser prefers to tell the truth; in the area below this line, the good adviser prefers to lie when he receives signal 1. The variable on the x-axis represents the ex-ante probability that an adviser is good (λ_1). The value on the y-axis represents the degree to which the good adviser cares about the first period (x_1). I assumed that the value of x_2 is equal to 1. The three figures only differ in the probability that an adviser receives a signal that corresponds with the state of the world; γ=0,51, γ=0,75 and γ=0,99.

Proposition 2. *Depending on the probability that the advisers receive the right signal (γ) and the ex-ante probability that the adviser is of the good type (λ_1), it is equally or more likely that a* ***bad adviser*** *deviates from his strategy of always announcing message 1 when the decision maker consults two advisers (simultaneously) instead of one adviser. When the values of γ and λ_1 are high, the bad adviser is more likely to deviate from his strategy of always announcing message 1, meaning that he is more likely to tell the truth when the decision maker consults two advisers (simultaneously) instead of one adviser.*

From figures 4, 5 and 6 it follows that proposition 2 holds. The lines in the figures 4, 5, and 6 indicate where the bad adviser is indifferent between lying (announcing message 1) and truth-telling (announcing message 0) for the situations of one adviser and two advisers (simultaneous) in the case of an imperfect signal. In the area below this line the bad adviser deviates from his strategy and tells the truth. The variable on the x-axis represents the ex-ante probability that an adviser is good (λ_1). The value on the y-axis represents the degree to which the bad adviser cares about the first period (Y_1). I assumed that the value of Y_2 is equal to 1. Figures 4, 5 and 6 only differ in the probability that an adviser receives a signal that corresponds with the state of the world; γ=0,51, γ=0,75 and γ=0,99.

In figure 6 (γ=0,99), a difference is visible between the lines representing the situations of one adviser and two advisers (simultaneous), whereas this difference is hardly visible in the figures 4 and 5 (γ=0,51; γ=0,75). The line representing the situation of two advisers (simultaneous) lies above the line that represents the situation of one adviser. This means that a bad adviser prefers to tell the truth for more values of Y_1 in the case of two advisers (simultaneous) than in the case of one adviser. This is because the lowest value of Y_1 for which a bad adviser does not have an incentive to deviate from the strategy of always announcing message 1 is higher when the decision maker consults two advisers (simultaneously) instead of one adviser. The difference between these lines representing one and two advisers (simultaneous) becomes larger the larger the value of γ becomes. This difference is visible when the value of λ_1 is high.

A reason for this result is that, in the case of two advisers, the messages that the advisers send reveal more about their type than in the case of one adviser. When the values of γ and λ_1 are high, the expected future payoffs of telling the truth are relatively high for a bad adviser, whereas his current benefits of lying are relatively low.

When the value of γ is relatively large, the probability that both advisers have received the same signal (s=0) in the first period is relatively high. Furthermore, when the value of λ_1 is relatively large, the probability that the other adviser is of the good type is relatively high. When the bad adviser receives signal 0, he knows that that the probability that the other adviser has also received signal 0 is large. As a result, there is a high probability that the other adviser sends message 0. When the bad adviser sends message 1 in that case the decision maker's belief about this bad type of the adviser (λ_2) is relatively low. The action that the decision maker takes in that case ($a_1(1,0)$), is relatively low as well.

On the other hand, when the bad adviser announces message 0 in the first period, he will be taken more seriously in the second period. His expected payoff for the second period will increase drastically when he announces message 0 in the first period. When the other adviser announces message 0 in the second period, the decision maker will receive two different messages (*(1,0)*), as the bad adviser always sends message 1 in the second period. When the decision maker believes that the adviser that has sent message 1 is of the good type, the corresponding messages cancel each other out. Hence, his action will be equal to $\frac{1}{2}$. However, when the decision maker believes that the probability that the adviser that has sent message 1 is of the good type is low, the action that the decision maker takes is close to zero. To summarize, when the values of γ and λ_1 are high, the expected future payoffs of telling the truth are relatively high for the bad adviser, whereas his current benefits of lying are relatively low.

To summarize, I showed that in the case of two advisers (simultaneous), good and bad advisers are more inclined to tell the truth than in the case of one adviser. Hence, by consulting two advisers (simultaneous), the discipline effect increases. This is beneficial for the decision maker, as the possibility of information transmission increases.

No equilibrium strategy. When a bad adviser deviates from his strategy of always announcing message 1 by sometimes telling the truth after having received signal 0 ($v<1$), the highest value for which the good adviser does not have an incentive to deviate from his truth-telling strategy will increase. In other words, a good adviser is more likely to tell the truth when bad advisers are more likely to tell the truth. When bad advisers also announce message 0, the reputational benefits of announcing message 0 decrease for the good advisers. To conclude, when the discipline effect of the bad adviser increases, the political correctness effect of the good adviser might decrease even further.

Values of v. So far, I only analysed whether the strategy of always announcing message 1 ($v=1$) could be an equilibrium strategy for the bad adviser. Below I examine what happens to the value of v when the bad adviser has an incentive to deviate from his strategy of always announcing 1. I analyse this by varying the parameters of γ, λ_1, Y_1 and Y_2 and by examining the similarities or the differences between the situations of one adviser and two advisers (simultaneous) subsequently.

When the first period is less important than the second period (Y_1 is low compared Y_2), the bad advisers in both the cases of one adviser and two advisers (simultaneous) have an incentive to deviate from the strategy of always announcing message 1. The reason for this is that in these cases the advisers care relatively much about their reputation. Furthermore, when the value of λ_1 is close to 0 or 1 the value of v is relatively high. When the adviser has a very low or a very high reputation, the beliefs of the decision maker about the type of the adviser will not change that much (except for the situation where v=1). This holds for both the situations of one adviser and two advisers (simultaneous).

When the value of γ is relatively low, the values of v are quite similar in these two situations. The reason for this is that the decision maker knows that the messages reveal less information about the state of the world when this value is low. The action of the decision maker will be close to $\frac{1}{2}$ after receiving any signal. Consulting an additional adviser does not change this.[21]

When the value of γ is relatively high, the values of v could differ for the three situations. The decision maker now knows that the messages could reveal more information about the state of the world. For almost any value of λ_1 the following holds: v(*two (simultaneous)*) < v (*one adviser*). This indicates that the probability that a bad adviser tells the truth about his observed signal is more likely in the case of consulting two advisers (simultaneous) than in the case of consulting one adviser.[22] The reason for this is that the messages that the advisers send reveal more information about the type of the adviser in the case of two advisers (simultaneous) than in the case of one adviser.

[21] See appendix 3.2.1
[22] See appendix 3.2.1

Figure 4

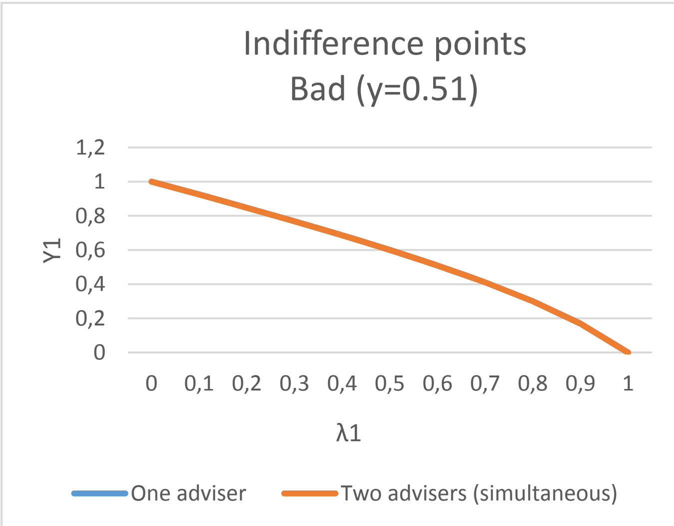


Figure 5

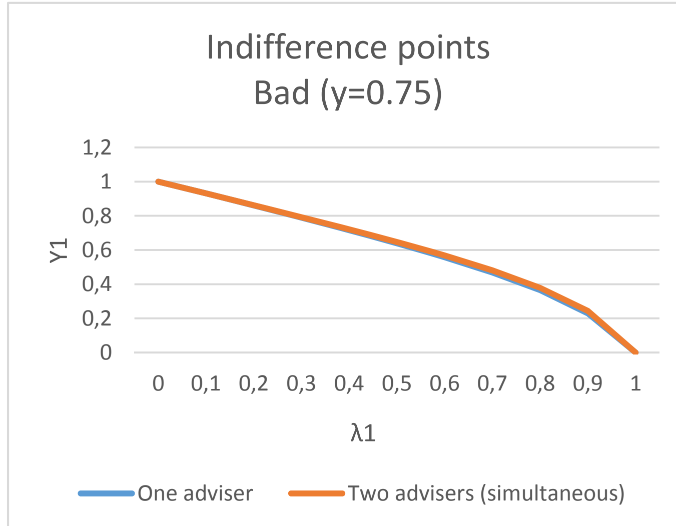
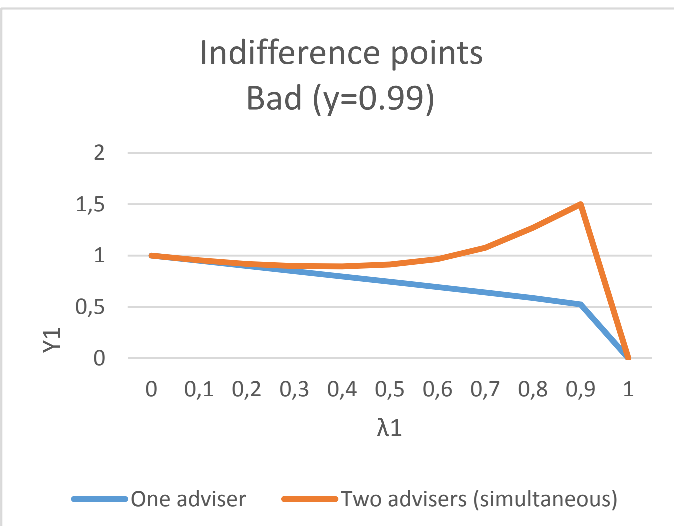


Figure 6



Figures 4, 5 and 6 indicate when the bad adviser is indifferent between lying and truth-telling. In the area above this line, the adviser behaves according to his strategy and lies about his signal (announcing message 1). In the area below this line the bad adviser deviates from his strategy and tells the truth (announcing message 0). The variable on the x-axis represents the ex-ante probability that an adviser is good (λ_1). The value on the y-axis represents the degree to which the bad adviser cares about the first period (Υ_1). I assumed that the value of Υ_2 is equal to 1. The three figures only differ in the probability that an adviser receives a signal that corresponds with the state of the world; γ=0,51, γ=0,75 and γ=0,99.

5.1.2 Simultaneous vs. sequential advising

Following from Section 5.1, where I only take the political correctness and discipline effect into account, the decision maker (weakly) prefers to consult two advisers (simultaneously) over consulting one adviser. In this section, I investigate the case of consulting two advisers more thoroughly. As the timing of advising (sequentially or simultaneously) might influence the political correctness and discipline effect as well, I investigate whether the decision maker prefers to consult two advisers sequentially or simultaneously.

Proposition 3. *In the case of sequential advising it is more likely that a **good adviser** deviates from his strategy of always telling the truth compared to the case of simultaneous advising (unbeneficial to the decision maker). Moreover, in the case of sequential advising it is more likely that a **bad adviser** deviates from his strategy of always sending message 1 compare to the case of simultaneous advising (beneficial to the decision maker). Hence, whether the decision maker prefers simultaneous or sequential advising is ambiguous.*

Good adviser. Figures 7, 8 and 9 show that in the case of sequential advising, the highest value of x_1 for which a good adviser does not deviate from his truth-telling strategy is higher than in the case of simultaneous advising. Furthermore, when the value of γ is relatively high, an equilibrium in which a good adviser always tells the truth is less likely in the case of sequential advising than in the case of simultaneous advising. This also holds for the case of one adviser.

The reason for the latter result is that in the case of sequential advising, the strategy of truth-telling can only be an equilibrium strategy when the second adviser that observes signal 1 after observing that the first adviser has announced message 0 does not have an incentive to deviate (see Section 4.2.4). When the second adviser observes that the first adviser has announced message 0, he believes that this first adviser has received signal 0 and that he is of the good type. Hence, the signals cancel each other out, i.e. the probability that the state of the world is 1 increases and is equal to $\frac{1}{2}$. Moreover, the decision maker believes that the first adviser is of the good type. When the probability that an adviser receives the right signal (γ) is relatively high, the belief of the decision maker about the type of the second adviser that has sent message 1 is relatively low. For that reason, the effect of announcing message 1 is relatively low; the difference between $a_1(0,1)$ and $a_1(1,1)$ is relatively low.

Hence, the political correctness effect increases when the advisers give their advice sequentially. This is unbeneficial for the decision maker, as less information transmission is possible.

Bad adviser. Figures 10, 11 and 12 show that the lowest value of Y_1 for which a bad adviser does not have an incentive to deviate from his strategy of always announcing message 1 is higher in the case of sequential advising than in the case of simultaneous advising. This is because of the additional information that the second adviser obtains about the type of the first adviser. When the value of γ is relatively high, the second bad adviser that has observed signal 0 and message 0 (of the first adviser) is the first to deviate. This second adviser benefits the most from having a good reputation, as the decision maker believes that the other adviser is of the good type (see Section 4.2.4).[23] This effect is large when the value of γ is almost equal to 1 and the value of λ_1 is relatively low (see figure 12). If the second bad adviser would not announce message 0, the probability that he will not be taken seriously in the second period is high. The probability that the state of the world is equal to 1 is large and as the probability that an adviser is of the good type is low, the belief of the decision maker about the type of the second adviser is low when he sends message 1. To conclude, the discipline effect increases when the advisers give their advice sequentially. This is beneficial for the decision maker, as more information transmission is possible.

No equilibrium strategy. As mentioned before, when the bad adviser deviates from his strategy of always announcing message 1, it is more likely that the good adviser tells the truth more often. This effect is beneficial for the decision maker.

Value of v. A bad adviser is more likely to lie (high value of v) about his observed signal when he cares less about his reputation (Y_1 is large compared to Y_2). The reason for this is that in these cases the signals that the advisers send do not have a large effect on the reputation of the adviser. This holds for the situations of one adviser, two advisers (simultaneous) and two advisers (sequential).
In the case of sequential advising, there are three situations possible in which the bad adviser might have an incentive to lie: (1) the first adviser has observed signal 0, (2) the second adviser has observed signal 0 and m_{-i}=0 and (3) the second adviser has observed signal 0 and m_{-i}=1. The value of v varies for these three possible situations. When the value of y is relatively low, the value of v(*two (sequential, sit.2)*) is lower than the value of v(*two (sequential, sit. 1)*) and v (*two(sequential, sit. 3)*). When the value of y is relatively high, the following equation holds:

v(*two (sequential, sit.2)*) < v(*two (sequential, sit. 1)*) = v(*two (simultaneous)*) < v (*two(sequential, sit. 3)*).[24]

[23] The lowest values of Y_1 for which the bad advisers do not have an incentive to deviate from their strategy of always announcing 1 in the case of simultaneous advising is equal to the lowest values of Y_1 for which the first bad advisers do not have an incentive to deviate from the strategy of always announcing 1 in the case of sequential advising.
[24] See appendix 3.2.2

As the bad adviser of situation 2 is the first to deviate from the strategy of always sending message 1, it is not possible to find an equilibrium strategy in which the bad advisers in situation 1, 2 and 3 have an identical strategy when the value of v(*two (sequential, sit.2)*) is not equal to 1.

Summary. To summarize, whether the decision maker prefers sequential or simultaneous advising is ambiguous. In the situation that advising takes place sequentially instead of simultaneously, the bad adviser has an incentive to tell the truth more often (discipline effect increases). On the one hand, the good adviser has an incentive to tell the truth less often (political correctness increases). On the other hand, when the bad adviser also announces message 0, the incentive that the good adviser has to tell the truth increases (political correctness decreases). Table 5 shows which form of advising is preferred by the decision maker in the different situations that are possible.

