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The importance of reputation in the auditing of companies: A game theory analysis [1]

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Abstract. Numerous, mainly empirical, studies of auditing behaviour have recently looked at the "reputation" of the auditor and the size of fees it attracts. Our model of the auditing market advances the study of the fundamental principles involved in determining behaviour in relation to the rewards and penalties using an extensive-form game of the auditing process. We set up a two-player fraud detection game with bribes, bonuses and fines faced by an auditor. Our model yields that the auditor's reputation, reflected in the size of bonuses, is critical to establishing a non-fraudulent behaviour by the client. Hence the model confirms expected behaviour. We further find the new insight, that while the existence of penalties deters fraud by the client, their size is not critical. This is a new understanding of what determines auditor behaviour. It is the perception of a possible penalty that moves the auditor in the direction of executing a thorough investigation using his acquired expertise.

Keywords: interdependent decisions, auditor reputation, game theory, perfect Bayesian equilibria

JEL codes : C72, M42, M48

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1 Introduction

The recent plethora of fraud cases involving audit firms and their clients prompts interest in the regulation of the auditing market. The regulatory body in the UK has concentrated on “rotation” and “fines” as deterrents to fraud. There is evidence that “rotation” in the UK auditing market, where four firms dominate, has increased neither competition nor choice. More importantly, recent empirical findings suggest that a fines-focused policy may not be justified or even relevant.

We set up a game theoretic model where the decisions of the auditor and those of his client, are independent. We posit that the auditor’s “reputation” and the financial rewards that stem from this reputation are crucial to the decisions taken by the players.

In our auditing model, cast in the form of a game tree, a client can either offer a bribe or not, and the auditor can either do a basic or an extensive audit. The purpose of the analysis here is to look for equilibrium strategies. These can take the form of a Nash equilibrium and a perfect Bayesian equilibrium. The latter involves the equilibrium beliefs of the players.

The auditing sector is highly concentrated. The same big four audit companies have audited all but nine of the UK’s 350 largest companies in the latest available financial year. Thus the introduction of mandatory rotation in 2016 has not been effective. The scarcity of alternatives is compounded by the fact that auditors, given the restrictions on what non-audit services an auditor can provide, are reluctant to give up lucrative consulting relationships with clients in order to become their auditor.

Ideas from game theory have been employed in various studies, (Sunder, 2002, Wilks & Zimbelman, 2004). Using the theory of common knowledge we can distinguish between a decision approach and a game theoretic one. In the former case players follow “zero order reasoning” (Wilks & Zimbelman, p.174); each player only looks at the conditions that affect him and not the others and then optimizes in relation to his payoffs. In this framework the client’s behaviour is not affected by the audit process and the approach is deterministic (Cavusoglu and Raghunathan, 2004).

While it is reasonable to assume that in the case of an accounting mistake made by the client, his behaviour will not be affected by the audit, it is naive to assume the same in the case of fraud. This corresponds to the case of “higher-order reasoning” (or lateral reasoning): we follow a game theory approach where the auditor’s actions impact on the probability of a client committing fraud. In other words fraudulent behaviour becomes endogenous as the client’s behaviour changes in relation to the auditor’s actions. Similarly, when assessing fraud risk, the auditor is aware of this and changes his configuration/process. As a result, there is strategic interdependence as the auditor’s expectation of the client’s action affects the latter’s action and vice versa. Hence each player’s best response changes based on the expected best response by the other player (Fellingham and Newman, 1985, Bloomfield, 1995, Zimbelman and Waller 1999, Coate et al., 2002, Wilks and Zimbelman, Anastasopoulos and Anastasopoulos, 2012). It is to this latter category of papers looking at fraud that our work belongs.

Our approach is substantially different in that we obtain results from analysing an extensive form game. We disentangle this interdependence of strategic decisions by using backward induction, to establish the *perfect Bayesian equilibria*, (PBE), which is characterised by consistent interdependent strategies and beliefs. As explained in the Appendix this concept is a stronger form of the idea of Nash equilibria (NE).

The rest of the paper is organised as follows. Section 2 discusses previous literature on auditing. Section 3 constructs the extensive form game and explains how the interdependence of decisions of the firm and his auditor results in the payoffs. Section 4 employs the powerful concepts from game theory of Nash equilibrium and Perfect Bayesian equilibrium. It describes the equilibrium strategies and distinguishes between the significance of the two ideas. Section 5 looks into the implications of alternative paths of decisions which leads to the equilibria. Throughout "Bribe" and "Bonus" in the payoffs are equal. Section 6 analyses the more involved cases where "Bribe" and "Bonus" are not equal. Section 7 focuses on the critical payoffs for the firm and the auditor in offering and accepting (or not) a bribe. Section 8 conveys the cornerstone concluding result that the reputation of the auditor and his worth are instrumental in establishing equilibria with non-fraudulent behaviour. Finally, the Appendix recalls concepts and definitions from game theory.

2 Previous findings

Fairchild (2007) argues that a long tenure allows for the building of expertise as the auditor becomes familiar with the client's business. This leads to a higher audit quality.[2] His model considers Nash equilibria without looking at the consistency of beliefs in such equilibria. The game he considers is a two-step one only, where neither party sees the actions of the other. The auditor's ability to detect fraud is taken to be a function of time, rather than an endogenous choice resulting from interdependencies in the game. As the probability of detection increases over time, the expected reward for revealing fraud increases too and eventually exceeds the cost.

In contrast, our paper focuses on the case where the game between the client and the auditor is a non-cooperative one. The auditor has already acquired expertise which he may decide to use following his rejection of a bribe. This is made possible by constructing an extensive form game where a subsequent move by the auditor following the client's actions is possible. We use the assumption that tenure with the same client leads to developing specialisation, and hence the ability to detect fraud even in the absence of an extensive audit.

There is wide spread agreement that a good reputation leads to higher fees and more clients.[3] Auditor reputation translates into a "bonus" payment *awarded by the market.* Such auditors are preferred by the clients as it enables them to be known for seeking credible financial reporting. *Our model incorporates this bonus dimension.*

On the other hand, litigation risk is believed to decrease the risk of coordination between a client and his auditor. Legal actions initiated by affected/stakeholder parties (investors, regulators, etc.) result to losses from compensation payments and regulator penalties, and harm auditor reputation.[4]

While early empirical results provide support for this view (Farmer et al., 1987, DeAngelo, 1981), later studies conclude that high litigation risk actually lowers audit quality rather

[2]Beck and Wu (2006) also discuss the building of expertise as a learning by doing process described by a recursive relation. Similarly, this is depicted by Laitinen and Laitinen (2015) as a process in which the ability of the auditor to detect fraud increases as a result of learning.

[3]See Barton, 2005, Weber et al., 2008, Tepalagul and Lin, 2015, Francis et al., 2017.

[4]For example see the lawsuit in Florida by a trustee of the failed mortgage lender Taylor, Bean & Whitaker, against PwC in 2016 seeking damages of $5.5 billion for failing to detect fraud.

than increases it (DeFond and Zhang, 2014). For counties like Germany and Norway, studies by Weber et al. (2008) and Hope and Langli (2010) find that the absence of serious litigation risk does not make auditors less likely to issue qualified reports. Higher quality is rewarded through the market by allowing the auditor to command higher fees. These rewards are sufficient to induce a more ethical behaviour from the side of the auditor without the need for a more interventionist or litigious approach.

Bigus (2011) argues that if reputation effects are sufficiently strong in a market, then limited liability will not matter as there will be a Nash equilibrium, where the auditor takes proper care and the affected investors do not sue. However, unlike our model which explicitly includes penalties for fraud, his work does not consider fraud but negligence.