Figure 7

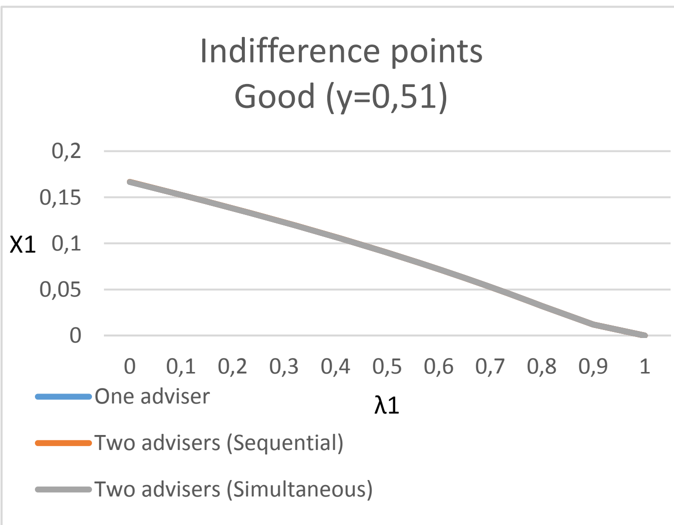


Figure 8

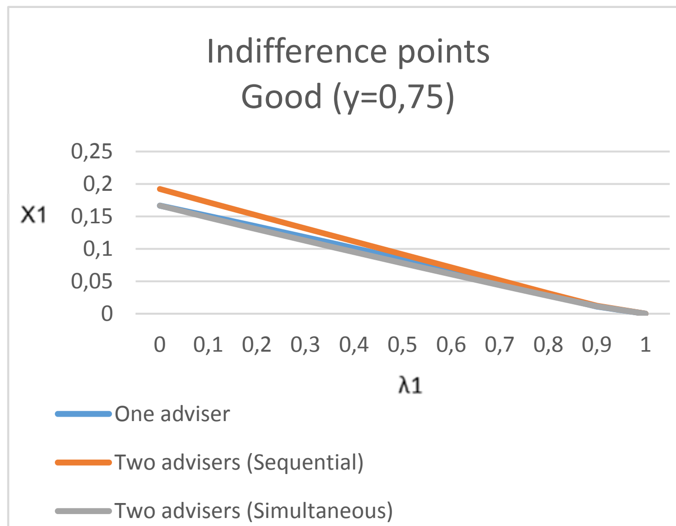
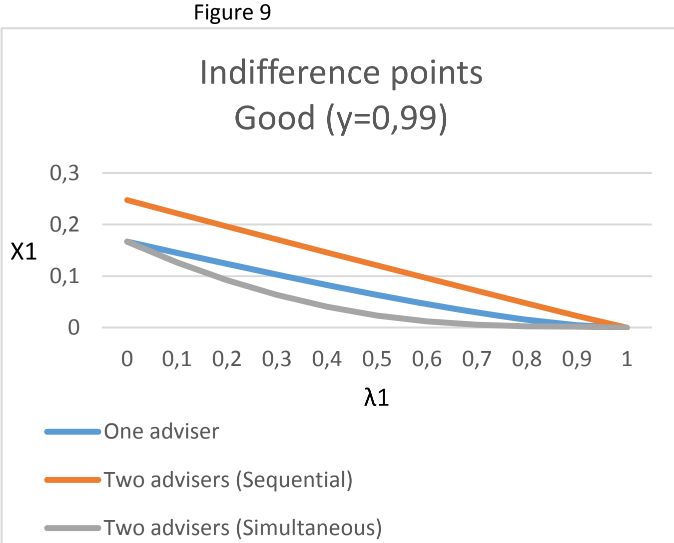


Figure 9



The lines in the figures 7, 8 and 9 indicate when the good adviser is indifferent between lying and truth-telling for the situations of one adviser, two advisers (simultaneous) and two advisers (sequential) in the case of an imperfect signal. In the area above this line, the good adviser prefers to tell the truth; in the area below this line the good adviser prefers to lie when he receives signal 1. The variable on the x-axis represents the ex-ante probability that an adviser is good (λ_1). The value on the y-axis represents the degree to which the good adviser cares about the first period (x_1). I assumed that the value of x_2 is equal to 1. These three figures only differ in the probability that an adviser receives a signal that corresponds with the state of the world; γ=0,51, γ=0,75 and γ=0,99.

Figure 10

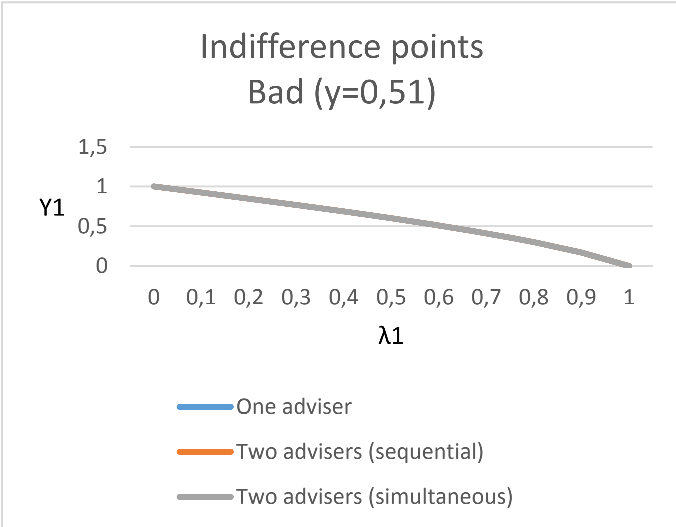


Figure 11

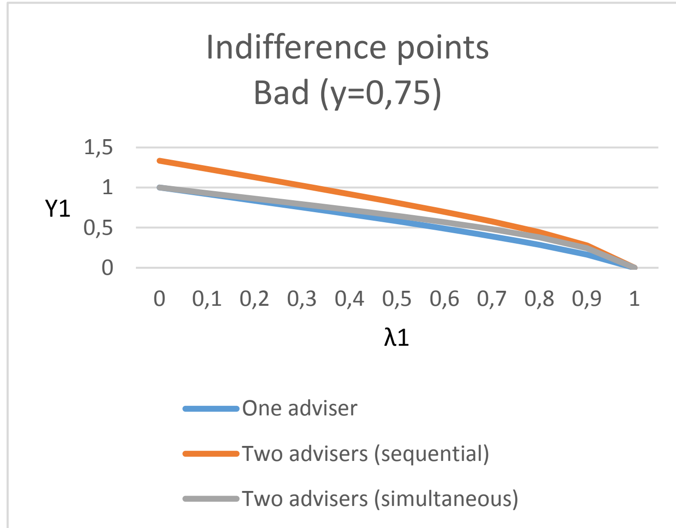
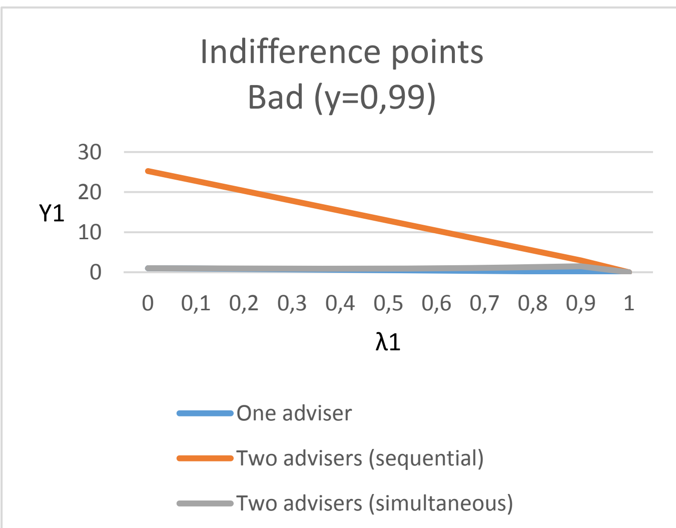


Figure 12



Figures 10, 11 and 12 indicate when the bad adviser is indifferent between lying and truth-telling. In the area above this line, the adviser behaves according to his strategy and lies about his signal (announcing message 1). In the area below this line, the bad adviser deviates from his strategy and tells the truth (announcing message 0). The variable on the x-axis represents the ex-ante probability that an adviser is good (λ_1). The value on the y-axis represents the degree to which the bad adviser cares about the first period (Y_1). I assumed that the value of Y_2 is equal to 1. The three figures only differ in the probability that an adviser receives a signal that corresponds with the state of the world; γ=0,51, γ=0,75 and γ=0,99.

Table 5

	Good adviser	Bad adviser	Preference of the decision maker
Sequential	Does not deviate	Does not deviate	
Simultaneous	Does not deviate	Does not deviate	No preferences
Sequential	Does not deviate	Deviates	
Simultaneous	Does not deviate	Does not deviate	Sequential
Sequential	Deviates	Does not deviate	
Simultaneous	Does not deviate	Does not deviate	Simultaneous
Sequential	Deviates	Deviates	
Simultaneous	Does not deviate	Does not deviate	Ambiguous
Sequential	Deviates	Deviates	
Simultaneous	Deviates	Deviates	Ambiguous

5.2 Welfare of the decision maker

So far, I only analysed the behaviour of the advisers. I showed that the political correctness can decrease and the discipline effect increases by consulting two advisers instead of one adviser.[25] Hence, both the good and the bad adviser have an incentive to tell the truth more often when the decision maker consults two advisers. This behaviour is beneficial for the decision maker, as more information transmission is possible.

In this section, I examine whether it is, overall, beneficial for the decision maker to consult two advisers. Figures 13, 14 and 15 show the expected utility of the decision maker for different values of λ_1 and γ, when he consults one respectively two advisers. I assumed that both advisers behave according to their strategy; a good adviser always tells the truth and a bad adviser always announces message 1. This figure shows that under this assumption, the expected utilities of the decision maker are higher when he consults two advisers instead of one adviser.

When the value of γ is low and the value of λ_1 increases, it becomes more beneficial for the decision maker to consult two advisers instead of one adviser. When the value of γ is low, a comparison of the two messages provides the decision maker with more information about the state of the world. The probability that the advisers receive different messages is high. Also, the higher the probability that the advisers are of the good type, the more information the messages contain about the state of the world.

When the value of γ is high,[26] the difference between the expected payoffs for the decision maker in the cases of one adviser and respectively two advisers is the lowest when the level of λ_1 is close to 0 or 1. When the probability that the advisers are good (λ_1) is reasonably low or high and the advisers receive a relatively precise signal (γ), it does not particularly matter whether the decision maker consults one or two advisers. The benefits of consulting an additional adviser in that case are relatively low, as the message of one single adviser contains (almost) the same information as the messages of two advisers. When the probability that an adviser is of the good type is close to zero or one, the probability that one adviser is of the good type is almost similar to the probability that at least one adviser is of the good type in the case of two advisers are being consulted.

[25] - Two advisers (simultaneous): political correctness decreases and discipline effect increases
- Two advisers (sequential): political correctness increases and discipline effect increases (stronger effect than in the case of simultaneous advising)

[26] ± $\gamma > 0.9$

As mentioned before, the behaviour of the advisers is more beneficial for the decision maker in the case of two advisers than in the case of one adviser. This holds when the decision maker chooses the most optimal way of advising (simultaneous or sequential). In this section, I also showed that it is more beneficial for the decision maker to consult two advisers instead of one adviser when good advisers always tell the truth and bad advisers always announce message 1.To conclude, overall, it is beneficial for the decision maker to consult two advisers.

Figure 13

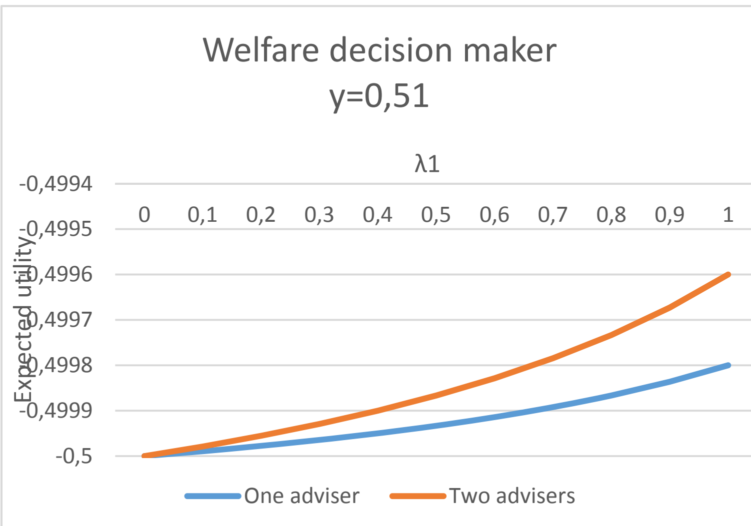


Figure 14

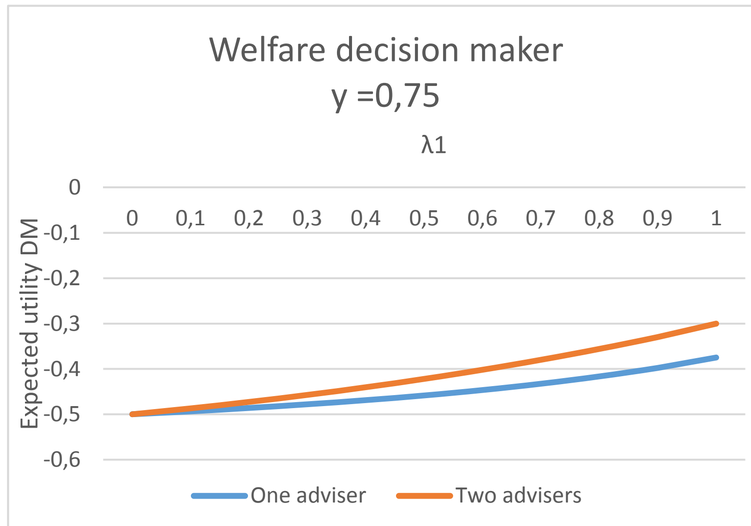
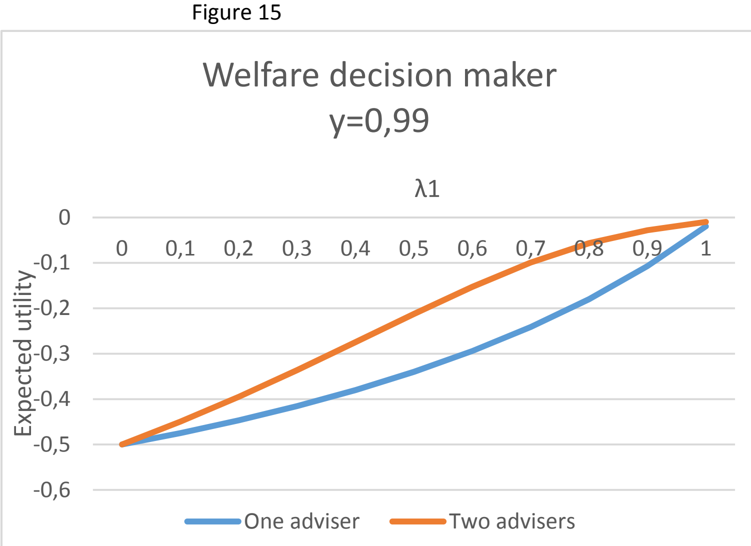


Figure 15



6. Conclusion

The aim of this thesis was to find the effect of consulting multiple advisers on the outcomes of Morris (2001). Morris (2001) found that good advisers that care about their reputation could have an incentive to lie (*political correctness*) as well as that bad advisers that care about their reputation could have an incentive to tell the truth more often (*discipline effect)*. I examined this by adding the possibility to consult multiple advisers (simultaneously or sequentially) to the model of Morris (2001).

First of all, I showed that the total expected welfare of the decision maker is higher when the decision maker consults two advisers instead of one adviser. Furthermore, I found that the political correctness and discipline effect are still present when the decision maker consults two advisers instead of one. However, by consulting two advisers, more information transmission might be possible. I drew a distinction between (1) the case in which the decision maker consults the advisers simultaneously and (2) the case in which the decision maker consults the two advisers sequentially. Depending on the values of certain variables either sequential or simultaneous advising provides the most information to the decision maker.

(1) Consulting two advisers that give their advice simultaneously is (weakly) preferred by the decision maker over consulting one adviser, as the possibility of information transmission might be higher in the former case. The good and bad advisers are more likely to tell the truth. The extent to which they tell the truth more often, depends on the quality of the information that they have at their disposal. The higher the quality of the information, the more likely the good and bad advisers are to tell the truth. By comparing the messages of the two advisers, the decision maker gets a better idea of the types of the advisers. This additional information helps him in making a better decision.

(2) Consulting two advisers that give their advice sequentially could be either less or more beneficial than consulting one adviser. On one hand, the good adviser is more likely to lie than in the case of one adviser (political correctness increases). On the other hand, the bad adviser is more likely to tell the truth than in the case of one adviser (discipline effect increases). Whether consulting two advisers that give their advice sequentially is more beneficial for the decision maker than consulting one adviser, depends on whether the latter effect dominates the first effect.

6.1 Limitations and directions for future research

The results of this thesis are only generalizable when the underlying assumptions are satisfied. One of these assumptions is that the advisers cannot be rewarded for announcing the right message in this model, except for the fact that the belief of the decision maker about the type of an adviser increases when his advice turned out to be good. When the decision maker has the possibility to commit himself to a contract in which he can reward an adviser that has announced the right message, advisers will have an additional incentive to tell the truth. In that case, the benefits of telling the truth will increase for both the cases in which one adviser and two advisers give their advice. As the payoff functions are adjusted in both cases, I conjecture that my results will hold when the decision maker can commit himself to a certain contract.

Another assumption of this model is that the state of the world is revealed after each period. In a situation where the state of the world is not revealed after the first period, I expect the advisers to exert more herding behaviour in the case of sequentially advising. The reason for this is that in the case that the state of the world is not revealed, the belief of the decision maker about the types of the advisers is determined by comparing the different messages that the advisers send. In the case that the state of the world is revealed, the belief of the decision maker about the types of the advisers is determined by comparing the message that the concerning adviser has sent with the actual state of the world. When the state of the world is not revealed, I conjecture that the political correctness effect increases even further in the case of sequential advising (which is unbeneficial for the decision maker). The good adviser has a stronger incentive to announce message 0 when he received signal 1 and observed that the first adviser has sent message 0. The comparison of the messages is more important now.

In this model, the preferences of the good adviser correspond to the preferences of the decision maker. The bad adviser always prefers the highest possible action. This preference sometimes corresponds to the interest of the decision maker (when the state of the world is 1). However, it is also possible that the preferences of the bad advisers are always the opposite of the preferences of the decision maker. In that case, the results of this thesis will change. This limitation is also mentioned by Morris (2001). The good advisers always have an incentive to tell the truth, as it increases reputational benefits.

Furthermore, an assumption in my model is that the precision of the signal is exogenously given. However, it is possible that the precision of the signal depends on the ability of the advisers and the effort taken by the advisers (Suurmond, Swank and Visser, 2004). Furthermore, Dur and Swank (2005) found that unbiased advisers put more effort in the collection of information than biased advisers. What the effect is of having the opportunity to consult multiple advisers on the collection of information in a model in which the precision of the signals is endogenously given is interesting to examine in further research.

In this model, I assumed a two-period model. However, a longer relationship between the decision maker and adviser could also be possible. In further research, it would be interesting to investigate the effect of consulting advisers in more than two periods on the results of this study.

Finally, in this thesis, I studied the cases in which the decision maker consults one adviser, two advisers (simultaneous) and two advisers (sequentially). It would be interesting to extend this thesis by examining a situation in which *n* advisers give their advice. I conjecture that the larger the number of advisers, the higher the incentives for the good and bad advisers to tell the truth.

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Appendix

1. Calculation chapter 4: second period

1.1 Actions of the decision maker

1.1.1 One adviser

The calculation of the action of the decision maker in the case of an imperfect signal and one adviser is identical to the calculation in Morris (2001).

$$\Pr(\omega_2=1 \mid m_2=1) = \frac{\Pr(m_2 = 1 \mid \omega_2 = 1) * \Pr(\omega_2=1)}{\Pr(m_2=1)} = \frac{\frac{1}{2}(\lambda_2\gamma+(1-\lambda_2))}{\frac{1}{2}(\lambda_2\gamma+(1-\lambda_2))+\frac{1}{2}(\lambda_2(1-\gamma)+(1-\lambda_2))} = \frac{1-\lambda_2+\lambda_2\gamma}{(2-\lambda_2)}$$

1.1.2 Two advisers

Four combinations of messages are possible: (1,1), (0,1), (1,0) and (0,0). The actions that the decision maker takes for the different combinations are the following:

$a_2(1,1)$

$$a_2(1,1) = \Pr(\omega_2=1 \mid m_{2,i}=1, m_{2,-i}=1) = \frac{\Pr(m_{2,i} = 1, m_{2,-i} = 1 \mid \omega_2 = 1) * \Pr(\omega_2=1)}{\Pr(m_{2,i}=1, m_{2,-i}=1)}$$

- $\Pr(m_{2,i}=1, m_{2,-i}=1 \mid \omega_2=1) = \Pr(m_{2,i}=1, m_{2,-i}=1 \mid s_{2,i}=0, s_{2,-i}=0) * \Pr(s_{2,i}=0, s_{2,-i}=0 \mid \omega_2=1) + \Pr(m_{2,i}=1, m_{2,-i}=1 \mid s_{2,i}=0, s_{2,-i}=1) * \Pr(s_{2,i}=0, s_{2,-i}=1 \mid \omega_2=1) + \Pr(m_{2,i}=1, m_{2,-i}=1 \mid s_{2,i}=1, s_{2,-i}=0) * \Pr(s_{2,i}=1, s_{2,-i}=0 \mid \omega_2=1) + \Pr(m_{2,i}=1, m_{2,-i}=1 \mid s_{2,i}=1, s_{2,-i}=1) * \Pr(s_{2,i}=1, s_{2,-i}=1 \mid \omega_2=1)$

  $= (1-\lambda_{2,i})(1-\lambda_{2,-i})(1-\gamma)^2 + (1-\lambda_{2,i})\gamma(1-\gamma) + (1-\lambda_{2,-i})\gamma(1-\gamma) + \gamma^2$

- $\Pr(\omega_2=1) = \frac{1}{2}$
- $\Pr(m_{2,i} = 1, m_{2,-i} = 1) = \Pr(m_{2,i}=1, m_{2,-i}=1 \mid s_{2,i}=0, s_{2,-i}=0) * \Pr(s_{2,i}=0, s_{2,-i}=0) + \Pr(m_{2,i}=1, m_{2,-i}=1 \mid s_{2,i}=0, s_{2,-i}=1) * \Pr(s_{2,i}=0, s_{2,-i}=1) + \Pr(m_{2,i}=1, m_{2,-i}=1 \mid s_{2,i}=1, s_{2,-i}=0) * \Pr(s_{2,i}=1, s_{2,-i}=0) + \Pr(m_{2,i}=1, m_{2,-i}=1 \mid s_{2,i}=1, s_{2,-i}=1) * \Pr(s_{2,i}=1, s_{2,-i}=1)$

  $\frac{1}{2}(1-\lambda_{2,i})(1-\lambda_{2,-i})(\gamma^2 + (1-\gamma)^2) + \frac{1}{2}(1-\lambda_{2,i})2\gamma(1-\gamma) + \frac{1}{2}(1-\lambda_{2,-i})2\gamma(1-\gamma) + \frac{1}{2}(\gamma^2 + (1-\gamma)^2)$

$$a_2(1,1) = \Pr(\omega_2=1 \mid m_{2,i}=1, m_{2,-i}=1) = \frac{\Pr(m_{2,i} = 1, m_{2,-i} = 1 \mid \omega_2 = 1) * \Pr(\omega_2=1)}{\Pr(m_{2,i}=1, m_{2,-i}=1)} =$$

$$\frac{(1-\lambda_{2,i})(1-\lambda_{2,-i})(1-\gamma)^2+(1-\lambda_{2,i})\gamma(1-\gamma)+(1-\lambda_{2,-i})\gamma(1-\gamma)+\gamma^2}{\gamma^2+(1-\gamma)^2+(1-\lambda_{2,i})2\gamma(1-\gamma)+(1-\lambda_{2,-i})2\gamma(1-\gamma)+(1-\lambda_{2,i})(1-\lambda_{2,-i})(\gamma^2+(1-\gamma)^2)}$$

$a_2(0,1)$

$a_2(0,1) = \Pr(\omega_2=1 \mid m_{2,i}=0, m_{2,-i}=1) = \frac{\Pr(m_{2,i} = 0, m_{2,-i} = 1|\omega_2 = 1)*\Pr(\omega_2=1)}{\Pr(m_{2,i} = 0, m_{2,-i} = 1)}$

- $\Pr(m_{2,i} = 0, m_{2,-i} = 1 \mid \omega_2=1) = \Pr(m_{2,i}=0, m_{2,-i}=1 \mid s_{2,i}=0, s_{2,-i}=0)* \Pr(s_{2,i}=0, s_{2,-i}=0 \mid \omega_2=1) + \Pr(m_{2,i}=0, m_{2,-i}=1 \mid s_{2,i}=0, s_{2,-i}=1)* \Pr(s_{2,i}=0, s_{2,-i}=1 \mid \omega_2=1)$
  $= \lambda_{2,i}*(1- \lambda_{2,-i})* (1-\gamma)^2 + \lambda_{2,i} * \gamma(1-\gamma)$ with $\lambda_{2,i} = 1$

- $\Pr(\omega_2=1) = \frac{1}{2}$

- $\Pr(m_{2,i} = 0, m_{2,-i} = 1) = \Pr(m_{2,i}=0, m_{2,-i}=1 | s_{2,i}=0, s_{2,-i}=0)* \Pr(s_{2,i}=0, s_{2,-i}=0) + \Pr(m_{2,i}=0, m_{2,-i}=1 | s_{2,i}=0, s_{2,-i}=1)* \Pr(s_{2,i}=0, s_{2,-i}=1)$
  $= \lambda_{2,i}*(1- \lambda_{2,-i})* \frac{1}{2} (\gamma^2 + (1-\gamma)^2)+ \lambda_{2,i} *\frac{1}{2} *2 \gamma(1-\gamma)$ with $\lambda_{2,i} = 1$

$a_2(0,1) = \Pr(\omega_2=1 \mid m_{2,i}=0, m_{2,-i}=1) = \frac{\Pr(m_{2,i} = 0, m_{2,-i} = 1|\omega_2 = 1)*\Pr(\omega_2=1)}{\Pr(m_{2,i} = 0, m_{2,-i} = 1)} =$
$\frac{(\mathbf{1-\lambda_{2,-i}})(\mathbf{1-\gamma})^{\mathbf{2}} + \boldsymbol{\gamma}(\mathbf{1-\gamma})}{(\mathbf{1-\lambda_{2,-i}})*(\gamma^2 + (1-\gamma)^2)+ \mathbf{2\gamma(1-\gamma)}}$

$a_2(1,0)$

$a_2(1,0) = \Pr(\omega_2=1 \mid m_{2,i}=1, m_{2,-i}=0) = \frac{\Pr(m_{2,i} = 1, m_{2,-i} = 0|\omega_2 = 1)*\Pr(\omega_2=1)}{\Pr(m_{2,i} = 1, m_{2,-i} = 0)}$

- $\Pr(m_{2,i} = 1, m_{2,-i} = 0 \mid \omega_2=1) = \Pr(m_{2,i}=1, m_{2,-i}=0 \mid s_{2,i}=0, s_{2,-i}=0)* \Pr(s_{2,i}=0, s_{2,-i}=0 \mid \omega_2=1) + \Pr(m_{2,i}=1, m_{2,-i}=0 \mid s_{2,i}=0, s_{2,-i}=1)* \Pr(s_{2,i}=0, s_{2,-i}=1 \mid \omega_2=1)$
  $= \lambda_{2,-i}*(1- \lambda_{2,i})* (1-\gamma)^2 + \lambda_{2,-i} * \gamma(1-\gamma)$ with $\lambda_{2,-i} = 1$

- $\Pr(\omega_2=1) = \frac{1}{2}$

- $\Pr(m_{2,i} = 1, m_{2,-i} = 0) = \Pr(m_{2,i}=1, m_{2,-i}=0 | s_{2,i}=0, s_{2,-i}=0)* \Pr(s_{2,i}=0, s_{2,-i}=0) + \Pr(m_{2,i}=1, m_{2,-i}=0 | s_{2,i}=1, s_{2,-i}=0)* \Pr(s_{2,i}=1, s_{2,-i}=0)$
  $= \lambda_{2,-i}*(1- \lambda_{2,i})* \frac{1}{2} (\gamma^2 + (1-\gamma)^2)+ \lambda_{2,-i} *\frac{1}{2} *2 \gamma(1-\gamma)$ with $\lambda_{2,-i} = 1$

$a_2(1,0) = \Pr(\omega_2=1 \mid m_{2,i}=1, m_{2,-i}=0) = \frac{\Pr(m_{2,i} = 1, m_{2,-i} = 0|\omega_2 = 1)*\Pr(\omega_2=1)}{\Pr(m_{2,i} = 1, m_{2,-i} = 0)} =$
$\frac{(\mathbf{1-\lambda_{2,i}})(\mathbf{1-\gamma})^{\mathbf{2}} + \boldsymbol{\gamma}(\mathbf{1-\gamma})}{(\mathbf{1-\lambda_{2,i}})*(\gamma^2 + (1-\gamma)^2)+ \mathbf{2\gamma(1-\gamma)}}$

$a_2(0,0)$

$a_2(0,0) = \Pr(\omega_2=1 \mid m_{2,i}=0, m_{2,-i}=0) = \frac{\Pr(m_{2,i} = 0, m_{2,-i} = 0 | \omega_2 = 1) * \Pr(\omega_2=1)}{\Pr(m_{2,i}=0, m_{2,-i}=0)}$

- $\Pr(m_{2,i}=0, m_{2,-i}=0 \mid \omega_2=1) = \Pr(m_{2,i}=0, m_{2,-i}=0 \mid s_{2,i}=0, s_{2,-i}=0) * \Pr(s_{2,i}=0, s_{2,-i}=0 \mid \omega_2=1)$
  $= \lambda_{2,i} * \lambda_{2,-i} * (1-\gamma)^2$ with $\lambda_{2,i} = 1$ and $\lambda_{2,-i} = 1$

- $\Pr(\omega_2=1) = \frac{1}{2}$

- $\Pr(m_{2,i}=0, m_{2,-i}=0) = \Pr(m_{2,i}=0, m_{2,-i}=0 | s_{2,i}=0, s_{2,-i}=0) * \Pr(s_{2,i}=0, s_{2,-i}=0)$
  $= \lambda_{2,i} * \lambda_{2,-i} * \frac{1}{2} (\gamma^2 + (1-\gamma)^2)$ with $\lambda_{2,i} = 1$ and $\lambda_{2,-i} = 1$

$a_2(0,0) = \Pr(\omega_2=1 \mid m_{2,i}=0, m_{2,-i}=0) = \frac{\Pr(m_{2,i} = 0, m_{2,-i} = 0 | \omega_2 = 1) * \Pr(\omega_2=1)}{\Pr(m_{2,i}=0, m_{2,-i}=0)} = \frac{(1-\gamma)^2}{\gamma^2 + (1-\gamma)^2} = \frac{\boldsymbol{\gamma^2 - 2\gamma + 1}}{\boldsymbol{2\gamma^2 - 2\gamma + 1}}$

1.2 Expected benefits of having a good reputation for a good adviser

1.2.1 One adviser

In the second period, the good adviser can receive signal 0 or 1. When the received signal is 0, he will announce message 0 . In that case, the action that the decision maker takes is equal to 0. If the received signal is 1, the action that the decision maker takes depends on the reputation of the adviser. The expected benefit of a having a good reputation will be the following:

$v_G [\lambda_2] = -x_2 * \Pr(s_2=1)*((\Pr(s_2=1 \mid \omega_2=1)*(\frac{1-\lambda_2 + \lambda_2\gamma}{(2-\lambda_2)} - 1)^2 + \Pr(s_2=1 \mid \omega_2=0)*(\frac{1-\lambda_2 + \lambda_2\gamma}{(2-\lambda_2)})^2 +$
$\Pr(s_2=0)*((\Pr(s_2=0 \mid \omega_2=1)*(1- \gamma-1)^2 + \Pr(s_2=0 \mid \omega_2=0)*(1-\gamma)^2)$

$= -x_2 (\frac{1}{2} \gamma(\frac{1-\lambda_2\gamma}{2-\lambda_2})^2 + \frac{1}{2} (1-\gamma)(\frac{1-\lambda_2 + \lambda_2\gamma}{2-\lambda_2})^2 + \frac{1}{2}(1-\gamma)\gamma^2 + \frac{1}{2}\gamma(1-\gamma)^2)$

1.2.2 Two advisers

$v_G [\lambda_2] = -x_2 * \Pr(\omega_2 = 1)* (\Pr(s_{2,i}=1, m_{2,-i}=1 \mid \omega_2=1) * (a_2(1,1)-1)^2 + \Pr(s_{2,i}=1, m_{2,-i}=1 \mid \omega_2=0)* a_2(1,1)^2 + \Pr(s_{2,i}=1, m_{2,-i}=0 \mid \omega_2=1)* (a_2(1,0)-1)^2 + \Pr(s_{2,i}=1, m_{2,-i}=0 \mid \omega_2=0) * a_2(1,0)^2) + \Pr(\omega_2 = 0)* (\Pr(s_{2,i}=0, m_{2,-i}=1 \mid \omega_2=1)* (a_2(0,1)-1)^2 + \Pr(s_{2,i}=0, m_{2,-i}=1 \mid \omega_2=0)*a_2(0,1)^2 + \Pr(s_{2,i}=0, m_{2,-i}=0 \mid \omega_2=1)* (a_2(0,0)-1)^2 + \Pr(s_{2,i}=0, m_{2,-i}=0 \mid \omega_2=0)*a_2(0,0))$

$v_G [\lambda_2] = -x_2 * (\frac{1}{2}*[(\gamma^2 + (2\gamma(1-\gamma)(1-\lambda_{2,-i})*\frac{1}{2})) *(a_2(1,1)-1)^2 + ((1-\gamma)^2 + 2\gamma(1-\gamma)(1-\lambda_{2,-i})* \frac{1}{2}) a_2(1,1)^2] + \frac{1}{2} *[(2\gamma(1-\gamma)\lambda_{2,-i}*\frac{1}{2})* (a_2(1,0)-1)^2 + (2\gamma(1-\gamma)\lambda_{2,-i}*\frac{1}{2})*a_2(1,0)^2) + \frac{1}{2} [(2\gamma(1-\gamma) *\frac{1}{2} + (1- \lambda_{2,-i})* (1-\gamma)^2) * (a_2(0,1)-1)^2 + (2\gamma(1-\gamma) *\frac{1}{2} + (1-\lambda_{2,-i})* \gamma^2) * a_2(0,1)^2] + \frac{1}{2} * [\lambda_{2,-i}*(1-\gamma)^2 *(a_2(0,0)-1)^2) + \lambda_{2,-i}*(\gamma)^2*a_2(0,0)^2]$

1.3 Expected benefits of having a good reputation for a bad adviser

1.3.1 One adviser

As the bad adviser always announces message 1 in the second period, the expected benefits of having a good reputation are equal to:

$V_B[\lambda_2] = y_2 * a_2(1)$

$v_B [\lambda_2] = y_2(\frac{1-\lambda_2+\lambda_2\gamma}{2-\lambda_2})$

1.3.2 Two advisers

When the other adviser is of the good type and has received signal 0, the bad adviser still benefits from having a good reputation. The expected benefits of having a good reputation are the following:

$v_B [\lambda_2] = Y_2(Prob(m_{2,-i}=1)* a_2(1,1) + Prob(m_{2,-i}=0)*a_2(1,0)$

$= Y_2 ((1-\frac{1}{2}\lambda_{2,-i})a_2(1,1) + \frac{1}{2}\lambda_{2,-i}*a_2(1,0)$

2. Calculations chapter 4: first period

2.1 Actions of the decision maker

2.1.1 One adviser

The calculation of the action of the decision maker in the case of an imperfect signal and one adviser is identical to the calculation in Morris (2001).

$$\Pr(\omega_1=1 | m_1=1) = \frac{\Pr(m_1=1|\omega_1=1)*\Pr(\omega_1=1)}{\Pr(m_1=1)} = \frac{\frac{1}{2}(\lambda_1\gamma+(1-\lambda_1))}{\frac{1}{2}(\lambda_1\gamma+(1-\lambda_1))+\frac{1}{2}(\lambda_1(1-\gamma)+(1-\lambda_1))} = \frac{1-\lambda_1+\lambda_1\gamma}{(2-\lambda_1)}$$

2.1.2 Two advisers

Four combinations of messages are possible: (1,1), (0,1), (1,0) and (0,0). Furthermore, in the first period it holds that: $\lambda_1 = \lambda_{1,I}, \lambda_{1,-i}$. The actions will be the following:

<u>a_1(1,1)</u>

$$a_1(1,1) = \Pr(\omega_1=1 \mid m_{1,i}=1, m_{1,-i}=1) = \frac{\Pr(m_{1,i}=1, m_{1,-i}=1|\omega_1=1)*\Pr(\omega_1=1)}{\Pr(m_{1,i}=1, m_{1,-i}=1)}$$

- $\Pr(m_{1,i}=1, m_{1,-i}=1 \mid \omega_1=1) = \Pr(m_{1,i}=1, m_{1,-i}=1 \mid s_{1,i}=0, s_{1,-i}=0) * \Pr(s_{1,i}=0, s_{1,-i}=0 \mid \omega_1=1) + \Pr(m_{1,i}=1, m_{1,-i}=1 \mid s_{1,i}=0, s_{1,-i}=1) * \Pr(s_{1,i}=0, s_{1,-i}=1 \mid \omega_1=1) + \Pr(m_{1,i}=1, m_{1,-i}=1 \mid s_{1,i}=1, s_{1,-i}=0) * \Pr(s_{1,i}=1, s_{1,-i}=0 \mid \omega_1=1) + \Pr(m_{1,i}=1, m_{1,-i}=1 \mid s_{1,i}=1, s_{1,-i}=1) * \Pr(s_{1,i}=1, s_{1,-i}=1 \mid \omega_1=1)$

  $= (1-\lambda_1)^2(1-\gamma)^2 + (1-\lambda_1)\gamma(1-\gamma) + (1-\lambda_1)\gamma(1-\gamma) + \gamma^2$

- $\Pr(\omega_1=1) = \frac{1}{2}$
- $\Pr(m_{1,i}=1, m_{1,-i}=1) = \Pr(m_{1,i}=1, m_{1,-i}=1 | s_{1,i}=0, s_{1,-i}=0) * \Pr(s_{1,i}=0, s_{1,-i}=0) + \Pr(m_{1,i}=1, m_{1,-i}=1 | s_{1,i}=0, s_{1,-i}=1) * \Pr(s_{1,i}=0, s_{1,-i}=1) + \Pr(m_{1,i}=1, m_{1,-i}=1 | s_{1,i}=1, s_{1,-i}=0) * \Pr(s_{1,i}=1, s_{1,-i}=0) + \Pr(m_{1,i}=1, m_{1,-i}=1 | s_{1,i}=1, s_{1,-i}=1) * \Pr(s_{1,i}=1, s_{1,-i}=1)$

  $\frac{1}{2}(1-\lambda_1)^2(\gamma^2 + (1-\gamma)^2) + \frac{1}{2}(1-\lambda_1)2\gamma(1-\gamma) + \frac{1}{2}(1-\lambda_1)2\gamma(1-\gamma) + \frac{1}{2}(\gamma^2 + (1-\gamma)^2)$

$a_1(1,1) = \Pr(\omega_1=1 \mid m_{1,i}=1, m_{1,-i}=1) = \frac{\Pr(m_{1,i}=1, m_{1,-i}=1|\omega_1=1)*\Pr(\omega_1=1)}{\Pr(m_{1,i}=1, m_{1,-i}=1)} =$

$$\frac{(\mathbf{1}-\boldsymbol{\lambda}_1)^2(\mathbf{1}-\boldsymbol{\gamma})^2+(\mathbf{1}-\boldsymbol{\lambda}_1)\boldsymbol{\gamma}(\mathbf{1}-\boldsymbol{\gamma})+(\mathbf{1}-\boldsymbol{\lambda}_1)\boldsymbol{\gamma}(\mathbf{1}-\boldsymbol{\gamma})+\boldsymbol{\gamma}^2}{\boldsymbol{\gamma}^2+(\mathbf{1}-\boldsymbol{\gamma})^2+(\mathbf{1}-\boldsymbol{\lambda}_1)\mathbf{2}\boldsymbol{\gamma}(\mathbf{1}-\boldsymbol{\gamma})+(\mathbf{1}-\boldsymbol{\lambda}_1)\mathbf{2}\boldsymbol{\gamma}(\mathbf{1}-\boldsymbol{\gamma})+(\mathbf{1}-\boldsymbol{\lambda}_1)^2(\boldsymbol{\gamma}^2+(\mathbf{1}-\boldsymbol{\gamma})^2)}$$

a_1(0,1)

$a_1(0,1) = \Pr(\omega_1=1 \mid m_{1,i}=0, m_{1,-i}=1) = \frac{\Pr(m_{1,i}=0, m_{1,-i}=1|\omega_1=1)*\Pr(\omega_1=1)}{\Pr(m_{1,i}=0, m_{1,-i}=1)}$

- $\Pr(m_{1,i}=0, m_{1,-i}=1 \mid \omega_1=1) = \Pr(m_{1,i}=0, m_{1,-i}=1 \mid s_{1,i}=0, s_{1,-i}=0) * \Pr(s_{1,i}=0, s_{1,-i}=0 \mid \omega_1=1) + \Pr(m_{1,i}=0, m_{1,-i}=1 \mid s_{1,i}=0, s_{1,-i}=1) * \Pr(s_{1,i}=0, s_{1,-i}=1 \mid \omega_1=1)$
  $= \lambda_1 (1-\lambda_1) * (1-\gamma)^2 + \lambda_1 * \gamma(1-\gamma)$

- $\Pr(\omega_1=1) = \frac{1}{2}$

- $\Pr(m_{1,i}=0, m_{1,-i}=1) = \Pr(m_{1,i}=0, m_{1,-i}=1 | s_{1,i}=0, s_{1,-i}=0) * \Pr(s_{1,i}=0, s_{1,-i}=0) + \Pr(m_{1,i}=0, m_{1,-i}=1 | s_{1,i}=0, s_{1,-i}=1) * \Pr(s_{1,i}=0, s_{1,-i}=1)$
  $= \lambda_1 (1-\lambda_1) * \frac{1}{2}(\gamma^2 + (1-\gamma)^2) + \lambda_1 * \frac{1}{2} * 2\gamma(1-\gamma)$

$a_1(0,1) = \Pr(\omega_1=1 \mid m_{1,i}=0, m_{1,-i}=1) = \frac{\Pr(m_{1,i}=0, m_{1,-i}=1|\omega_1=1)*\Pr(\omega_1=1)}{\Pr(m_{1,i}=0, m_{1,-i}=1)} =$

$$\frac{(\mathbf{1}-\boldsymbol{\lambda}_1)(\mathbf{1}-\boldsymbol{\gamma})^2+\boldsymbol{\gamma}(\mathbf{1}-\boldsymbol{\gamma})}{(\mathbf{1}-\boldsymbol{\lambda}_1)*(\gamma^2+(1-\gamma)^2)+\mathbf{2}\boldsymbol{\gamma}(\mathbf{1}-\boldsymbol{\gamma})}$$

a_1(1,0)

$a_1(1,0) = \Pr(\omega_1=1 \mid m_{1,i}=1, m_{1,-i}=0) = \frac{\Pr(m_{1,i}=1, m_{1,-i}=0|\omega_1=1)*\Pr(\omega_1=1)}{\Pr(m_{1,i}=1, m_{1,-i}=0)}$

- $\Pr(m_{1,i}=1, m_{1,-i}=0 \mid \omega_1=1) = \Pr(m_{1,i}=1, m_{1,-i}=0 \mid s_{1,i}=0, s_{1,-i}=0)*\Pr(s_{1,i}=0, s_{1,-i}=0 \mid \omega_1=1) + \Pr(m_{1,i}=1, m_{1,-i}=0 \mid s_{1,i}=1, s_{1,-i}=0)*\Pr(s_{1,i}=1, s_{1,-i}=0 \mid \omega_1=1)$
  $= \lambda_1(1-\lambda_1)*(1-\gamma)^2 + \lambda_1*\gamma(1-\gamma)$

- $\Pr(\omega_1=1) = \frac{1}{2}$

- $\Pr(m_{1,i}=1, m_{1,-i}=0) = \Pr(m_{1,i}=1, m_{1,-i}=0 | s_{1,i}=0, s_{1,-i}=0)*\Pr(s_{1,i}=0, s_{1,-i}=0) + \Pr(m_{1,i}=1, m_{1,-i}=0 | s_{1,i}=1, s_{1,-i}=0)*\Pr(s_{1,i}=1, s_{1,-i}=0)$
  $= \lambda_1(1-\lambda_1)*\frac{1}{2}(\gamma^2 + (1-\gamma)^2) + \lambda_1*\frac{1}{2}*2\gamma(1-\gamma)$

$a_1(1,0) = \Pr(\omega_1=1 \mid m_{1,i}=1, m_{1,-i}=0) = \frac{\Pr(m_{1,i}=1, m_{1,-i}=0|\omega_1=1)*\Pr(\omega_1=1)}{\Pr(m_{1,i}=1, m_{1,-i}=0)} =$
$\frac{\mathbf{(1-\lambda_1)(1-\gamma)^2 + \gamma(1-\gamma)}}{\mathbf{(1-\lambda_1)}*(\gamma^2 + (1-\gamma)^2) + \mathbf{2\gamma(1-\gamma)}}$

$\underline{a_1(0,0)}$

$a_1(0,0) = \Pr(\omega_1=1 \mid m_{1,i}=0, m_{1,-i}=0) = \frac{\Pr(m_{1,i}=0, m_{1,-i}=0|\omega_1=1)*\Pr(\omega_1=1)}{\Pr(m_{1,i}=0, m_{1,-i}=0)}$

- $\Pr(m_{1,i}=0, m_{1,-i}=0 \mid \omega_1=1) = \Pr(m_{1,i}=0, m_{1,-i}=0 \mid s_{1,i}=0, s_{1,-i}=0)*\Pr(s_{1,i}=0, s_{1,-i}=0 \mid \omega_1=1)$
  $= \lambda_1^2(1-\gamma)^2$

- $\Pr(\omega_1=1) = \frac{1}{2}$

- $\Pr(m_{1,i}=0, m_{1,-i}=0) = \Pr(m_{1,i}=0, m_{1,-i}=0 | s_{1,i}=0, s_{1,-i}=0)*\Pr(s_{1,i}=0, s_{1,-i}=0)$
  $= \frac{1}{2}\lambda_1^2(\gamma^2 + (1-\gamma)^2)$

$a_1(0,0) = \Pr(\omega_1=1 \mid m_{1,i}=0, m_{1,-i}=0) = \frac{\Pr(m_{1,i}=0, m_{1,-i}=0|\omega_1=1)*\Pr(\omega_1=1)}{\Pr(m_{1,i}=0, m_{1,-i}=0)} = \frac{(1-\gamma)^2}{\gamma^2 + (1-\gamma)^2} = \frac{\mathbf{\gamma^2-2\gamma+1}}{\mathbf{2\gamma^2-2\gamma+1}}$

2.2 Beliefs of the decision maker about the type of the adviser

2.2.1 One adviser

$\lambda_2 = \wedge(\lambda_1, m_1, \omega_1)$

$\wedge(\lambda_1, 0, \omega_1) = 1$

$\wedge(\lambda_1, 1, 1) = \frac{\Pr(m_1=1, \omega_1=1|Good)*\Pr(\text{Good})}{\Pr(m_1=1, \omega_1=1)} = \frac{\gamma\lambda_1}{\gamma\lambda_1 + (1-\lambda_1)}$

$\wedge(\lambda_1, 1, 0) = \frac{(1-\gamma)\lambda_1}{(1-\gamma)\lambda_1+(1-\lambda_1)}$

2.2.2 Two advisers

In this case, the beliefs of the decision maker about the type of the adviser are equal to the beliefs of the decision maker in the case of one adviser. This is because the decision maker observes the state of the world after the first period.

Table 7

$\wedge(\lambda_1, m_i, m_{-i},\omega_1)$	$\lambda_{2,i}$	$\lambda_{2,-i}$
$\wedge(\lambda_1, 1, 1,1)$	$\frac{\gamma\lambda_1}{\gamma\lambda_1+(1-\lambda_1)}$	$\frac{\gamma\lambda_1}{\gamma\lambda_1+(1-\lambda_1)}$
$\wedge(\lambda_1, 1, 1,0)$	$\frac{(1-\gamma)\lambda_1}{(1-\gamma)\lambda_1+(1-\lambda_1)}$	$\frac{(1-\gamma)\lambda_1}{(1-\gamma)\lambda_1+(1-\lambda_1)}$
$\wedge(\lambda_1, 1, 0,1)$	$\frac{\gamma\lambda_1}{\gamma\lambda_1+(1-\lambda_1)}$	1
$\wedge(\lambda_1, 1, 0,0)$	$\frac{(1-\gamma)\lambda_1}{(1-\gamma)\lambda_1+(1-\lambda_1)}$	1
$\wedge(\lambda_1, 0, 1,1)$	1	$\frac{\gamma\lambda_1}{\gamma\lambda_1+(1-\lambda_1)}$
$\wedge(\lambda_1, 0, 1,0)$	1	$\frac{(1-\gamma)\lambda_1}{(1-\gamma)\lambda_1+(1-\lambda_1)}$
$\wedge(\lambda_1, 0, 0,1)$	1	1
$\wedge(\lambda_1, 0, 0,0)$	1	1

2.3 Total utility functions: truth-telling and lying (good adviser)

2.3.1 One adviser

U_G(Truth-telling: s_1=1, m_1=1)

$-x_1(\gamma(\frac{\gamma\lambda_1-1}{(2-\lambda_1)})^2 + (1-\gamma)(\frac{\gamma\lambda_1-\lambda_1+1}{(2-\lambda_1)})^2) + (\gamma) * v_G[\wedge(\lambda_1, 1, 1)] + (1-\gamma) * v_G[\wedge(\lambda_1, 1, 0)]$

- The expected value of λ_2 is equal to: $\gamma*\wedge(\lambda_1, 1, 1) + (1-\gamma) *\wedge(\lambda_1, 1, 0) = \gamma* \frac{\gamma\lambda_1}{\gamma\lambda_1+(1-\lambda_1)} + (1-\gamma)* \frac{(1-\gamma)\lambda_1}{(1-\gamma)\lambda_1+(1-\lambda_1)}$
- The expected benefits of having a good reputation in the second period are the following:

  $-x_2 (\frac{1}{2}\gamma(\frac{1-\lambda_2\gamma}{2-\lambda_2})^2 + \frac{1}{2}(1-\gamma)(\frac{1-\lambda_2+\lambda_2\gamma}{2-\lambda_2})^2 + \frac{1}{2}(1-\gamma)\gamma^2 + \frac{1}{2}\gamma(1-\gamma)^2)$ with $E(\lambda_2) = \gamma* \frac{\gamma\lambda_1}{\gamma\lambda_1+(1-\lambda_1)} + (1-\gamma)* \frac{(1-\gamma)\lambda_1}{(1-\gamma)\lambda_1+(1-\lambda_1)}$

Total payoff function of truth-telling is the following:

$-x_1(\gamma(\frac{\gamma\lambda_1-1}{(2-\lambda_1)})^2 + (1-\gamma)(\frac{\gamma\lambda_1-\lambda_1+1}{(2-\lambda_1)})^2) -x_2 (\frac{1}{2}\gamma(\frac{1-\lambda_2\gamma}{2-\lambda_2})^2 + \frac{1}{2}(1-\gamma)(\frac{1-\lambda_2+\lambda_2\gamma}{2-\lambda_2})^2 + \frac{1}{2}(1-\gamma)\gamma^2 + \frac{1}{2}\gamma(1-\gamma)^2)$

with $E(\lambda_2) = \gamma* \frac{\gamma\lambda_1}{\gamma\lambda_1+(1-\lambda_1)} + (1-\gamma)* \frac{(1-\gamma)\lambda_1}{(1-\gamma)\lambda_1+(1-\lambda_1)}$

U_G(Lying: s_1=1, m_1=0)

$-x_1(\gamma (1-\gamma-1)^2 +(1-\gamma)(1-\gamma)^2) - x_2*(\frac{1}{2}(\gamma(\gamma-1)^2 + (1-\gamma)*\gamma^2) + \frac{1}{2}(\gamma(1-\gamma)^2+(1-\gamma)\gamma^2)) =$