It is traditionally believed that an auditor "*can be moved away from inappropriate behaviour*" (Hatherly et al., 1996, Iscenko et al., 2016) through suitable amendments in the payoffs by a regulator and the legal framework in a country, taking the form of big penalties and/or damages claims by investors respectively. *However, our model suggests that this is not as important as the existence and size, in a country, of a bonus effect bestowed as a reward for reputation to the auditor.*

The studies of Germany and Norway confirm that the absence of litigation costs in some developed countries does not adversely affect honest behaviour by the auditor. The creation of a professional ethos is more the result of the size of carrots (the market bonus of more money and higher fees that the reputation of high quality in auditing brings) rather than sticks. Indeed in our paper we find that while the existence of the latter is important, *penalty size is not of critical importance.* Rather, what is important is the existence of bonuses framed as market rewards for enhanced market reputation, and also how such bonuses compare to bribes offered by clients to auditors to cover fraud.[5] It is only in developing countries, such as China, where social norms of ethical behaviour are not yet well established, and auditors are not facing the possibility of a substantial litigation risk that monitoring accompanied by strong sanctions is necessary. (Lisic et. al., 2015).

Our findings indicate that if the rewards from successfully uncovering fraud match the rewards from a bribe, we then have three Nash equilibria all of which are PBE ones and involve either Fraud or Non Fraud. If bribes exceed such rewards then the credible Nash equilibrium that remains (in the sense of being a PBE one) is the one that involves Fraud by the client and a bribe accepted by the auditor to cover fraud. Finally, if bonuses exceed bribes, then there are two PBEs both of which involve Non Fraud by the client.

[5]The principle of stressing the importance of rewards over penalties is echoed in the recent literature on executive compensation. Such work is based on the assumption that the manager is loss averse. Consequently, compensation schemes in the form of fixed salaries with stock options are preferable in designing incentives, given the manager's strong asymmetric dislike for losses (de Meza and Webb, 2007). We wish to stress that while our model does not include any behavioural assumptions of loss aversion, we similarly find support for more bonuses using a game theoretic formulation of auditing. Bigus (2015) also argues that even in the absence of loss averse behaviour by the auditor, reputation matters and can compensate for the existence of limited litigation costs. However, similarly to his 2011 paper, mentioned earlier, he considers again negligence, not fraud.

3 Analysis of graphs

3.1 The structure of the model

There are two players. P1, the client, who plays first and chooses between No Fraud (NF) and Fraud (F) and P2, the auditor, who follows without knowing what P1 has chosen. Thus P2 acts under imperfect information, but with perfect recall as he has not forgotten any information that he had before.[6] From the indistinguishable nodes η_1 and η_2 he can choose, in a synchronized move, to play either the pure strategy BA (basic audit) or EA (extended audit). Also, P1, from the indistinguishable nodes η_3 and η_4, chooses in a synchronized move to play either the pure strategy Bribe or No Bribe, without being able to observe whether the auditor has chosen BA or EA.

First we look at the notation which characterizes gains, costs, bonuses and bribes.

Notation of payoffs to the client:

(i) C_{BA}: Gain after a basic audit in the absence of fraud

(ii) C_{EA}: Gain after an extended audit in the absence of fraud

(iii) C_F: Gain from fraud

(iv) C_D: Penalty if fraud is detected

(v) C_{BR}: Cost of the bribe offered to the auditor.

Notation of payoffs to the auditor:

(i) A_{BR}: Gain from the bribe.

(ii) A_{BO}: Bonus to the auditor from detecting the fraud

(iii) A_{BA}: Cost of a basic audit

(iv) A_{EA}: Cost of extended audit

(v) A_L: Cost of failing to detect the fraud.

The tree develops in two separate ways. If P1 has chosen NF the game terminates. The outcome in terms of payoffs depends on the effort that P2 expends. P1 does not feel the need to come back and, for example, make a money offer, i.e. to offer a bribe. If on the other hand P1 has played F, then the game does not terminate with the effort of P2. Instead, first P1 offers or does not offer a bribe while being ignorant as to how determined P2 is to pursue the investigation further. So P2 is faced either with a bribe, which he accepts or rejects, or with a no-bribe situation. If he rejects the bribe or if there is no bribe, then in the case of BA, he will have to decide whether to pursue a deeper investigation[7] of the client. In the case of EA the fraud will have been detected from the outset and the client will be punished unless he offers a bribe which the auditor accepts.

Below we explain how the payoffs are formed. Gains and/or losses are over and above the basic payments between the two companies; e.g. fees paid by the client to the auditor for his services.

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[6] See the Appendix

[7] This will be denoted in the diagrams as "extra effort" or "no extra effort".

3.2 The calculation of payoffs of the agents

For the two agents, that is the client and the auditor, we make the following assumptions with respect to the combination of gain, penalty, cost and bonus in calculating their payoffs.

The calculation of payoffs of the client

(i) Gains for the client through an increase in reputation, in the absence of fraud, following a *Basic Audit*, BA, where the books are found by the auditor to be in order. $C_{BA} \geq 0$.

(ii) Gains for the client through an increase in reputation, in the absence of fraud, following an *Extended Audit*, EA, where the books are found by the auditor to be in order. Clearly $C_{EA} > C_{BA}$. However as we will see below this is not a critical assumption for establishing NE or PBE solutions.

(iii) Gains for the client if the audit fails to reveal the fraud that he has committed: C_F. The gain from fraud exceeds C_{EA}, the gains from being found to be in the clear by an extended audit ($C_F > C_{EA}$).

(iv) Value of the penalty, D, if fraud is detected by the auditor: $C_D < 0$. We note that if it is certain that the fraud will definitely be revealed by the market at some later stage then C_D would be, in absolute terms, larger. We assume that the penalty exceeds the gains from fraud, i.e. $C_F + C_D < 0$.

(v) The value of the bribe (BR) if it is offered by the client and accepted by the auditor: $C_{BR} < 0$. We assume that the payment of a bribe is less than the value of the fraud and also that this net payoff from fraud is larger than C_{BA}, i.e. $C_F + C_{BR} > C_{BA}$.

The calculation of payoffs of the Auditor

(i) The gain from the bribe, BR: $A_{BR} > 0$. Obviously, $A_{BR} = -C_{BR}$.

(ii) The bonus, BO, from detecting fraud: $A_{BO} > 0$.

While the bonus is awarded to an auditor by the market, the size of this award in our model depends on the importance a society places on rewarding honest behaviour and on framing such rewards as bonuses rather than as part of the basic payment from the client to the auditor. We can set $A_{BO}(\lambda)$, where λ is a social parameter for a country's institutional environment comprising the set of social norms as we discussed in section 2.

We examine separately the cases where $A_{BR} = A_{BO}$, $A_{BR} > A_{BO}$ and $A_{BR} < A_{BO}$. Whether the bonus is equal to (or exceeds) the bribe, rather than the latter strictly exceeding the former, is crucial for non-fraudulent behaviour, NF, to be a credible, PBE equilibrium. In other words, the existence of carrots and their magnitude is critical to induce ethical behaviour. This bonus is reflected in the form of enhanced reputation which commands higher fees.

(iii) Cost to the auditor of a basic audit, BA: $A_{BA} < 0$. Also, $A_{BA} + A_{BR} > 0$.

(iv) Cost to the auditor of an extended audit, EA: $A_{EA} < 0$. Clearly $|A_{EA}| > |A_{BA}|$.

(v) Cost to the auditor of not detecting fraud through a loss, $A_L < 0$.

The size of A_L could include litigation costs from failing to uncover fraud. Legal actions can be initiated by affected/stakeholder parties (investors, regulators, etc.). There is also the loss of fees from lost clients. We note that it is not certain that the fraud will eventually be uncovered by the regulator or other stakeholders. The inclusion of the cost A_L in our model is made simply to allow for such a possibility, which the auditor should bear in mind taking into account other cases in the past. We will return to this point in our analysis below.

3.3 The overall calculation of payoffs

From the above discussion, we have the following rules for the calculation of payoffs corresponding to the choices[8] of the agents:

–P1 plays "NF" and P2 plays "BA"; the books are found to be in order: Player P1 gets C_{BA} and P2 gets A_{BA}.

–P1 plays "NF" and P2 plays "EA": Player P1 gets C_{EA} and P2 gets A_{EA}.

–P1 plays "F, Bribe" and P2 plays "BA, Reject, Ex".
The payoff for the client is the sum of the gain from fraud and the cost of detection, i.e. C_F+C_D. The auditor who is experienced rejects the bribe offered after a basic audit and through a deeper investigation he detects the fraud. The payoff P2 obtains is A_{BO}+A_{BA}; he gets a bonus for detecting the fraud following the fact that he expended effort A_{BA}.

–P1 plays "F, Bribe" and P2 plays "BA, Reject, NEx".
The auditor applies basic audit and fails to detect the fraud. The payoff of P1 from the fraud is C_F . The auditor here receives A_{BA}, reflecting the basic audit expended effort and also suffers reputation loss, i.e. he receives payoff $A_{BA} + A_L$.

–P1 plays "F, Bribe" and P2 plays "BA, Accept,.".
P1 retains the value from the fraud and pays a bribe, i.e. C_F +C_{BR}. The auditor plays basic audit and accepts the bribe, with payoff A_{BA}+A_{BR}.

–P1 plays "F, No Bribe" and P2 plays "BA,.,Ex".
The client gains from fraud C_F, but because of a deeper investigation performed by an experienced auditor his fraud is detected and he has to pay the penalty C_D, i.e. he receives C_F+C_D. The auditor receives a payoff of A_{BO} for detecting the fraud through a deeper investigation, while A_{BA} reflects his cost of the basic audit, i.e. he receives payoff A_{BA}+A_{BO}.

–P1 plays "F, No Bribe" and P2 plays "BA, ., NEx".
The client gains from the fraud C_F and this is not detected by the auditor. The auditor expends effort A_{BA} and also suffers loss of reputation A_L i.e. he receives payoff A_{BA}+A_L.

–P1 plays "F, Bribe" and P2 "EA, Reject,.".
The client gains from the fraud C_F but, because of the extended audit the fraud has been detected and reported by the auditor and he has to pay a penalty C_D; i.e. he receives payoff $C_F + C_D$.
The auditor expends A_{EA} and gains a bonus A_{BO} for detecting the fraud through an extended audit; i.e. he receives payoff $A_{EA} + A_{BO}$.

–P1 plays "F, Bribe" and P2 "EA, Accept, .".
The client gains from the fraud C_F and he has to pay a bribe C_{BR}; i.e. he receives payoff

[8] If in the description of strategies there is a ".", this follows the convention that any alternative pure strategy available at that point can be placed in that position.

$C_F + C_{BR}$.
The auditor gets a bribe A_{BR} and he has an extended audit cost A_{EA}; i.e. he receives payoff $A_{BR} + A_{EA}$.

–P1 plays “F, No Bribe” and P2 plays “EA, ., .”.
The client gains from the fraud C_F but the fraud is detected by the auditor leading to a fine C_D; i.e. he receives payoff $C_F + C_D$.
The auditor gains because he gets a bonus A_{BO} but has to expend A_{EA}; i.e. he receives payoff $A_{EA} + A_{BO}$.

4 Looking for NE and PBE

In this section we consider the case where for the auditor the payoff from the bribe is equal to the bonus, i.e. $A_{BR} = A_{BO}$. We are looking for the existence of pure strategy equilibria and PBEs. For a pure strategy a player must declare his choice at every information set at which he is to act. We describe three pure strategy equilibria in Figure 1 and in Figures 2 and 3 we begin the explanation of backward induction of optimal strategies in obtaining the solutions. Further issues concerning equilibria are also analysed in the next section.

The first pure Nash equilibrium (NE) is shown through the heavy black lines. P1, when he is to act and depending on his position, plays “F, Bribe”. P2, when he is to act, plays “BA, Accept and Ex”. The payoffs of the two players are $(C_F + C_{BR}, A_{BA} + A_{BR})$.

We now check that these strategies form a NE. Suppose P1 plays “F, Bribe”, which is taken as fixed. If P2 switches to “EA” then he cannot increase his payoff. Neither can he retain “BA” and change the rest of his strategy and improve his payoff.
Next suppose that P2 plays “BA, Accept and Ex”, which is taken as fixed. First P1 cannot switch to “NF” and improve his payoff.

Neither can P1 change to “No Bribe” and improve his payoff. Hence the pair of strategies “F, Bribe; BA, Accept and Ex” form a NE.

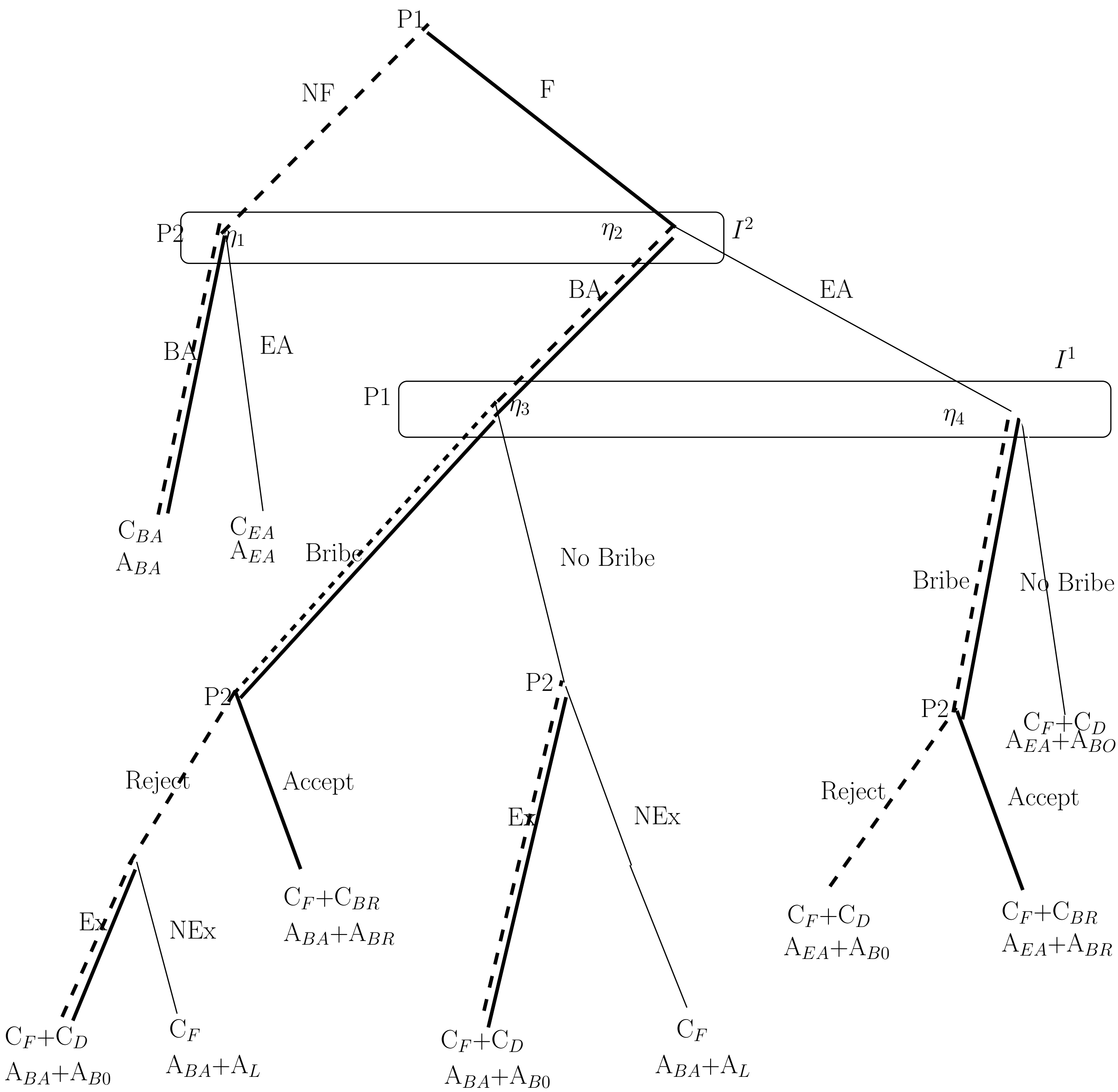
The second pure NE is shown through the heavy interrupted lines. P1, when he is to act and depending on his position, plays “NF, Bribe”. P2, when he is to act, plays “BA, Reject and Ex”. The payoffs of the two players are $(C_{BA},\ A_{BA})$.

We now check that these strategies form a NE. Suppose P1 plays “NF, Bribe”, which is taken as fixed. If P2 switches to “EA” then he cannot increase his payoff.
Next suppose that P2 plays “BA, Reject and Ex”, which is taken as fixed. First P1 cannot switch to “F” or to “F, No Bribe” and improve his payoff.