$-x_1((\gamma)^3 +(1-\gamma)^2) - (x_2*(\gamma(\gamma-1)^2 + (1-\gamma)\gamma^2) =$

$-x_1((\gamma)^3 +(1-\gamma)^3) - x_2*(\gamma(1-\gamma))$

2.3.2 Two advisers (simultaneous)

U_G(Truth-telling: s_1=1, m_1=1)

$-x_1((\gamma^2*(a_1(1,1)-1)^2 + (1-\gamma)^2*a_1(1,1)^2 + 2\gamma(1-\gamma)(\lambda_{1,}*(\frac{1}{2}(a_1(1,0)-1)^2 + \frac{1}{2}(a_1(1,0))^2 + (1-\lambda_1)(\frac{1}{2}(a_1(1,1)-1)^2 + \frac{1}{2}(a_1(1,1)^2))] + \gamma\, v_G[(1, m_{1,-i},1)] + (1-\gamma)\, v_G[(1, m_{1,-i},0)]$

- The expected value of $\lambda_{2,i}$ is equal to: $\gamma*\wedge(\lambda_1, 1, m_{-I}, 1) + (1-\gamma) *\wedge(\lambda_1, 1, m_{-I}, 0) = \gamma* \frac{\gamma\lambda_1}{\gamma\lambda_1+(1-\lambda_1)} + (1-\gamma)* \frac{(1-\gamma)\lambda_1}{(1-\gamma)\lambda_1+(1-\lambda_1)}$
- The expected value of $\lambda_{2,-i} = \lambda_1$
- The expected benefits of a good reputation are the following:

$-x_2 * (\frac{1}{2}*[(\gamma^2 + (2\gamma(1-\gamma)(1-\lambda_{2,-i})*\frac{1}{2})) *(a_2(1,1)-1)^2 + ((1-\gamma)^2 + 2\gamma(1-\gamma)(1-\lambda_{2,-i})* \frac{1}{2})\, a_2(1,1)^2] + \frac{1}{2} *[(2\gamma(1-\gamma)\lambda_{2,-i}*\frac{1}{2})* (a_2(1,1)-1)^2 + (2\gamma(1-\gamma)\lambda_{2,-i}*\frac{1}{2})*a_2(1,1)^2)$

With $\lambda_{2,I} = \gamma* \frac{\gamma\lambda_1}{\gamma\lambda_1+(1-\lambda_1)} + (1-\gamma)* \frac{(1-\gamma)\lambda_1}{(1-\gamma)\lambda_1+(1-\lambda_1)}$ and $\lambda_{2,-I} = \lambda_1$

Total payoff of truth-telling is the following:

$-x_1((\gamma^2*(a_1(1,1)-1)^2 + (1-\gamma)^2*a_1(1,1)^2 + 2\gamma(1-\gamma)(\lambda_{1,}*(\frac{1}{2}(a_1(1,0)-1)^2 + \frac{1}{2}(a_1(1,0))^2 + (1- \lambda_1)(\frac{1}{2}(a_1(1,1)-1)^2 + \frac{1}{2}(a_1(1,1)^2)]\ \ -x_2 * (\frac{1}{2}*[(\gamma^2 + (2\gamma(1-\gamma)(1-\lambda_{2,-i})*\frac{1}{2})) *(a_2(1,1)-1)^2 + ((1-\gamma)^2 + 2\gamma(1-\gamma)(1-\lambda_{2,-i})* \frac{1}{2})\, a_2(1,1)^2] + \frac{1}{2} *[(2\gamma(1-\gamma)\lambda_{2,-i}*\frac{1}{2})* (a_2(1,1)-1)^2 + (2\gamma(1-\gamma)\lambda_{2,-i}*\frac{1}{2})*a_2(1,1)^2)$

With $\lambda_{2,I} = \gamma* \frac{\gamma\lambda_1}{\gamma\lambda_1+(1-\lambda_1)} + (1-\gamma)* \frac{(1-\gamma)\lambda_1}{(1-\gamma)\lambda_1+(1-\lambda_1)}$ and $\lambda_{2,-I} = \lambda_1$

<u>U_G(Lying: s_1=1, m_1=0)</u>
$-x_1(\gamma^2(a_1(0,1)-1)^2 + (1- \gamma)^2(a_1(0,1)^2) + (2\gamma(1-\gamma) *(\frac{1}{2}\lambda_1*(a_1(0,0)-1)^2 + \frac{1}{2}\lambda_1* a_1(0,0)^2 + \frac{1}{2}(1-\lambda_1) *(a_1(0,1)-1)^2 + \frac{1}{2}(1-\lambda_1)* a_1(0,1)^2 + v_G [\lambda_{2,i} = 1]$

$= -x_1(\gamma^2(a_1(0,1)-1)^2 + (1- \gamma)^2(a_1(0,1)^2) + (2\gamma(1-\gamma) *(\frac{1}{2}\lambda_1*(a_1(0,0)-1)^2 + \frac{1}{2}\lambda_1* a_1(0,0)^2 + \frac{1}{2}(1-\lambda_1) *(a_1(0,1)-1)^2 + \frac{1}{2}(1-\lambda_1)* a_1(0,1)^2 -x_2 * (\frac{1}{2}*[(\gamma^2 + (2\gamma(1-\gamma)(1-\lambda_{2,-i})*\frac{1}{2})) *(a_2(1,1)-1)^2 + ((1-\gamma)^2 + 2\gamma(1-\gamma)(1-\lambda_{2,-i})* \frac{1}{2})\, a_2(1,1)^2] + \frac{1}{2} *[(2\gamma(1-\gamma)\lambda_{2,-i}*\frac{1}{2})* (a_2(1,1)-1)^2 + (2\gamma(1-\gamma)\lambda_{2,-i}*\frac{1}{2})*a_2(1,1)^2)$

With $\lambda_{2,I} = 1$ and $\lambda_{2,-I} = \lambda_1$

2.4 Total utility functions: truth-telling and lying (bad adviser)

2.4.1 One adviser

- U_B(Truth-telling: s_1= 0, m_1 = 0) = $Y_1(1-\gamma) + Y_2\gamma$

- U_B(Lying: s_1=0, m_1 = 1) = $Y_1(\frac{\gamma\lambda_1-\lambda_1+1}{(2-\lambda_1)}) + v_B[\lambda_2]$

  With $v_B[\lambda_2] = Y_2\ ((1-\frac{1}{2}\lambda_{2,-i}) * \frac{1}{1+(1-\lambda_{2,i})(1-\lambda_{2,-i})})$

  and $E(\lambda_2) = (1-\gamma)* \frac{\gamma\lambda_1}{\gamma\lambda_1+(1-\lambda_1)} + \gamma* \frac{(1-\gamma)\lambda_1}{(1-\gamma)\lambda_1+(1-\lambda_1)}$

Total payoff of lying:

$Y_1(\frac{\gamma\lambda_1-\lambda_1+1}{(2-\lambda_1)}) + Y_2\ (\frac{\gamma\lambda_2-\lambda_2+1}{(2-\lambda_2)}))$ with $E(\lambda_2) = (1-\gamma)* \frac{\gamma\lambda_1}{\gamma\lambda_1+(1-\lambda_1)} + \gamma* \frac{(1-\gamma)\lambda_1}{(1-\gamma)\lambda_1+(1-\lambda_1)}$

2.4.2 Two advisers (simultaneous)

- U_B(Truth-telling: s_1= 0, m_1 = 0)= Y_1*(Pr($m_{1,-i}$=1)*$a_1(0,1)$ + Pr($m_{1,-i}$=0)*$a_1(0,0)$) + Y_2* ((Pr($m_{2,-i}$=1)*$a_2(1,1)$ + Pr($m_{2,-i}$=0)*$a_2(1,0)$)

  = $Y_1(((1-\lambda_1)(\gamma^2+(1-\gamma)^2)+2\gamma(1-\gamma))*a_1(0,1)+\lambda_1(\gamma^2+(1-\gamma)^2)*a_1(0,0))+Y_2*((1-\frac{1}{2}\lambda_{2,-i})a_2(1,1)+\frac{1}{2}\lambda_{2,-i}*a_2(1,0))$

  = $Y_1((\lambda_1(2\gamma-2\gamma^2)+(1-\lambda_1))*a_1(0,1)+(\lambda_1*(2\gamma^2-2\gamma+1))*a_1(0,0))+Y_2*((1-\frac{1}{2}\lambda_{2,-i})a_2(1,1)+\frac{1}{2}\lambda_{2,-i}*a_2(1,0))$

- U_B(Lying: s_1=0, m_1 = 1) = Y_1*(Pr($m_{1,-i}$=1)*$a_1(1,1)$ + Pr($m_{1,-i}$=0)*$a_1(1,0)$) + Y_2* ((Pr($m_{2,-i}$=1)*$a_2(1,1)$ + Pr($m_{2,-i}$=0)*$a_2(1,0)$)

  = $Y_1(((1-\lambda_1)(\gamma^2+(1-\gamma)^2)+2\gamma(1-\gamma))*a_1(1,1)+\lambda_1(\gamma^2+(1-\gamma)^2)*a_1(1,0))+Y_2*((1-\frac{1}{2}\lambda_{2,-i})a_2(1,1)+\frac{1}{2}\lambda_{2,-i}*a_2(1,0))$

  = $Y_1((\lambda_1(2\gamma-2\gamma^2)+(1-\lambda_1))*a_1(1,1)+(\lambda_1*(2\gamma^2-2\gamma+1))*a_1(1,0))+Y_2*((1-\frac{1}{2}\lambda_{2,-i})a_2(1,1)+\frac{1}{2}\lambda_{2,-i}*a_2(1,0))$

2.5 Two advisers (sequential)

2.5.1 Good advisers

Adviser (1): good first adviser

Adviser (2): second, good adviser that has observed that the first adviser announced message 0

Adviser (3): second, good adviser that has observed that the first adviser announced message 1

(1) The considerations of the good, first adviser will be the same as the consideration of the good adviser in the case of simultaneously advising. The first adviser believes that the second, good or bad adviser acts according to his strategy. The second adviser does not learn whether the first adviser has lied as he might have received a different signal.

- $U_{G,1}$(Truth-telling: s_1=1, m_1=1) = $-x_1((\gamma^2*(a_1(1,1)-1)^2+(1-\gamma)^2*a_1(1,1)^2+2\gamma(1-\gamma)(\lambda_{1,}*(\frac{1}{2}(a_1(1,0)-1)^2+\frac{1}{2}(a_1(1,0))^2+(1-\lambda_1)(\frac{1}{2}(a_1(1,1)-1)^2+\frac{1}{2}(a_1(1,1)^2)]+\gamma\, v_G[(1, m_{1,-i},1)]+(1-\gamma)\, v_G[(1, m_{1,-i},0)]$ with $\lambda_{2,I}=\gamma*\frac{\gamma\lambda_1}{\gamma\lambda_1+(1-\lambda_1)}+(1-\gamma)*\frac{(1-\gamma)\lambda_1}{(1-\gamma)\lambda_1+(1-\lambda_1)}$ and $\lambda_{2,-I}=\lambda_1$
- $U_{G,1}$(Lying: s_1=1, m_1=0) = $-x_1(\gamma^2(a_1(0,1)-1)^2+(1-\gamma)^2(a_1(0,1)^2)+(2\gamma(1-\gamma)*(\frac{1}{2}\lambda_1*(a_1(0,0)-1)^2+\frac{1}{2}\lambda_1*a_1(0,0)^2+\frac{1}{2}(1-\lambda_1)*(a_1(0,1)-1)^2+\frac{1}{2}(1-\lambda_1)*a_1(0,1)^2+v_G[\lambda_{2,i}=1]$ with $\lambda_{2,I}=1$ and $\lambda_{2,-I}=\lambda_1$

(2) As the first adviser has sent message 0, the second adviser believes that the first adviser is of the good type and has received signal 0. Hence, the probability that the state of the world is equal to 1 is $\frac{1}{2}$. The expected utilities of lying and truth-telling are the following:

- $U_{G,2}(s_1 = 1, m_{1,-i} = 0, m_{1,i} = 1) = -x_1(\frac{1}{2}(a_1(0,1)-1)^2 + \frac{1}{2}(a_1(0,1)^2) + v_G[\lambda_{2,i}, \lambda_{2,-i} = 1])$
  With $\lambda_{2,i} = \frac{1}{2} * \frac{\gamma\lambda_1}{\gamma\lambda_1 + (1-\lambda_1)} + \frac{1}{2} * \frac{(1-\gamma)\lambda_1}{(1-\gamma)\lambda_1 + (1-\lambda_1)}$
- $U_{G,2}(s_1 = 1, m_{1,-i} = 0, m_{1,i} = 0) = -x_1(\frac{1}{2}(a_1(0,0)-1)^2 + \frac{1}{2}(a_1(0,0)^2) + v_G[\lambda_{2,i} = 1, \lambda_{2,-i} = 1])$

(3) When the first adviser has sent message 1, the second, good adviser does not know the type of the first adviser and the received signal for sure. First, he updates his belief about the first adviser and the probability that the first adviser actually has received signal 1. As a bad adviser always announces m=1 regardless of his signal, the probability that the first adviser has received signal 1 respectively 0 is equal to:

$\Pr(s_{-i} = 1 | s_i = 1, m_{-i} = 1) = \frac{\gamma^2 + (1-\gamma)^2}{\gamma^2 + (1-\gamma)^2 + 2\gamma(1-\gamma)(1-\lambda_1)}$
$\Pr(s_{-i} = 0 | s_i = 1, m_{-i} = 1) = \frac{2\gamma(1-\gamma)(1-\lambda_1)}{\gamma^2 + (1-\gamma)^2 + 2\gamma(1-\gamma)(1-\lambda_1)}$

Taking these values into account, the expected utilities of truth-telling and lying for the second, good adviser will be equal to:

- $U_{G,2}(s_1 = 1, m_{1,-i} = 1, m_{1,i} = 1) = -x_1 * (\Pr(\omega_1 = 1 | m_{1,-i} = 1, s_{1,i} = 1) * (a_1(1,1)-1)^2 + \Pr(\omega_1 = 0 | m_{1,-i} = 1, s_{1,i} = 1) * a_1(1,1)^2 + v_G[\lambda_{2,i}])$

- $U_{G,2}(s_1 = 1, m_{1,-i} = 1, m_{1,i} = 0) = -x_1 * (\Pr(\omega_1 = 1 | m_{1,-i} = 1, s_{1,i} = 1) * (a_1(1,0)-1)^2 + \Pr(\omega_1 = 0 | m_{1,-i} = 1, s_{1,i} = 1) * a_1(1,0)^2 + v_G[\lambda_{2,i} = 1])$

With $\Pr(\omega_1 = 1 | m_{1,-i} = 1, s_{1,i} = 1) = \Pr(s_{-i} = 1 | s_i = 1, m_{-i} = 1) * \Pr(\omega_1 = 1 | s_{1,-i} = 1, s_{1,i} = 1) + \Pr(s_{-i} = 0 | s_i = 1, m_{-i} = 1) * \Pr(\omega_1 = 1 | s_{1,-i} = 0, s_{1,i} = 1)$

$= \frac{\gamma^2 + (1-\gamma)^2}{\gamma^2 + (1-\gamma)^2 + 2\gamma(1-\gamma)(1-\lambda_1)} * \frac{\gamma^2}{2\gamma^2 - 2\gamma + 1} + \frac{2\gamma(1-\gamma)(1-\lambda_1)}{\gamma^2 + (1-\gamma)^2 + 2\gamma(1-\gamma)(1-\lambda_1)} * \frac{1}{2}$

and $\Pr(\omega_1 = 0 | m_{1,-i} = 1, s_{1,i} = 1) = \Pr(s_{-i} = 1 | s_i = 1, m_{-i} = 1) * \Pr(\omega_1 = 0 | s_{1,-i} = 1, s_{1,i} = 1) + \Pr(s_{-i} = 0 | s_i = 1, m_{-i} = 1) * \Pr(\omega_1 = 0 | s_{1,-i} = 0, s_{1,i} = 1)$

$= \frac{\gamma^2 + (1-\gamma)^2}{\gamma^2 + (1-\gamma)^2 + 2\gamma(1-\gamma)(1-\lambda_1)} * \frac{\gamma^2 - 2\gamma + 1}{2\gamma^2 - 2\gamma + 1} + \frac{2\gamma(1-\gamma)(1-\lambda_1)}{\gamma^2 + (1-\gamma)^2 + 2\gamma(1-\gamma)(1-\lambda_1)} * \frac{1}{2}$