With respect to the corresponding PBE, in the *first case*, player P2 believes that he is with probability 1 at node η_2 and P1 that he is at η_3 with probability 1. Furthermore the optimality condition of the decisions from the single nodes is also satisfied as a PBE requires.

With respect to the corresponding PBE in the *second case*, player P2 believes that he is with probability 1 at node η_1 and P1 can assign arbitrary beliefs to the nodes in I_1 because the optimal path does not visit this information set. He might as well assign probability 1 to node η_3.

We follow a similar approach for the *third case* where P1 plays “NF, No Bribe” and P2 plays “BA, Reject, Ex”. The payoffs of the two players are as in the second case,



1st: A pure strategy NE:
(F, Bribe; BA, Accept, Ex)
(Shown on the graph by the bold lines)

2nd: A pure NE:
(NF, Bribe; BA, Reject, Ex)
(Shown on the graph by the dotted lines)

3rd: Another pure NE is also:
(NF, No Bribe; BA, Reject, Ex)
This can also can be traced on the graph.

All three Nash equilibria are also perfect Bayesian equilibria

Figure 1

(C_{BA}, A_{BA}) and it is easy to show that these two strategies are also both NE and PBE. This third NE can also be traced by looking at Figure 1.

In considering the various strategies we could for the lower part of the tree expand the notation by attaching an index indicating the point, the subgame, from which the decision is taken. That would rather complicate matters and in any case in folding up the tree through the subgames no information is lost.

There are 32 possible combinations of pairs of strategies of the two players. The issue is now to consider together all available pairs and see whether they form an equilibrium.

-First, any pair (NF, .; EA, ., .) is not a NE, as P2 can switch to “BA, ., .” and improve his payoff. Next any pair (F, .; EA, ., .) is also not a NE. Player P2 can switch to “BA, ., .” and improve his payoff. Hence EA is a dominated strategy. This takes care of all developments of the tree from “EA”.

We next look at the combinations which are left to be considered for a possible NE. In the first instance we consider the various strategies which involve BA and see whether a combination with “NF,.” from the side of P1 will do. We have (i) “BA, Reject, Ex”; (ii) “BA, Reject, NEx”; (iii) “BA, Accept, Ex”; (iv) ”BA, Accept, NEx”. We combine each with “NF, .” and examine what happens.

We have the pairs:

-(NF, .; BA, Reject, Ex) are both NE, both with payoffs (C_{BA}, A_{BA}) as discussed above.

-All (NF,.; BA, Reject, NEx) can not be Nash because P1 can switch to “F, No Bribe” and increase his payoff from C_{BA} to C_F.

-Also all (NF,.; BA, Accept, .) can not be Nash because P1 can increase his payoff by switching to “F, Bribe” from C_{BA} to $C_F + C_{BR}$.

Next we consider the combinations with “F,.”. We recall that as we have found above (F, Bribe; BA, Accept, Ex) is a pure NE with payoffs ($C_F + C_{BR}$, $A_{BA} + A_{BR}$). We need to consider the various strategies that involve “F, ” from the side of P1.

We have the pairs:

-All (F, .; BA, Reject, Ex) can not be NE because P1 can switch to “NF,.” and increase his payoff from $C_F + C_D$ to C_{BA}.

-(F, Bribe; BA, Reject, NEx) can not be NE because P2 can switch to“BA, Reject, Ex” and increase his payoff from $A_{BA} + A_L$ to $A_{BA} + A_{BR}$. The preference of the strategy “Ex” by P2 does not depend on the actual size of A_{BR} as A_L is negative.

-(F, No Bribe; BA, Accept, Ex). This is not NE. P1 can switch to “NF, .”and increase his payoff from $C_F + C_D$ to C_{BA}.

-(F, Bribe, BA, Accept, NEx) is not a NE as P1 can switch to “F, No Bribe” and increase his payoff from $C_F + C_{BR}$ to C_F.

-All (F, No Bribe; BA, ., NEx) can not be NE because P2 can switch to “BA, ,., Ex” and increase his payoff from $A_{BA} + A_L$ to $A_{BA} + A_{BO}$. The preference of the strategy “Ex” by P2 does not depend on the actual size of A_{BO} as A_L is negative.

We have concluded above that there exist three pure strategies NE. We want to see which of these form a PBE and if possible which are the most reasonable to prevail.

We reduce the tree through backward induction on the optimal strategies. We consider the optimal choices (best strategies) of P2 at the single nodes information sets. This way no PBE can be lost. We start from Figure 1 ignoring the heavy black lines. A first step in the folding up process is shown in Figure 2. We note that the moves through the choices are unique and unambiguous.

On the other hand, when we fold up from Figure 2 every time P2 has to choose, he can play either "Reject" or "Accept" because in both cases he gets the same payoff, that is $A_{BA} + A_{BO} = A_{BA} + A_{BR}$ in one case and $A_{EA} + A_{BO} = A_{EA} + A_{BR}$ in the other. This indifference in payoffs for P2 will show up in different formulations of the final version of the tree.

One formulation is in the upper part of Figure 3. Suppose we start with this graph and we forget about the past moves.

P1 has played F and in I^1 he acts again. We look at I^1. If P1 has arrived there, then Bribe is better for him (dominates) than No-Bribe. So P1 offers Bribe and we go, through backward induction, to the right hand side of the lower graph . P1 plays F and we have the beginning of a NE. We return to Figure 3 below.

5 Discussion of the theoretical results and choice of NE

In this section we continue with the case of $A_{BR} = A_{BO}$. The NEs and the PBEs are obtained in Figures 3 to 6 through backward induction. In folding up the game tree, we consider the possible alternative choices of P2.

We have obtained the following NE with corresponding payoff pairs for players P1 and P2:

(F, Bribe; BA, Accept, Ex), with payoffs pair $(C_F + C_{BR},\ A_{BA} + A_{BR})$.

(NF, Bribe; BA, Reject, Ex), with payoffs pair $(C_{BA},\ A_{BA})$.

(NF, No Bribe; BA, Reject, Ex), with payoffs pair $(C_{BA},\ A_{BA})$.

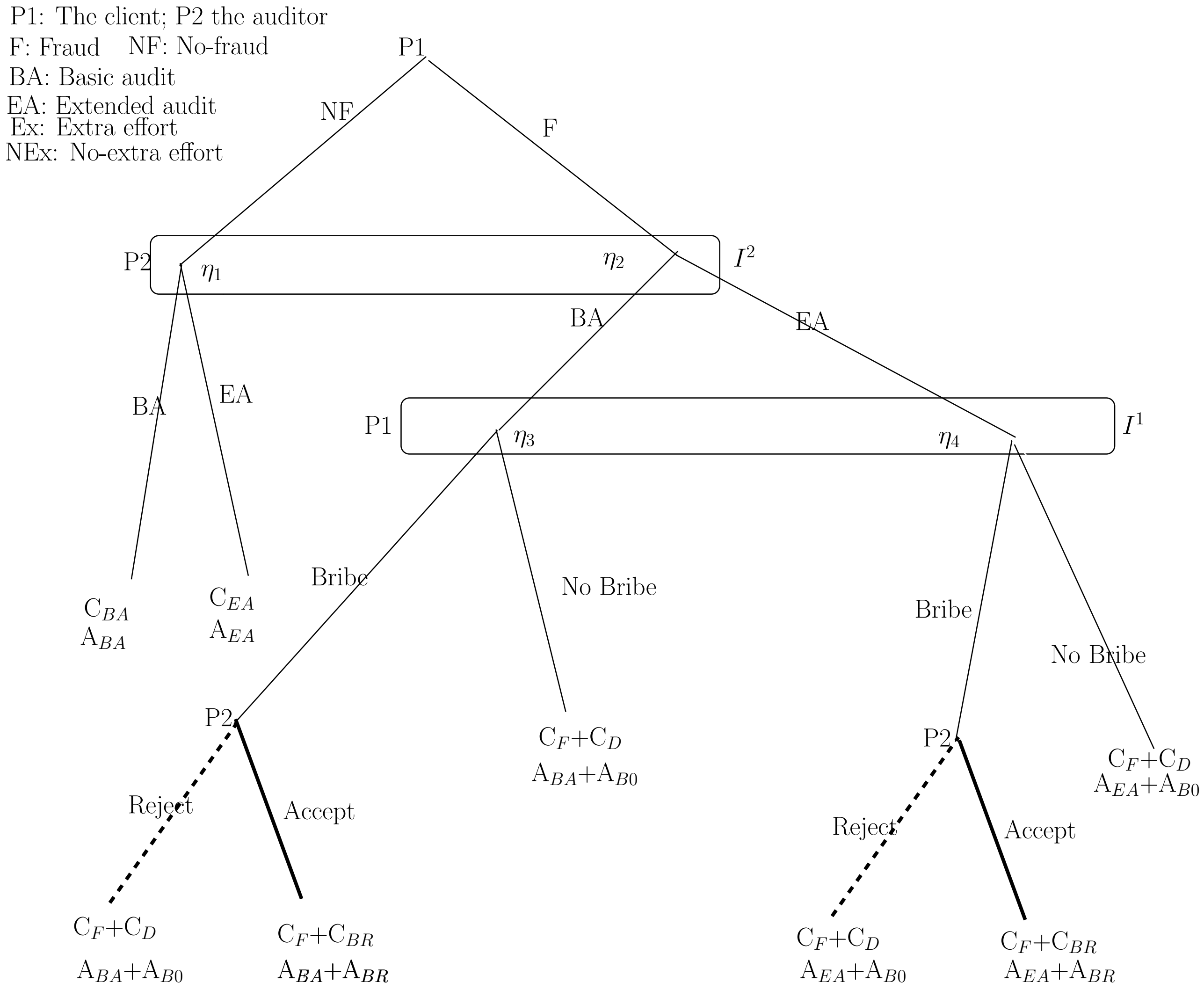
As we have shown all of the NE can also be captured as PBEs. When the corresponding directed optimal path of a NE goes through a particular information set the node it visits is believed with probability 1. If there is also another node in the same information set then it carries probability (belief) 0.

In Figure 3 we capture the beginning of NE. P2 has chosen to play "Accept" from the left-hand-side and also "Accept" from the right-hand-side subgame in Figure 2. The choices "F" and "BA" give the beginning of the NE: (F, Bribe; BA, Accept, Ex) with payoffs $(C_F + C_{BR},\ A_{BA} + A_{BR})$.

In Figure 4 P2 has chosen to play "Reject" from the left-hand-side and also "Reject" from the right-hand-side subgame in Figure 2. For optimality P1 can either play "No Bribe" or "Bribe". These choices lead to the corresponding NE: (NF, No Bribe; BA, Reject, Ex) and (NF, Bribe; BA, Reject, Ex) both with payoffs pair $(C_{BA},\ A_{BA})$.

In Figure 5 P2 has chosen to play "Reject" from the left-hand-side and "Accept" from the right-hand-side subgame in Figure 2. For P1 the strategy "Bribe" dominates "No Bribe" and this leads to the lower part of the graph in Figure 5. The choices "NF" and "BA" give the beginning of a NE. Retracing the previous steps of backward induction we confirm the NE: (NF, Bribe; BA, Reject, Ex) with payoffs pair $(C_{BA},\ A_{BA})$.

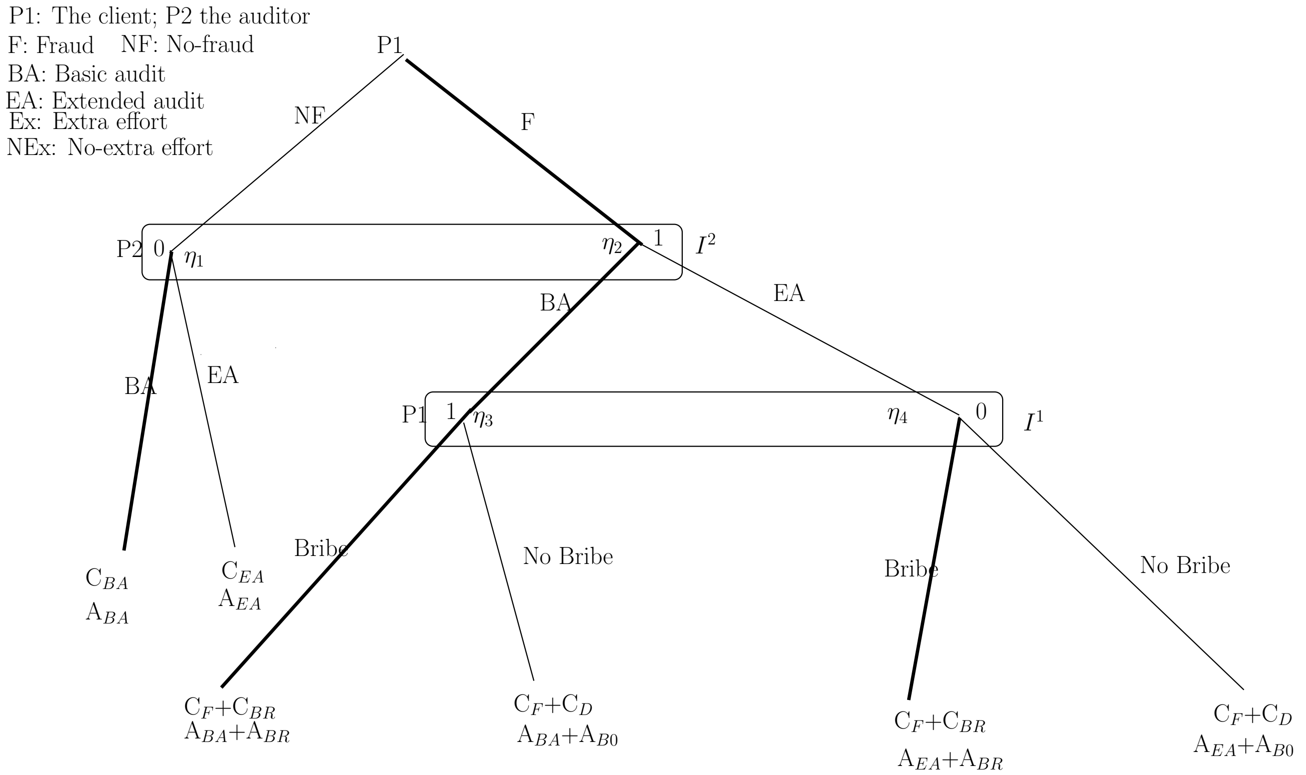
In Figure 6 P2 has chosen to play "Accept" from the left-hand-side and "Reject" from the right-hand-side subgame in Figure 2. For P1 the strategy "Bribe" dominates "No Bribe"



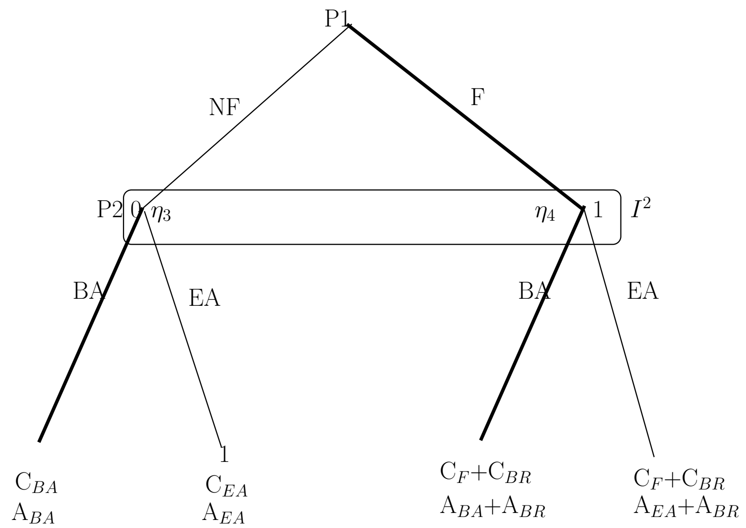
The folding up procces:
The interrupted lines imply an alternative move that could be made.
We shall look at the implications.