- $U_{G,2}(s_1=1, m_{1,-i}=1, m_{1,i}=1) = -x_1\Big(\Big(\frac{\gamma^2+(1-\gamma)^2}{\gamma^2+(1-\gamma)^2+2\gamma(1-\gamma)(1-\lambda_1)} * \frac{\gamma^2}{2\gamma^2-2\gamma+1} + \frac{2\gamma(1-\gamma)(1-\lambda_1)}{\gamma^2+(1-\gamma)^2+2\gamma(1-\gamma)(1-\lambda_1)} * \frac{1}{2}\Big)(a_1(1,1)-1)^2 + \Big(\frac{\gamma^2+(1-\gamma)^2}{\gamma^2+(1-\gamma)^2+2\gamma(1-\gamma)(1-\lambda_1)} * \frac{\gamma^2-2\gamma+1}{2\gamma^2-2\gamma+1} + \frac{2\gamma(1-\gamma)(1-\lambda_1)}{\gamma^2+(1-\gamma)^2+2\gamma(1-\gamma)(1-\lambda_1)} * \frac{1}{2}\Big)(a_1(1,1)^2 + v_G[\lambda_{2,i}, \lambda_{2,-i}]\Big)$

  with $E(\lambda_{2,i}) = E(\lambda_{2,-i}) = \Big(\frac{\gamma^2+(1-\gamma)^2}{\gamma^2+(1-\gamma)^2+2\gamma(1-\gamma)(1-\lambda_1)} * \frac{\gamma^2}{2\gamma^2-2\gamma+1} + \frac{2\gamma(1-\gamma)(1-\lambda_1)}{\gamma^2+(1-\gamma)^2+2\gamma(1-\gamma)(1-\lambda_1)} * \frac{1}{2}\Big) * \frac{\gamma\lambda_1}{\gamma\lambda_1+(1-\lambda_1)} + \Big(\frac{\gamma^2+(1-\gamma)^2}{\gamma^2+(1-\gamma)^2+2\gamma(1-\gamma)(1-\lambda_1)} * \frac{(1-\gamma)^2}{2\gamma^2-2\gamma+1} + \frac{2\gamma(1-\gamma)(1-\lambda_1)}{\gamma^2+(1-\gamma)^2+2\gamma(1-\gamma)(1-\lambda_1)} * \frac{1}{2}\Big) * \frac{(1-\gamma)\lambda_1}{(1-\gamma)\lambda_1+(1-\lambda_1)}$

- $U_{G,2}(s_1=1, m_{1,-i}=1, m_{1,i}=0) = -x_1\Big(\Big(\frac{\gamma^2+(1-\gamma)^2}{\gamma^2+(1-\gamma)^2+2\gamma(1-\gamma)(1-\lambda_1)} * \frac{\gamma^2}{2\gamma^2-2\gamma+1} + \frac{2\gamma(1-\gamma)(1-\lambda_1)}{\gamma^2+(1-\gamma)^2+2\gamma(1-\gamma)(1-\lambda_1)} * \frac{1}{2}\Big)(a_1(1,0)-1)^2 + \Big(\frac{\gamma^2+(1-\gamma)^2}{\gamma^2+(1-\gamma)^2+2\gamma(1-\gamma)(1-\lambda_1)} * \frac{\gamma^2-2\gamma+1}{2\gamma^2-2\gamma+1} + \frac{2\gamma(1-\gamma)(1-\lambda_1)}{\gamma^2+(1-\gamma)^2+2\gamma(1-\gamma)(1-\lambda_1)} * \frac{1}{2}\Big)(a_1(1,0)^2 + v_G[\lambda_{2,i}=1, \lambda_{2,-i}]\Big)$

  with $\lambda_{2,I} = 1$ and $\lambda_{2,-i} = \Big(\frac{\gamma^2+(1-\gamma)^2}{\gamma^2+(1-\gamma)^2+2\gamma(1-\gamma)(1-\lambda_1)} * \frac{\gamma^2}{2\gamma^2-2\gamma+1} + \frac{2\gamma(1-\gamma)(1-\lambda_1)}{\gamma^2+(1-\gamma)^2+2\gamma(1-\gamma)(1-\lambda_1)} * \frac{1}{2}\Big) * \frac{\gamma\lambda_1}{\gamma\lambda_1+(1-\lambda_1)} + \Big(\frac{\gamma^2+(1-\gamma)^2}{\gamma^2+(1-\gamma)^2+2\gamma(1-\gamma)(1-\lambda_1)} * \frac{\gamma^2-2\gamma+1}{2\gamma^2-2\gamma+1} + \frac{2\gamma(1-\gamma)(1-\lambda_1)}{\gamma^2+(1-\gamma)^2+2\gamma(1-\gamma)(1-\lambda_1)} * \frac{1}{2}\Big) * \frac{(1-\gamma)\lambda_1}{(1-\gamma)\lambda_1+(1-\lambda_1)}$

2.5.2 Comparison indifference points – good advisers – imperfect signal

Figure 16

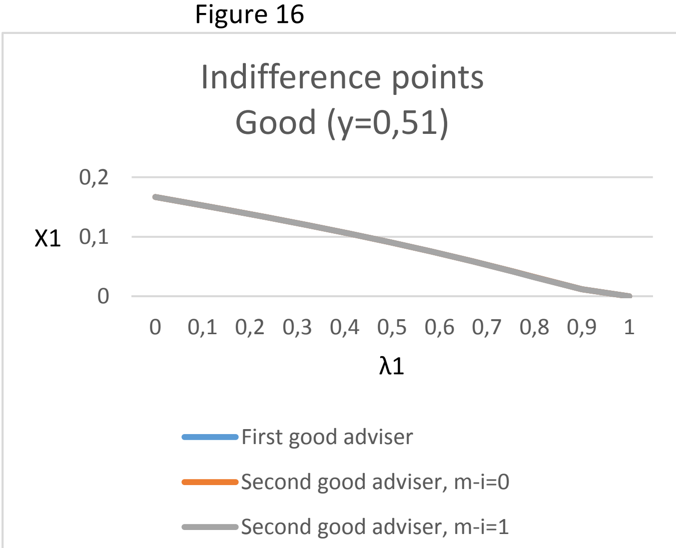


Figure 17

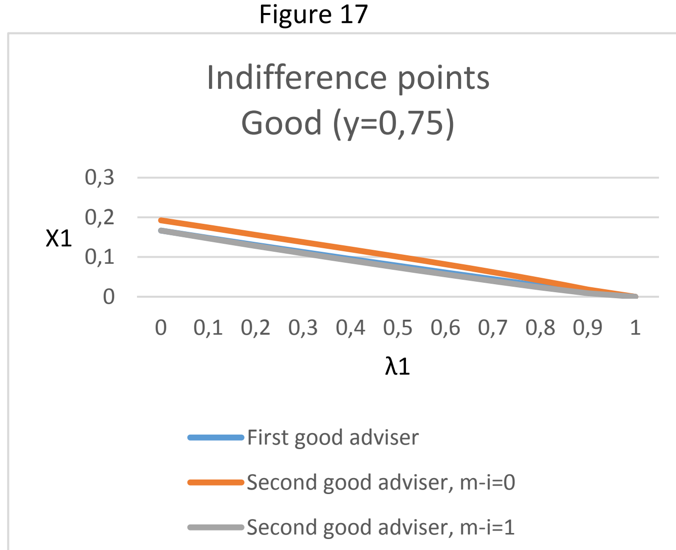
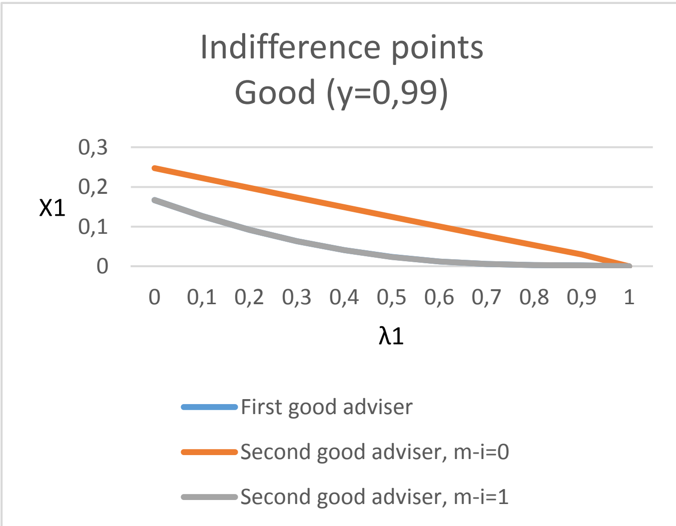


Figure 18



As the line of the second, good adviser that has observed that the first adviser has sent message 0 is in any case equal to or higher than the lines of the first good adviser and the second, good adviser that had noticed that the first adviser has sent message 1, an equilibrium in which the good adviser tells the truth can only exist when this good adviser does not have an incentive to lie.

2.5.3 Bad advisers – imperfect signal

Adviser (1): bad, first adviser

Adviser (2): second, bad adviser that has observed that the first adviser announces message 0

Adviser (3): second, bad adviser that has observed that the first adviser announces message 1

$\Pr(s_{-i} = 1|s_i = 0, m_{-i} = 1) = \frac{2\gamma(1-\gamma)}{(\gamma^2+(1-\gamma)^2)*(1-\lambda_1)+2\gamma(1-\gamma)}$

$\Pr(s_{-i} = 0|s_i = 0, m_{-i} = 1) = \frac{(\gamma^2+(1-\gamma)^2)*(1-\lambda_1)}{(\gamma^2+(1-\gamma)^2)*(1-\lambda_1)+2\gamma(1-\gamma)}$

(1) The bad first adviser has an incentive to deviate at the same moments as the bad adviser in the case of simultaneous advising:

- $U_{B,1}$(Truth-telling: s_1= 0, m_1 = 0)= $Y_1((\lambda_1(2\gamma-2\gamma^2)+1-\lambda_1)*a_1(0,1) + (\lambda_1*(2\gamma^2-2\gamma+1))*a_1(0,0)) + Y_2*((1-\frac{1}{2}\lambda_{2,-i})a_2(1,1) + \frac{1}{2}\lambda_{2,-i}*a_2(1,0))$
  with $\lambda_{2,i}$=1 and $\lambda_{2,-i} = \lambda_1$

- $U_{B,1}$(Lying: s_1=0, m_1 = 1) = $Y_1((\lambda_1(2\gamma-2\gamma^2)+(1-\lambda_1))*a_1(1,1) + (\lambda_1*(2\gamma^2-2\gamma+1))*a_1(1,0)) + Y_2*((1-\frac{1}{2}\lambda_{2,-i})a_2(1,1) + \frac{1}{2}\lambda_{2,-i}*a_2(1,0))$
  with $\lambda_{2,i}= (1-\gamma)*\frac{\gamma\lambda_1}{\gamma\lambda_1+(1-\lambda_1)} + \gamma*\frac{(1-\gamma)\lambda_1}{(1-\gamma)\lambda_1+(1-\lambda_1)}$, $\lambda_{2,-i} = \lambda_1$

(2) When the first adviser sends message 0, the second, bad adviser believes that the other adviser is of the good type and has received signal 0. Therefore, his expected payoffs will be the following:

- $U_{B,2}(s=0, m_{-i}=0, m_i=0)= Y_1(a_1(0,0)+ v_B[\lambda_{2,i}=1, \lambda_{2,-i}=1]$
- $U_{B,2}(s=0, m_{-i}=0, m_i=1)= Y_1(a_1(0,1)+ v_B[\lambda_{2,i,}, \lambda_{2,-i}=1]$

With $\lambda_{2,i} = \frac{(1-\gamma)^2}{\gamma^2+(1-\gamma)^2} * \frac{\gamma\lambda_1}{\gamma\lambda_1+(1-\lambda_1)} + \frac{\gamma^2}{\gamma^2+(1-\gamma)^2} * \frac{(1-\gamma)\lambda_1}{(1-\gamma)\lambda_1+(1-\lambda_1)}$

(3) When the first adviser sends message 1, the payoffs of the second, bad adviser will be as follows:

- $U_{B,2}(s=0, m_{-i}=1, m_i=0)= Y_1*a_1(1,0)+ v_B[\lambda_{2,i}=1, \lambda_{2,-i}]$
  with $\lambda_{2,-i} = (\frac{(\gamma^2+(1-\gamma)^2)*(1-\lambda_1)}{(\gamma^2+(1-\gamma)^2)*(1-\lambda_1)+2\gamma(1-\gamma)}* \frac{(1-\gamma)^2}{2\gamma^2-2\gamma+1} + \frac{2\gamma(1-\gamma)}{(\gamma^2+(1-\gamma)^2)*(1-\lambda_1)+2\gamma(1-\gamma)} * \frac{1}{2})* \frac{\gamma\lambda_1}{\gamma\lambda_1+(1-\lambda_1)} + (\frac{(\gamma^2+(1-\gamma)^2)*(1-\lambda_1)}{(\gamma^2+(1-\gamma)^2)*(1-\lambda_1)+2\gamma(1-\gamma)}* \frac{(\gamma)^2}{2\gamma^2-2\gamma+1} + \frac{2\gamma(1-\gamma)}{(\gamma^2+(1-\gamma)^2)*(1-\lambda_1)+2\gamma(1-\gamma)} * \frac{1}{2})* \frac{(1-\gamma)\lambda_1}{(1-\gamma)\lambda_1+(1-\lambda_1)}$
- $U_{B,2}(s=0, m_{-i}=1, m_i=1)= Y_1(a_1(1,1)+ v_B[\lambda_{2,i}, \lambda_{2,-i}]$
  with $\lambda_{2,i} = \lambda_{2,-i} = (\frac{(\gamma^2+(1-\gamma)^2)*(1-\lambda_1)}{(\gamma^2+(1-\gamma)^2)*(1-\lambda_1)+2\gamma(1-\gamma)}* \frac{(1-\gamma)^2}{2\gamma^2-2\gamma+1} + \frac{2\gamma(1-\gamma)}{(\gamma^2+(1-\gamma)^2)*(1-\lambda_1)+2\gamma(1-\gamma)} * \frac{1}{2})* \frac{\gamma\lambda_1}{\gamma\lambda_1+(1-\lambda_1)} + (\frac{(\gamma^2+(1-\gamma)^2)*(1-\lambda_1)}{(\gamma^2+(1-\gamma)^2)*(1-\lambda_1)+2\gamma(1-\gamma)}* \frac{(\gamma)^2}{2\gamma^2-2\gamma+1} + \frac{2\gamma(1-\gamma)}{(\gamma^2+(1-\gamma)^2)*(1-\lambda_1)+2\gamma(1-\gamma)} * \frac{1}{2})* \frac{(1-\gamma)\lambda_1}{(1-\gamma)\lambda_1+(1-\lambda_1)}$

Figure 19

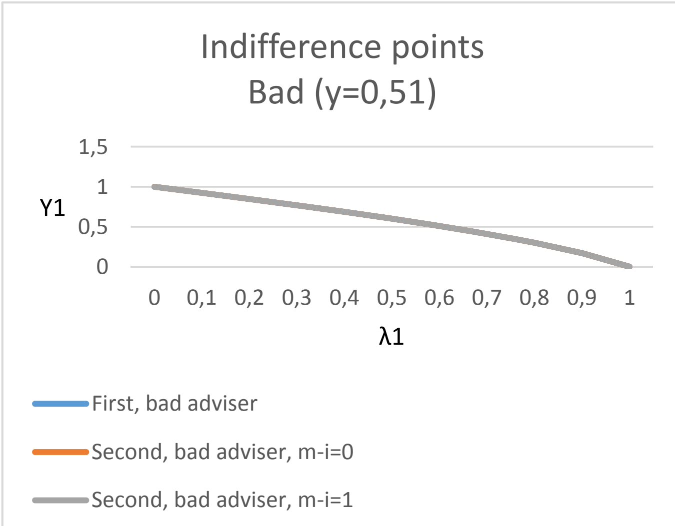


Figure 20

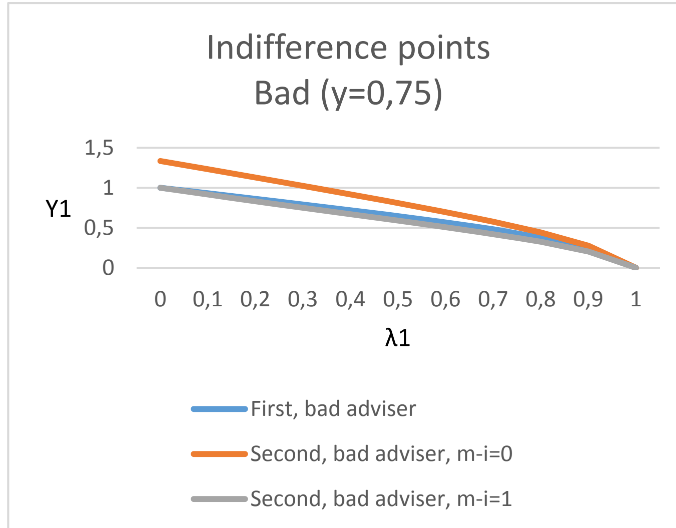
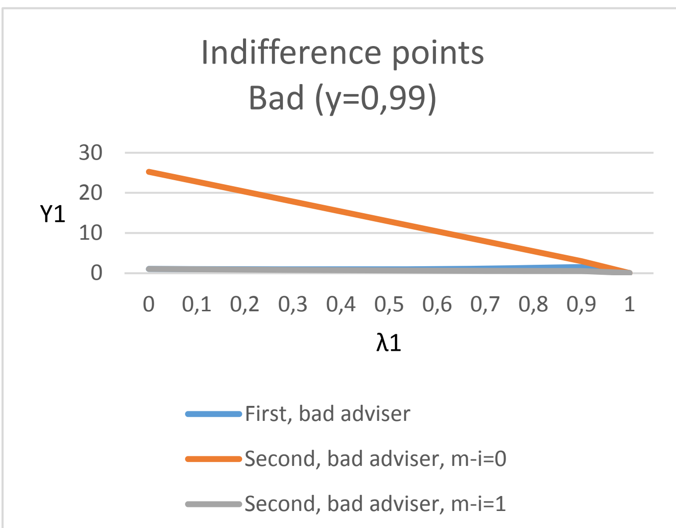


Figure 21



These figures show that the second adviser that has observed that the first adviser has announced message 0 (situation 2) is the first to deviate from the strategy of always sending message 1. Hence, an equilibrium in which the bad advisers always send message 1 can only exist when this bad adviser does not have an incentive to lie. In Chapter 5, I take his payoff functions into account.