Figure 2

CASE1: Accept, Accept



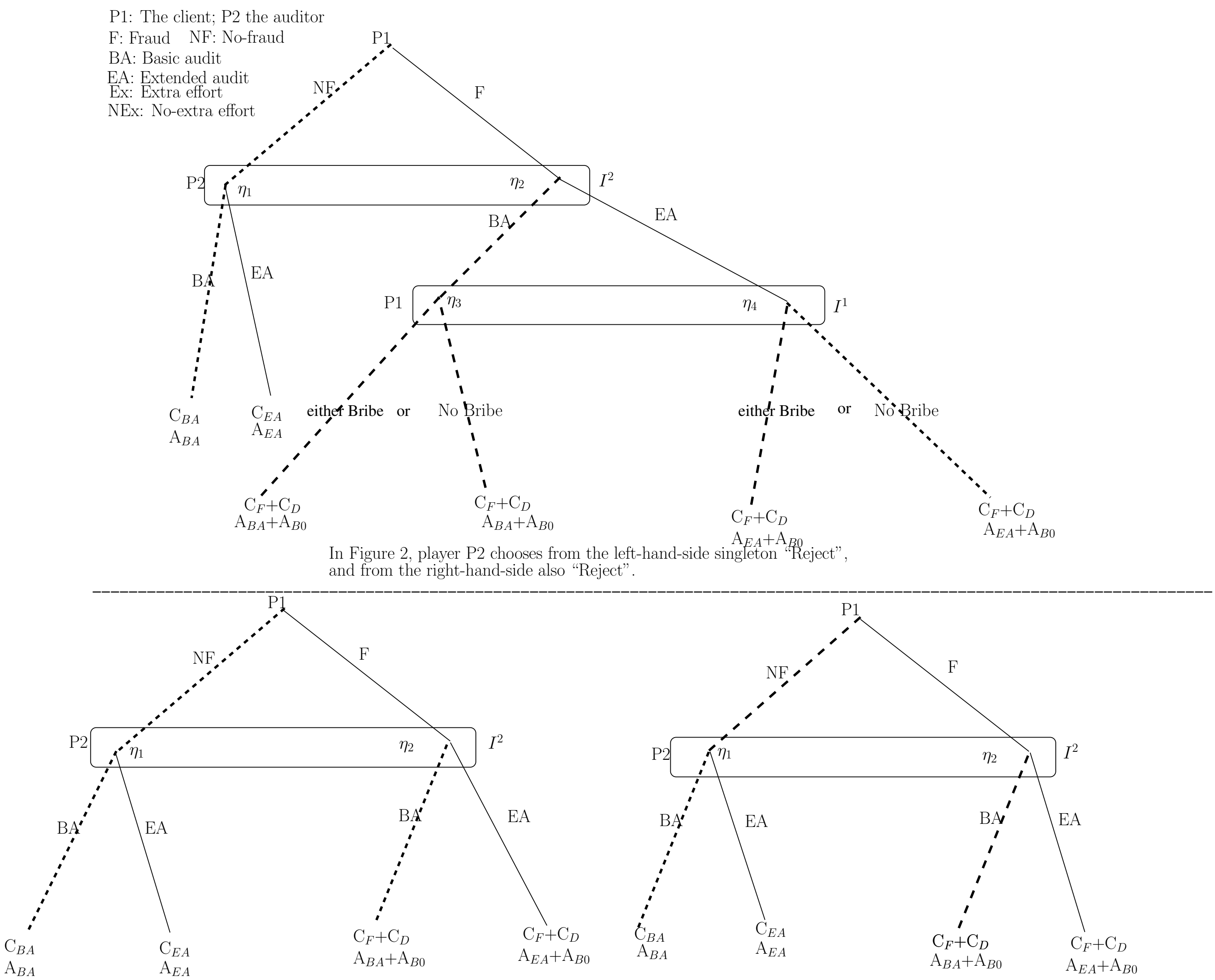
In Figure 2 player P2 chooses from the left-hand-side singleton " Accept", and from the right-hand-side also "Accept".



P1 plays "Bribe" which dominates "No Bribe".
"NF" and "BA" is not NE, "NF" and "EA" is not NE,
"F" and "BA" starts a NE, "F" and "EA" is not NE.
The game continues to the NE: (F, Bribe; BA, Accept, Ex).

Figure 3

CASE 2: Reject-Reject



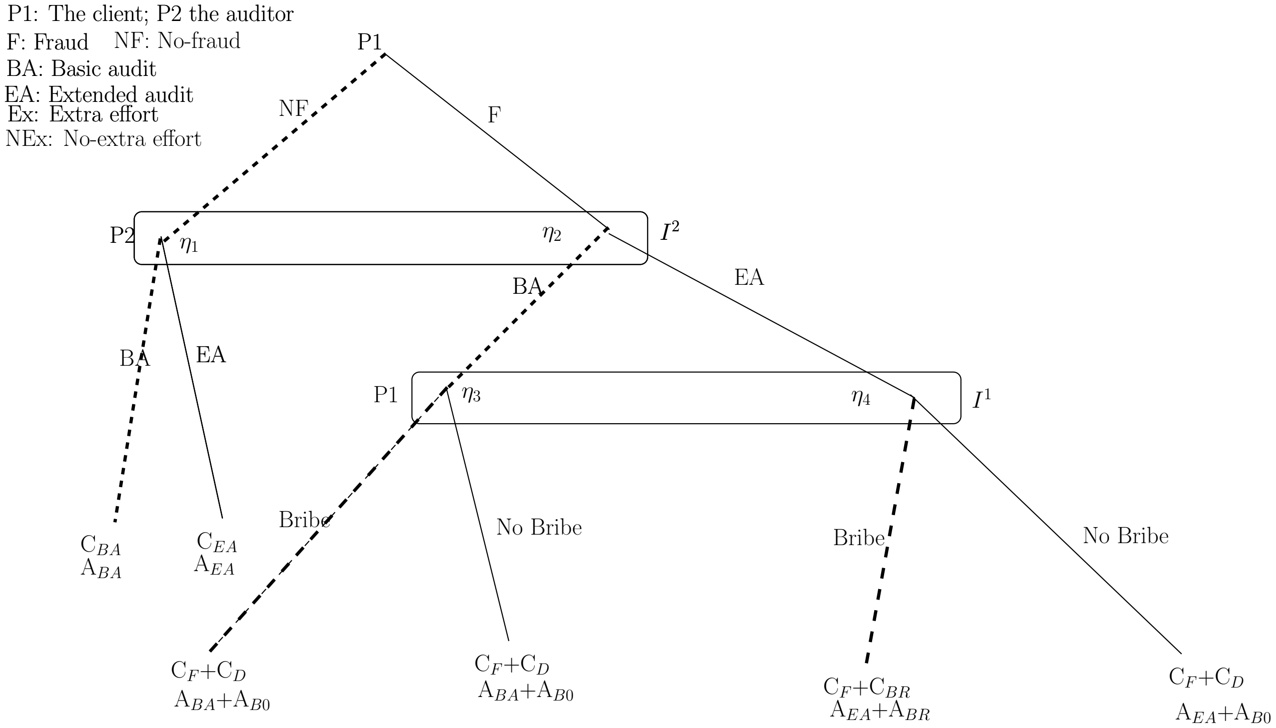
For optimality, P1 can choose either ''No Bribe'' or ''Bribe''.

Under the assumption that P1 plays "No Bribe":
"NF" and "BA" starts NE, "NF" and "EA" is not NE,
"F" and "BA" is not NE, "F" and "EA" is not NE.
The games continues to the NE: (NF, No Bribe: BA, Reject, Ex).

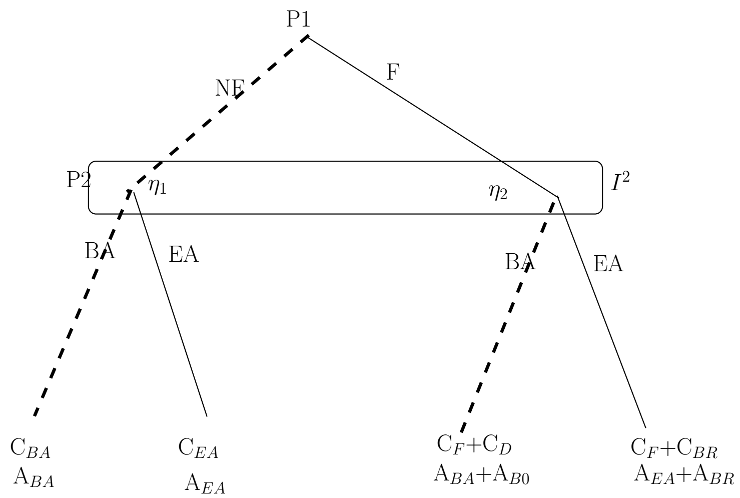
Under the assumption that P1 plays "Bribe":
"NF" and "BA" is NE, "NF" and "EA" is not NE,
"F" and "BA" is not NE, "F" and "EA" is not NE.
The games continues to the NE: (NF, Bribe: BA, Reject, Ex).

Figure 4

CASE 3: Reject-Accept



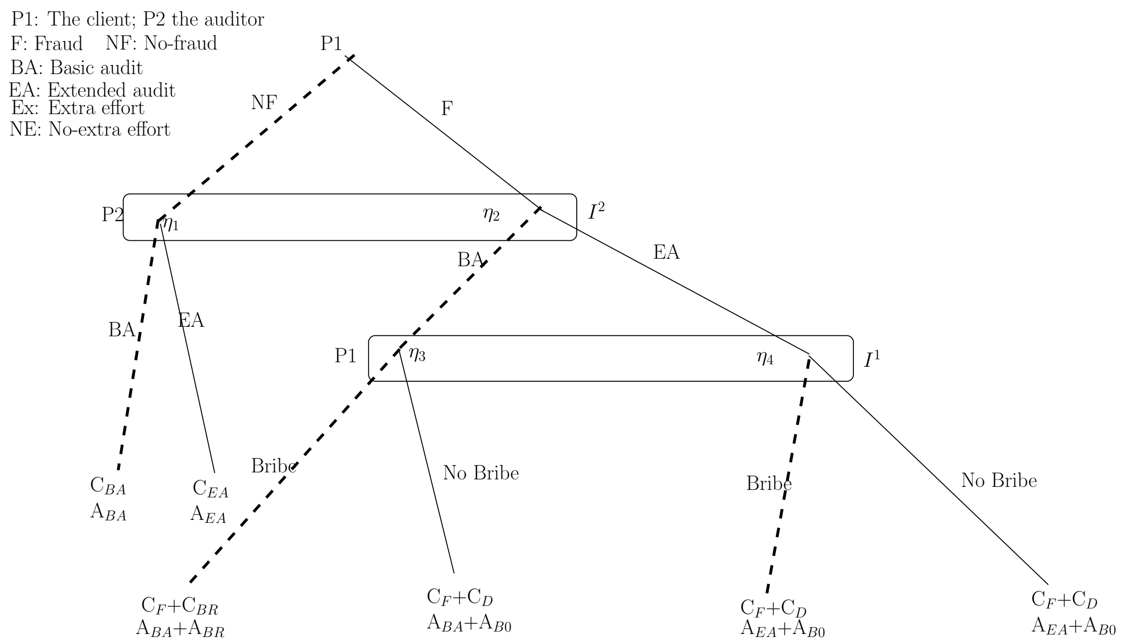
In Figure 2, player P2 chooses from the left-hand-side singleton "Reject", and from the right-hand-side "Accept".



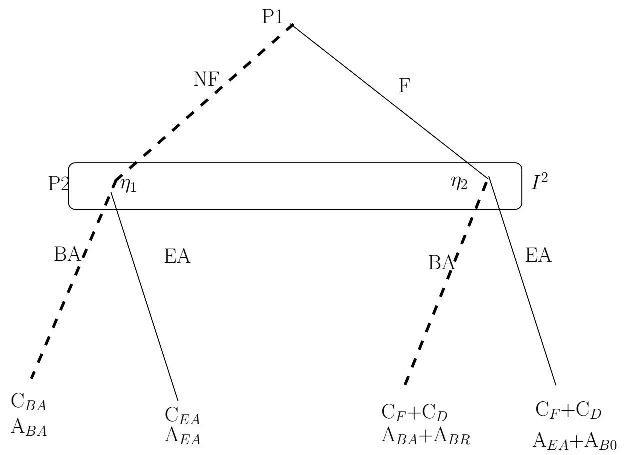
P1 plays "Bribe" which dominates "No Bribe".
"NF" and "BA" start a NE, "NF" and "EA" is not a NE,
"F" and "BA" is not a NE, "F" and "EA" is not a NE,
The games continues to the NE: (NF, Bribe; BA, Reject, Ex).

Figure 5

Case 4: Accept-Reject



In Figure 2, player P2 chooses from the left-hand-side singleton "Accept", and from the right-hand-side "Reject".



P1 plays "Bribe" which dominates "No Bribe".
"NF" and "BA" starts a NE, "NF" and "EA" is not a NE,
"F" and "BA" is not a NE, "F" and "EA" is not a NE,
The game continues to NE: (NF, Bribe; BA, Reject, Ex).

Figure 6

and this leads to the lower part of the graph in Figure 6. The choices “NF” and “BA” give the beginning of a NE. Retracing the previous steps of backward induction we confirm the NE: (NF, Bribe; BA, Reject, Ex) with payoffs pair $(C_{BA},\ A_{BA})$.

The real question that arises concerns the most likely NE (PBE) to prevail. The NE is a technical definition and here it is satisfied by alternative strategy profiles. On the other hand the payoffs pair $(C_F + C_{BR},\ A_{BA} + A_{BR})$ dominated strictly the pair $(C_{BA},\ A_{BA})$.

The most likely NE to prevail is (F, Bribe; BA, Accept, Ex), with payoffs pair $(C_F + C_{BR},\ A_{BA} + A_{BR})$. Although they are in a non-cooperative game, the players will realise, having common knowledge of its structure, that at least in the long run they themselves and their opponent will form (F, Bribe; BA, Accept, Ex), with payoffs pair $(C_F + C_{BR},\ A_{BA} + A_{BR})$.

The model implies that the most likely practice is that a firm will attempt deception, unlawful tactics and be ready to offer a bribe. On the other hand the auditor, will confine himself to a basic audit and accept the bribe. Both players confine themselves to looking after their own interests. We note that in the above discussion of establishing NE and PBEs the assumption $C_{EA} > C_{BA}$ has not been used. The same applies for the actual size of the negative payoff A_L.

6 The relation between the “Bribe” and the “Bonus”

In the previous section we considered the case where the payoff from a Bribe was equal to that of the Bonus. We next turn our attention to the case where these two fundamentals are not equal. As mentioned in section 3, we can formulate the bonus as $A_{BO}(\lambda)$, where λ is a society parameter that reveals the importance of the existence of honest behaviour in a country. Clearly different societies assign different importance to honest behaviour. The bonus in our model is not connected directly to the personal ability of an auditor. It is determined by the socioeconomic norms in a society. So it is important to analyze the equilibria when the bonus is small and when it is large as compared to the bribes on offer.

6.1 The Bribe is larger than the Bonus.

First we consider the sub-case where $A_{BR} > A_{BO}$. This case is analyzed in Figure 7. We first examine the strategy (F, Bribe; BA, Accept, Ex). This is a pure NE with payoffs $(C_F + C_{BR}, A_{BA} + A_{BR})$. Suppose P1 plays “F, Bribe”, which is taken as fixed. Then if P2 switches to “EA” he can not increase his payoff as $A_{EA} + A_{BR} < A_{BA} + A_{BR}$. Neither can he retain “BA” and change the rest of his strategy and improve his payoff. Next suppose that P2 plays “BA, Accept, Ex” which is taken as fixed. P1 can not switch to “NF” and improve his payoff as C_{BA} is less than $C_F + C_{BR}$.

We next show that (F, Bribe; BA, Accept, Ex) is a PBE using backward induction. Using Figure 7 we first fold for P2 having chosen to play “Accept, Ex” from the left hand side and also from the right hand side subgame as $A_{BA} + A_{BR} > A_{BA} + A_{BO} > A_{BA} + A_L$ and $A_{EA} + A_{BR} > A_{EA} + A_{BO}$ correspondingly. This results to the upper tree in Figure 8. In the next stage P1 will choose to play “Bribe” from both the left hand side and the right hand side as $C_F + C_{BR} > C_F + C_D$. This results to the lower tree on the left hand side in Figure 8. Finally, in the following stage P2 will play “BA” both on the left hand side subgame where P1 plays “NF” as well as on the right hand side subgame where P1 plays “F”, as both $A_{BA} > A_{EA}$ and $A_{BA} + A_{BR} > A_{BA} + A_{BO}$. Finally P1 plays “F” as

$C_F + C_{BR} > C_{BA}$.