3. Comparison

3.1 One adviser and two advisers (simultaneous)

3.1.1 Good adviser

Table 9

	One adviser	Two advisers (simultaneous)
U_G(telling the truth; good adviser: $s_{1,i}$=1, $m_{1,i}$=1)	$-x_1(\gamma(\frac{\gamma\lambda_1-1}{(2-\lambda_1)})^2 + (1-\gamma)(\frac{\gamma\lambda_1-\lambda_1+1}{(2-\lambda_1)})^2) + (\gamma)*v_G[\wedge(\lambda_1, 1, 1)] + (1-\gamma)*v_G[\wedge(\lambda_1, 1, 0)$	$-x_1((\gamma^2*(a_1(1,1)-1)^2 + (1-\gamma)^2*a_1(1,1)^2 + 2\gamma(1-\gamma)(\lambda_{1,}*(\frac{1}{2}(a_1(1,0)-1)^2 + \frac{1}{2}(a_1(1,0))^2 + (1-\lambda_1)(\frac{1}{2}(a_1(1,1)-1)^2 + \frac{1}{2}(a_1(1,1)^2))] + \gamma\ v_G[(1, m_{1,-i},1)] + (1-\gamma)\ v_G[(1, m_{1,-i},0)]$
U_G(lying; good adviser: $s_{1,i}$=1, $m_{1,i}$=0)	$-x_1((\gamma)^3 + (1-\gamma)^2) - x_2*(\gamma - \gamma^2)$	$-x_1(\gamma^2(a_1(0,1)-1)^2 + (1-\gamma)^2(a_1(0,1)^2) + (2\gamma(1-\gamma) *(\frac{1}{2}\lambda_1*(a_1(0,0)-1)^2 + \frac{1}{2}\lambda_1* a_1(0,0)^2 + \frac{1}{2}(1-\lambda_1) *(a_1(0,1)-1)^2 + \frac{1}{2}(1-\lambda_1)* a_1(0,1)^2 + v_G [\lambda_{2,i} = 1]$

3.1.2 Bad adviser

Table 11

	One adviser	Two advisers (simultaneous)
U_B(telling the truth; bad adviser: $s_{1,i}$=0, $m_{1,i}$ = 0)	$Y_1(1-\gamma) + Y_2\gamma$	$Y_1((\lambda_1(2\gamma-2\gamma^2)+1-\lambda_1)*a_1(0,1) + (\lambda_1*(2\gamma^2-2\gamma+1))*a_1(0,0)) + Y_2*((1-\frac{1}{2}\lambda_{2,-i})a_2(1,1) + \frac{1}{2}\lambda_{2,-i}*a_2(1,0))$
U_B(lying; bad adviser: $s_{1,i}$=0, $m_{1,i}$=1)	$Y_1(\frac{\gamma\lambda_1-\lambda_1+1}{(2-\lambda_1)}) + v_B[\lambda_2]$	$Y_1((\lambda_1(2\gamma-2\gamma^2)+1-\lambda_1)*a_1(1,1) + (\lambda_1*(2\gamma^2-2\gamma+1))*a_1(1,0)) + Y_2*((1-\frac{1}{2}\lambda_{2,-i})a_2(1,1) + \frac{1}{2}\lambda_{2,-i}*a_2(1,0))$

3.2 Bad adviser - value of v

3.2.1 One adviser and two advisers (simultaneous)

One adviser

Payoff bad adviser (lying – truth-telling) = $Y_1(\frac{\gamma+(1-\lambda_1)(1-\gamma)v}{1+(1-\lambda_1)v} - (1-\gamma)) + Y_2(\frac{1-\dot{\lambda}_2+\dot{\lambda}_2\gamma}{(2-\dot{\lambda}_2)} - \frac{1-\overline{\lambda_2}+\overline{\lambda_2}\gamma}{(2-\overline{\lambda_2})})$

With $E(\dot{\lambda}_2) = (1-\gamma)* \frac{\gamma\lambda_1}{\gamma\lambda_1+(1-\lambda_1)(\gamma+(1-\gamma)v)} + \gamma* \frac{(1-\gamma)\lambda_1}{(1-\gamma)\lambda_1+(1-\lambda_1)(1-\gamma+\gamma v)}$ and $E(\overline{\lambda_2}) = \frac{\lambda_1}{(1-v+v\lambda_1)}$

Two advisers (simultaneous)

Payoff bad adviser (lying – truth-telling) = $Y_1*(((1-\lambda_1)v(\gamma^2+(1-\gamma^2))+2\gamma(1-\gamma))*(a_1(1,1) - a_1(0,1)) + ((v\lambda_1-v+1)(\gamma^2+(1-\gamma)^2)*(a_1(1,0) - a_1(0,0))) + Y_2*(((1-\frac{1}{2}\lambda_1)*(a_2(1,1,\dot{\lambda}_{2,i}) - a_2(1,1,\overline{\lambda_{2,i}})) + (\frac{1}{2}\lambda_1*(a_2(1,0,\dot{\lambda}_{2,i}) - a_2(1,0,\overline{\lambda_{2,i}})))$

With:

$E(\dot{\lambda}_{2,i}) = (1-\gamma)* \frac{\gamma\lambda_1}{\gamma\lambda_1+(1-\lambda_1)(\gamma+(1-\gamma)v)} + \gamma* \frac{(1-\gamma)\lambda_1}{(1-\gamma)\lambda_1+(1-\lambda_1)(1-\gamma+\gamma v)}$ and $E(\overline{\lambda_{2,i}}) = \frac{\lambda_1}{(1-v+v\lambda_1)}$

- $a_1(1,1) = \frac{v^2(1-\lambda_1)^2(1-\gamma)^2+2v(1-\lambda_1)\gamma(1-\gamma)+\gamma^2}{\gamma^2+(1-\gamma)^2+2v(1-\lambda_1)2\gamma(1-\gamma)+(1-\lambda_1)^2v^2(\gamma^2+(1-\gamma)^2)}$
- $a_1(0,1) = \frac{(1-\lambda_1)v(1-\gamma)^2+\gamma(1-\gamma)}{(1-\lambda_1)v(\gamma^2+(1-\gamma)^2)+2\gamma(1-\gamma)}$
- $a_1(0,1) = \frac{(1-\lambda_1)v(1-\gamma)^2+\gamma(1-\gamma)}{(1-\lambda_1)v(\gamma^2+(1-\gamma)^2)+2\gamma(1-\gamma)}$
- $a_1(0,0) = \frac{\gamma^2-2\gamma+1}{2\gamma^2-2\gamma+1}$
- $a_2(1,1) = \frac{(1-\lambda_{2,i})(1-\lambda_1)(1-\gamma)^2+(1-\lambda_{2,i})\gamma(1-\gamma)+(1-\lambda_1)\gamma(1-\gamma)+\gamma^2}{\gamma^2+(1-\gamma)^2+(1-\lambda_{2,i})2\gamma(1-\gamma)+(1-\lambda_1)2\gamma(1-\gamma)+(1-\lambda_{2,i})(1-\lambda_1)(\gamma^2+(1-\gamma)^2)}$
- $a_2(1,0) = \frac{(1-\lambda_{2,i})(1-\gamma)^2+\gamma(1-\gamma)}{(1-\lambda_{2,i})*(\gamma^2+(1-\gamma)^2)+2\gamma(1-\gamma)}$

y=0,51

Figure 22

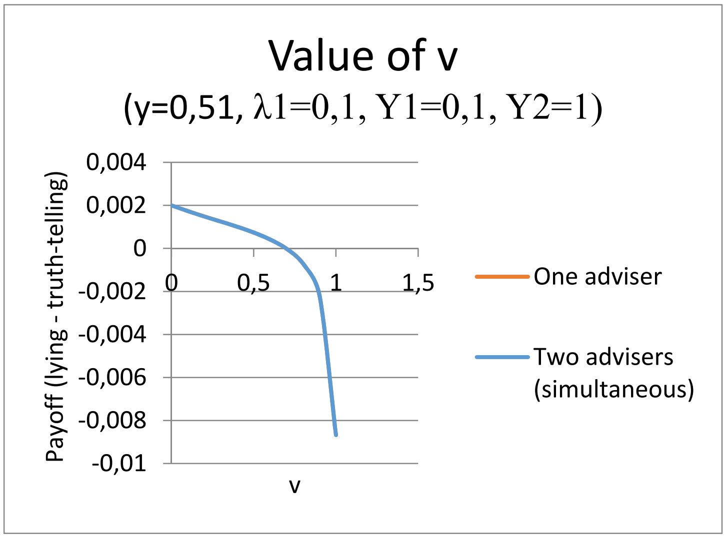


Figure 23

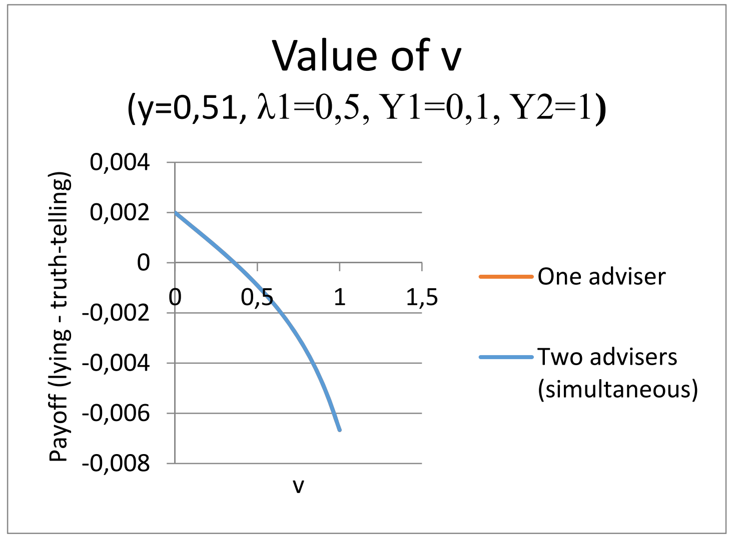
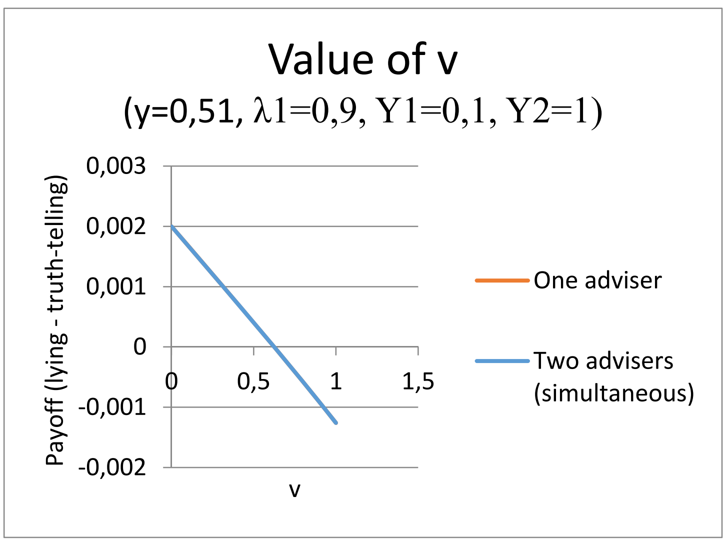


Figure 24



The variable on the x-axis represents the value of v. The value on the y-axis represents the payoff (lying – truth-telling). In the area above the x-axis, the bad adviser prefers lying. In the area below the x-axis the bad adviser prefers truth-telling. The value of v will be equal to the value at which the payoff (lying – truth-telling) is equal to zero.

y=0,9

Figure 25

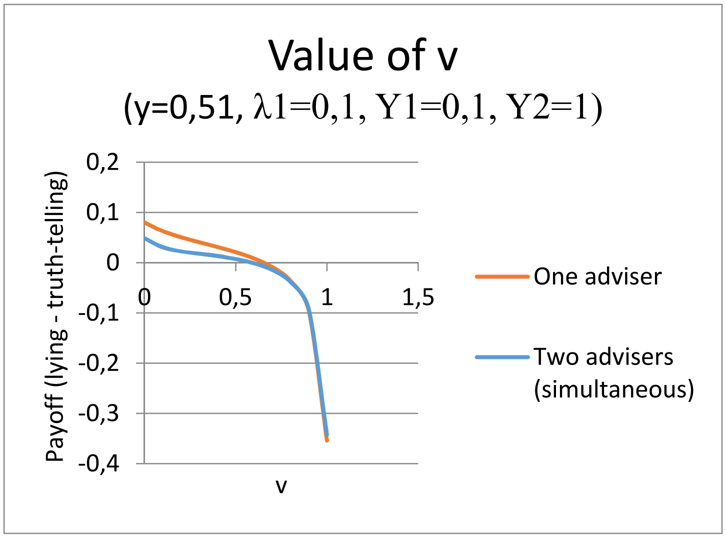


Figure 26

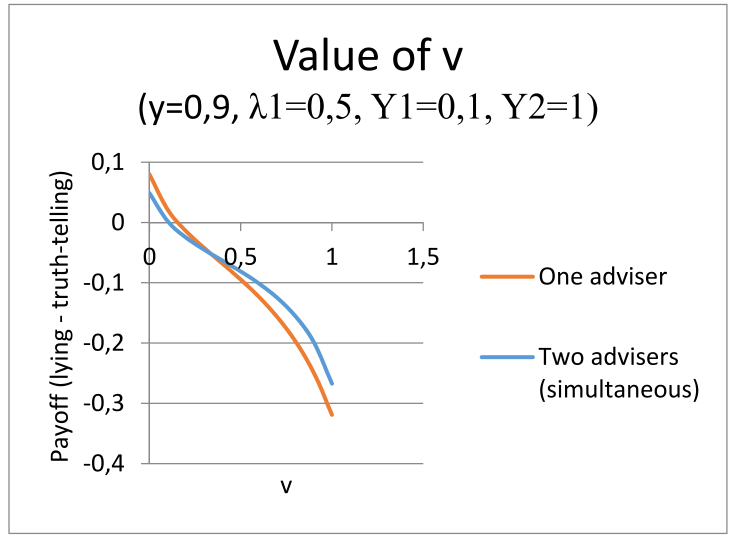
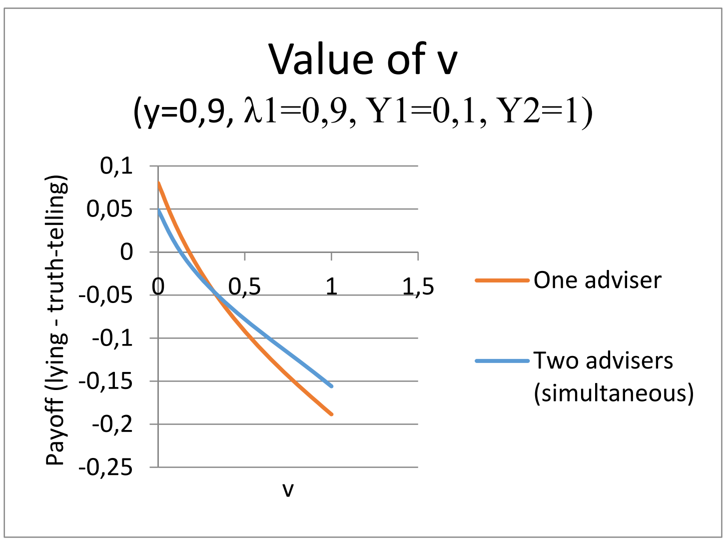


Figure 27



3.2.2 Two advisers (simultaneous) and two advisers (sequential)

Adviser (1): bad, first adviser

Payoff bad adviser (lying – truth-telling) = Y_1*(((1- λ_1)v(γ^2+(1- γ^2))+2γ(1-γ))* (a_1(1,1) – a_1(0,1)) + ((vλ_1-v+1)(γ^2+(1-γ)^2)*(a_1(1,0) – a_1(0,0))) + Y_2* (((1-$\frac{1}{2}$ λ_1)*($a_2(1,1,\dot{\lambda}_{2,i})$ - $a_2(1,1,\overline{\lambda_{2,\iota}})$) + ($\frac{1}{2}$ λ_1* ($a_2(1,0,\dot{\lambda}_{2,i})$ - $a_2(1,0,\overline{\lambda_{2,\iota}})$))

With:

- $E(\dot{\lambda}_{2,i})$ =(1-γ)* $\frac{\gamma\lambda_1}{\gamma\lambda_1+(1-\lambda_1)(\gamma+(1-\gamma)v)}$ + γ* $\frac{(1-\gamma)\lambda_1}{(1-\gamma)\lambda_1+(1-\lambda_1)(1-\gamma+\gamma v)}$ and $E(\overline{\lambda_{2,\iota}})$ = $\frac{\lambda_1}{(1-v+v\lambda_1)}$

Adviser (2): second, bad adviser that has observed that the first adviser announces message 0

Y_1*(a_1(1,0) – a_1(0,0))) + Y_2* (((1-$\frac{1}{2}$ $\lambda_{2,-i}$)*($a_2(1,1,\dot{\lambda}_{2,i})$ - $a_2(1,1,\overline{\lambda_{2,\iota}})$) + ($\frac{1}{2}$ $\lambda_{2,-i}$* ($a_2(1,0,\dot{\lambda}_{2,i})$ - $a_2(1,0,\overline{\lambda_{2,\iota}})$))

With:

- $E(\dot{\lambda}_{2,i})$ = $\frac{(1-\gamma)^2}{\gamma^2+(1-\gamma)^2}$ * $\frac{\gamma\lambda_1}{\gamma\lambda_1+(1-\lambda_1)(\gamma+(1-\gamma)v)}$ +$\frac{\gamma^2}{\gamma^2+(1-\gamma)^2}$ * $\frac{(1-\gamma)\lambda_1}{(1-\gamma)\lambda_1+(1-\lambda_1)(1-\gamma+\gamma v)}$
- $E(\overline{\lambda_{2,\iota}})$ = $E(\lambda_{2,-i})$ = $\frac{\lambda_1}{(1-v+v\lambda_1)}$

Adviser (3): second, bad adviser that has observed that the first adviser announces message 1

Y_1*(a_1(1,1) – a_1(1,0))) + Y_2* (((1-$\frac{1}{2}$ $\lambda_{2,-i}$)*($a_2(1,1,\dot{\lambda}_{2,i})$ - $a_2(1,1,\overline{\lambda_{2,\iota}})$) + ($\frac{1}{2}$ $\lambda_{2,-i}$* ($a_2(1,0,\dot{\lambda}_{2,i})$ - $a_2(1,0,\overline{\lambda_{2,\iota}})$))

With:

- $E(\dot{\lambda}_{2,i})$ = $E(\lambda_{2,-i})$ = ($\frac{(\gamma^2+(1-\gamma)^2)v(1-\lambda_1)}{(\gamma^2+(1-\gamma)^2)v(1-\lambda_1)+2\gamma(1-\gamma)}$* $\frac{(1-\gamma)^2}{2\gamma^2-2\gamma+1}$ + $\frac{2\gamma(1-\gamma)}{(\gamma^2+(1-\gamma)^2)v(1-\lambda_1)+2\gamma(1-\gamma)}$ * $\frac{1}{2}$)* $\frac{\gamma\lambda_1}{\gamma\lambda_1+(1-\lambda_1)(\gamma+(1-\gamma)v)}$ + ($\frac{(\gamma^2+(1-\gamma)^2)v(1-\lambda_1)}{(\gamma^2+(1-\gamma)^2)v(1-\lambda_1)+2\gamma(1-\gamma)}$* $\frac{(\gamma)^2}{2\gamma^2-2\gamma+1}$ + $\frac{2\gamma(1-\gamma)}{(\gamma^2+(1-\gamma)^2)v(1-\lambda_1)+2\gamma(1-\gamma)}$ * $\frac{1}{2}$)* $\frac{(1-\gamma)\lambda_1}{(1-\gamma)\lambda_1+(1-\lambda_1)(1-\gamma+\gamma v)}$
- $E(\overline{\lambda_{2,\iota}})$ = $\frac{\lambda_1}{(1-v+v\lambda_1)}$

- $a_1(1,1) = \frac{v^2(1-\lambda_1)^2(1-\gamma)^2+2v(1-\lambda_1)\gamma(1-\gamma)+\gamma^2}{\gamma^2+(1-\gamma)^2+2v(1-\lambda_1)2\gamma(1-\gamma)+(1-\lambda_1)^2v^2(\gamma^2+(1-\gamma)^2)}$
- $a_1(0,1) = \frac{(1-\lambda_1)v(1-\gamma)^2+\gamma(1-\gamma)}{(1-\lambda_1)v(\gamma^2+(1-\gamma)^2)+2\gamma(1-\gamma)}$
- $a_1(0,1) = \frac{(1-\lambda_1)v(1-\gamma)^2+\gamma(1-\gamma)}{(1-\lambda_1)v(\gamma^2+(1-\gamma)^2)+2\gamma(1-\gamma)}$
- $a_1(0,0) = \frac{\gamma^2-2\gamma+1}{2\gamma^2-2\gamma+1}$
- $a_2(1,1) = \frac{(1-\lambda_{2,i})(1-\lambda_1)(1-\gamma)^2+(1-\lambda_{2,i})\gamma(1-\gamma)+(1-\lambda_1)\gamma(1-\gamma)+\gamma^2}{\gamma^2+(1-\gamma)^2+(1-\lambda_{2,i})2\gamma(1-\gamma)+(1-\lambda_1)2\gamma(1-\gamma)+(1-\lambda_{2,i})(1-\lambda_1)(\gamma^2+(1-\gamma)^2)}$
- $a_2(1,0) = \frac{(1-\lambda_{2,i})(1-\gamma)^2+\gamma(1-\gamma)}{(1-\lambda_{2,i})*(\gamma^2+(1-\gamma)^2)+2\gamma(1-\gamma)}$

y=0,51

Figure 28

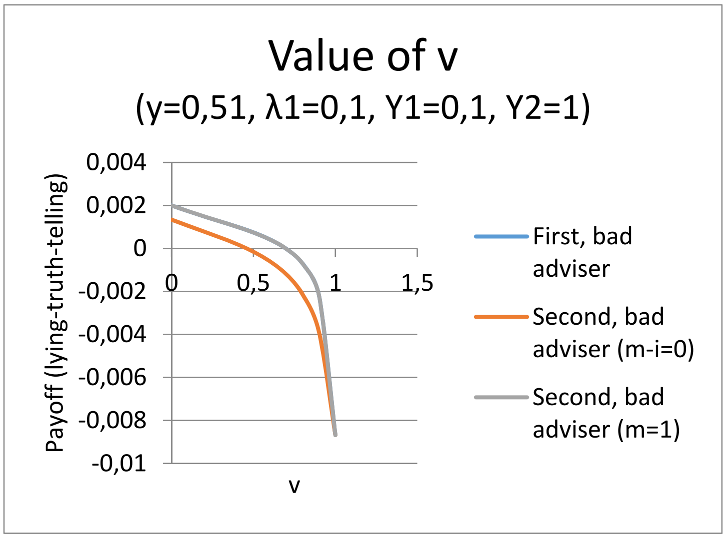


Figure 29

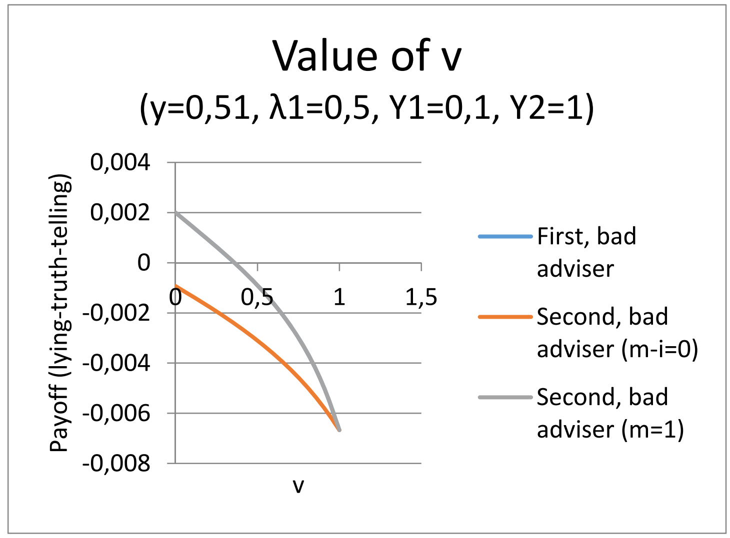
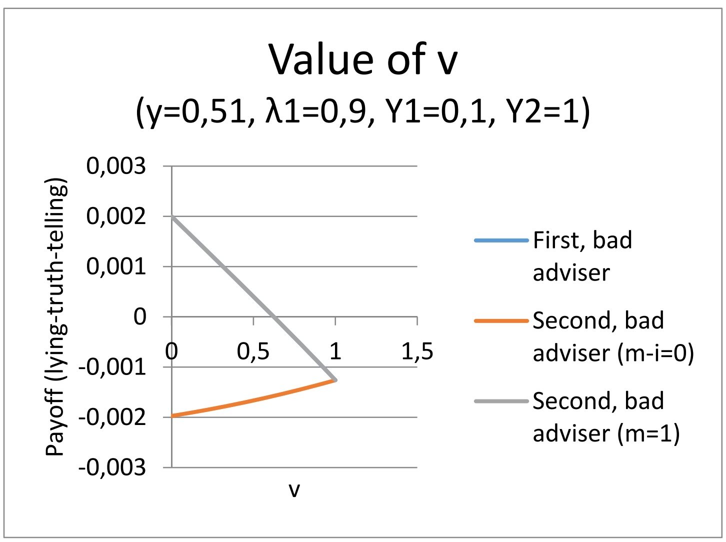


Figure 30



y=0,9

Figure 31

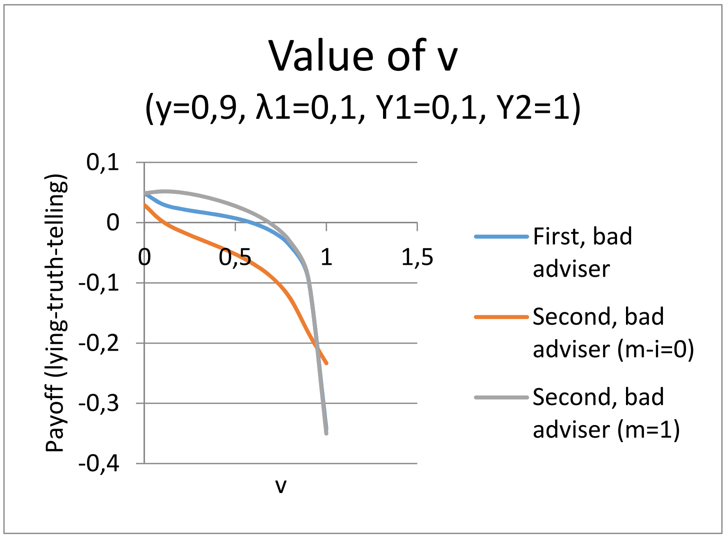


Figure 32

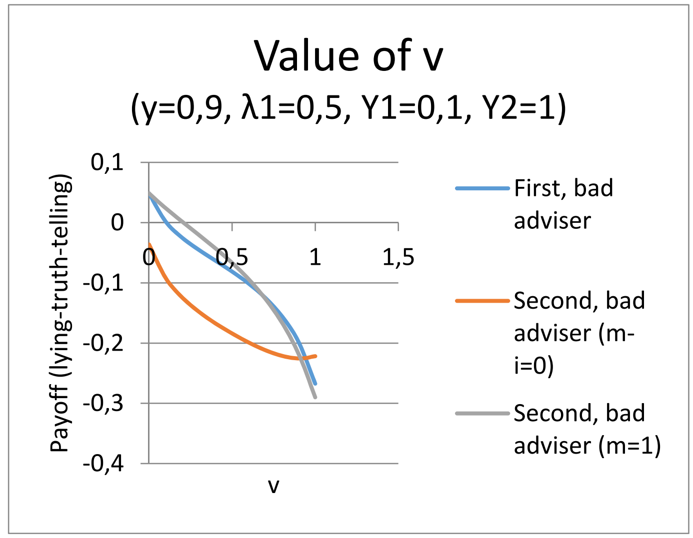
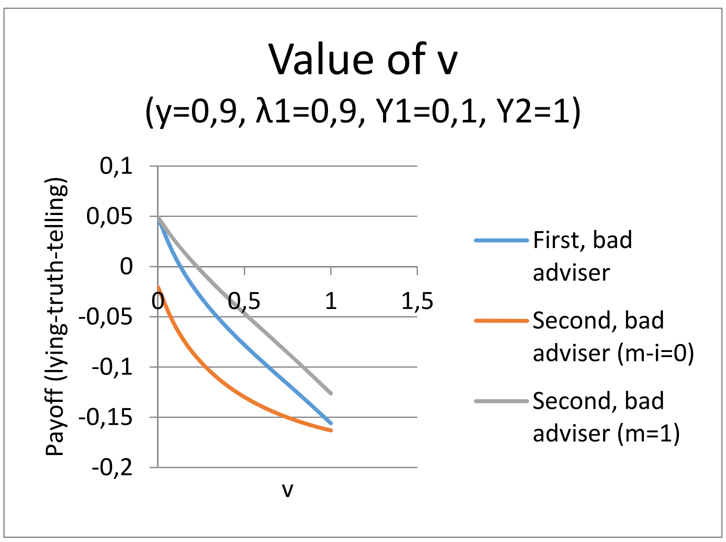


Figure 33



4. Welfare of the decision maker

4.1 One adviser

Utility function of the decision maker:

$-x_1(a_1-\omega_1)^2 - x_2(a_2-\omega_2)^2$

For simplicity, the values of x_1 and x_2 are equal to 1. The results will not change when using different values.

The expected payoffs of the first period for the decision maker are identical to the expected payoffs of the second period for the decision maker. The reason for this is that the expected value of λ_2 is equal to λ_1.

Expected payoff of the first period for the decision maker:

$\Pr(\omega_1=1)*\Pr(m_1=1|\omega_1=1) * (a_1(1)-1)^2) + \Pr(\omega_1=0)*\Pr(m_1=1|\omega_1=0) *a_1(1)^2 +$
$\Pr(\omega_1=1)*\Pr(m_1=0|\omega_1=1) * (a_1(0)-1)^2) + \Pr(\omega_1=0)*\Pr(m_1=0|\omega_1=0) *a_1(0)^2$

$= \frac{1}{2}* (\gamma + (1-\lambda_1)(1-\gamma))* (a_1(1)-1)^2) + \frac{1}{2}*((1-\gamma)+ \gamma(1-\lambda_1))* a_1(1)^2 + \frac{1}{2}*(\lambda_1*(1-\gamma))*((a_1(0)-1)^2) + \frac{1}{2}*\lambda_1*\gamma*a_1(0)^2$

Total expected payoff for the decision maker:

= 2*Expected payoff of the first period

$= (\gamma + (1-\lambda_1)(1-\gamma))* (a_1(1)-1)^2) + ((1-\gamma)+ \gamma(1-\lambda_1))* a_1(1)^2 + (\lambda_1*(1-\gamma))*((a_1(0)-1)^2) + \lambda_1*\gamma*a_1(0)^2$

4.2 Two advisers

Expected payoff of the first period for the decision maker:

$\Pr(\omega_1=1)*\Pr\left(m_{1,i}=1, m_{1,-i}=1\middle|\omega_1=1\right) * (a_1(1,1)-1)^2) + \Pr(\omega_1=0)*\Pr\left(m_{1,i}=1, m_{1,-i}=1\middle|\omega_1=0\right)$
$*a_1(1,1)^2 + \Pr(\omega_1=1)*\Pr\left(m_{1,i}=1, m_{1,-i}=0\middle|\omega_1=1\right) * (a_1(1,0)-1)^2) +$
$\Pr(\omega_1=0)*\Pr\left(m_{1,i}=1, m_{1,-i}=0\middle|\omega_1=0\right) * a_1(1,0)^2 + \Pr(\omega_1=1)*\Pr\left(m_{1,i}=0, m_{1,-i}=1\middle|\omega_1=1\right) *$
$(a_1(0,1)-1)^2) + \Pr(\omega_1=0)*\Pr\left(m_{1,i}=0, m_{1,-i}=1\middle|\omega_1=0\right) * a_1(0,1)^2 +$
$\Pr(\omega_1=1)*\Pr\left(m_{1,i}=0, m_{1,-i}=0\middle|\omega_1=1\right) * (a_1(0,0)-1)^2) + \Pr(\omega_1=0)*\Pr\left(m_{1,i}=0, m_{1,-i}=0\middle|\omega_1=0\right) *$
$a_1(0,0)^2$

$= \frac{1}{2} * (\gamma^2 + 2\gamma(1-\gamma)(1-\lambda_1) + (1-\gamma)^2(1-\lambda_1)^2)*((a_1(1,1)-1)^2) + \frac{1}{2} * (\gamma^2(1-\lambda_1)^2 + 2\gamma(1-\gamma)(1-\lambda_1)+(1-\gamma)^2)* a_1(1,1)^2 + (\lambda_1(1-\gamma)*((1-\gamma)(1-\lambda_1)+\gamma)) * ((a_1(1,0)-1)^2) + (\gamma\lambda_1 * (\gamma(1-\lambda_1)+ (1-\gamma))) *a_1(1,0)^2 + \frac{1}{2} (\lambda_1^2(1-\gamma)^2)*((a_1(0,0)-1)^2) + \frac{1}{2} \lambda_1^2\gamma^2 *(a_1(0,0)^2)$

Total expected payoff for the decision maker:

= 2*Expected payoff of the first period

= $(\gamma^2 + 2\gamma(1-\gamma)(1-\lambda_1) + (1-\gamma)^2(1-\lambda_1)^2)*((a_1(1,1)-1)^2) + (\gamma^2(1-\lambda_1)^2 + 2\gamma(1-\gamma)(1-\lambda_1)+(1-\gamma)^2)* a_1(1,1)^2 + 2(\lambda_1(1-\gamma)*((1-\gamma)(1-\lambda_1)+\gamma)) * ((a_1(1,0)-1)^2) + 2(\gamma\lambda_1 * (\gamma(1-\lambda_1)+ (1-\gamma))) *a_1(1,0)^2 + (\lambda_1^2(1-\gamma)^2)*((a_1(0,0)-1)^2) + \lambda_1^2\gamma^2 *(a_1(0,0)^2)$