We now return to Figure 7 and analyse alternative pure NE for this case. The strategies (NF, Bribe; BA, Reject, Ex) and (NF, No Bribe; BA, Reject, Ex) are both NEs with payoffs (C_{BA}, A_{BA}). For the first strategy given that P2 plays "BA, Reject, Ex", P1 can not improve his payoff by playing "No Bribe", nor can it improve his payoff by keeping "Bribe" and playing "F" as $C_F + C_D < C_{BA}$. Given that P1 plays "NF, Bribe", P2 can not improve his payoff neither by playing "EA" instead of "BA", nor by retaining "BA" and playing "Accept".

For the second strategy (NF, No Bribe; BA, Reject, Ex), given that P1 plays "NF, No Bribe", P2 can not improve his payoff by switching to "EA" instead of "BA", nor by playing "Accept". Given that P2 plays "BA, Reject, Ex", P1 can not improve his payoff by playing "Bribe", nor can it improve his payoff by keeping "No Bribe" and playing "F".

As it is obvious from the backward induction derivation in Figure 8, none o these two alternative NE is a PBE. At the folding up P1 plays "F" as $C_{BR} + C_F > C_{BA}$. This is because the auditor is no longer indifferent between "Reject" and "Accept" as he was when $A_{BR} = A_{BO}$. P2 will choose "Accept" both from the left hand side and from the right hand side subgame and this will lead to the lower part of Figure 8 as it will be optimal for P1 to choose "Bribe".

Hence, given his beliefs, the choice of "No Fraud" by the client is not optimal.

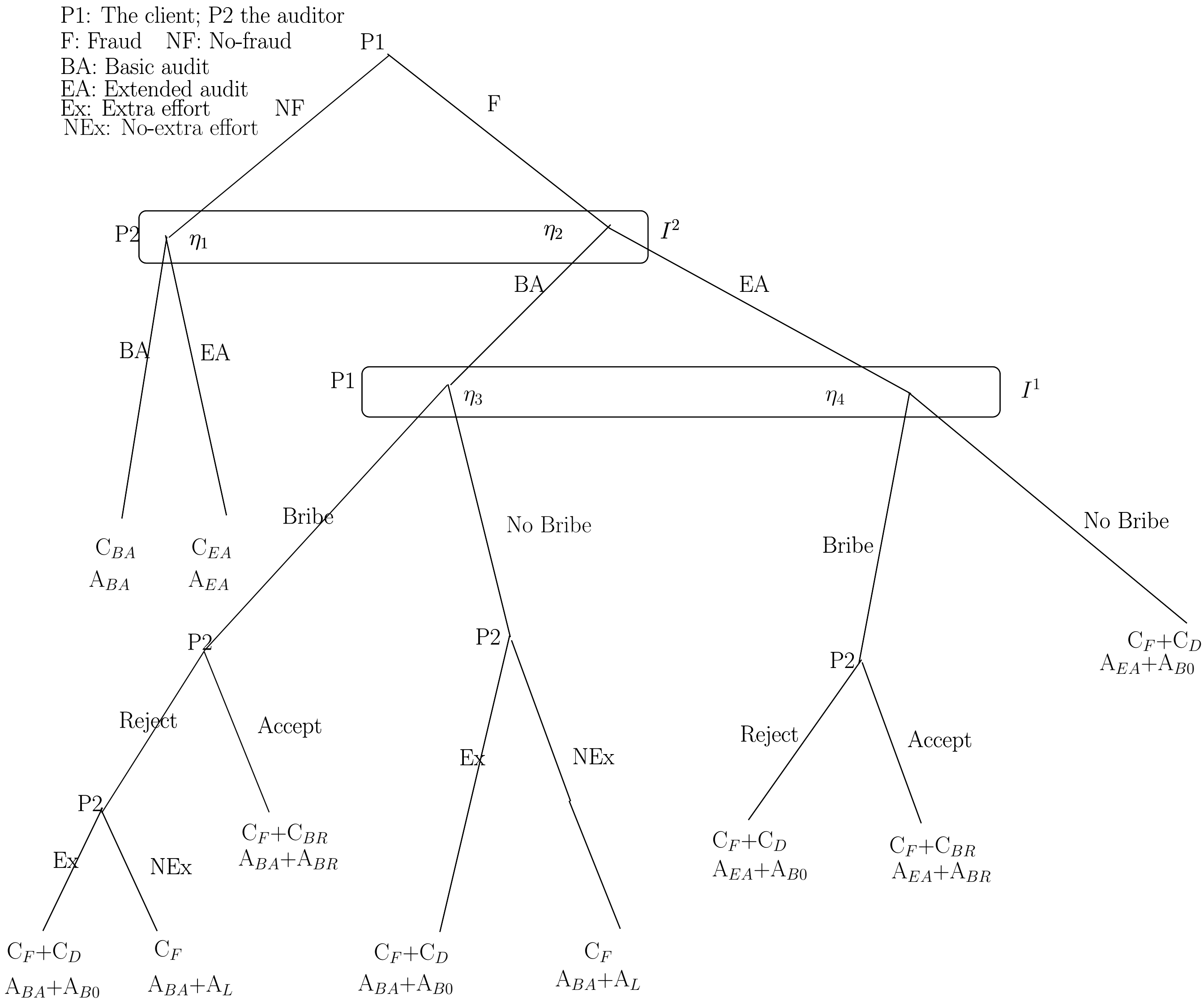
6.2 The Bribe is smaller than the Bonus.

Now we look at the sub-case where $A_{BR} < A_{BO}$. This case is also analyzed in Figure 7. We first examine the strategy (NF, Bribe; BA, Reject, Ex). This is a pure NE with payoffs (C_{BA}, A_{BA}). Suppose P1 plays "NF, Bribe", which is taken as fixed. Then if P2 switches to "EA" he can not increase his payoff as $A_{EA} < A_{BA}$. Neither can he retain "BA" and change the rest of his strategy and improve his payoff. Next suppose that P2 plays "BA, Reject, Ex" which is taken as fixed. P1 can not switch to "F" or "F, No Bribe" as in both cases $C_F + C_D < C_{BA}$.

We also examine the strategy (NF, No Bribe; BA, Reject, Ex). This is a pure NE with payoffs (C_{BA}, A_{BA}). Suppose P1 plays "NF, No Bribe", which is taken as fixed. Then if P2 switches to "EA" he can not increase his payoff as $A_{EA} < A_{BA}$. Neither can he retain "BA" and change the rest of his strategy and improve his payoff. Next suppose that P2 plays "BA, Reject, Ex" which is taken as fixed. P1 can not switch to "F" and improve his payoff as $C_F + C_D < C_{BA}$.

We next show that both (NF, Bribe; BA, Reject , Ex) and (NF, No Bribe; BA, Reject, Ex) are PBEs using backwards induction. As shown in Figure 9 we first fold for P2 having chosen to play "Reject, Ex" from the left hand side and also from the right hand side subgame as $A_{BA} + A_{BO} > A_{BA} + A_{BR} > A_{BA} + A_L$ and $A_{EA} + A_{BO} > A_{EA} + A_{BR}$ correspondingly. In the next stage P1 will choose to play "Bribe" or "No Bribe" from both the left hand side and the right hand side as in both cases the payoff is $C_F + C_D$. P1 is indifferent between playing "Bribe" or "No Bribe" as in both cases P2 will play "Reject". Then, in the following stage P2 will play "BA" both on the left had side subgame as well as on the right hand side subgame as both $A_{BA} > A_{EA}$ and $A_{BA} + A_{BO} > A_{EA} + A_{BO}$ respectively. Finally P1 plays "NF" as $C_{BA} > C_F + C_D$.

Consequently the choice of "No Fraud" by the client is now consistent with his beliefs.

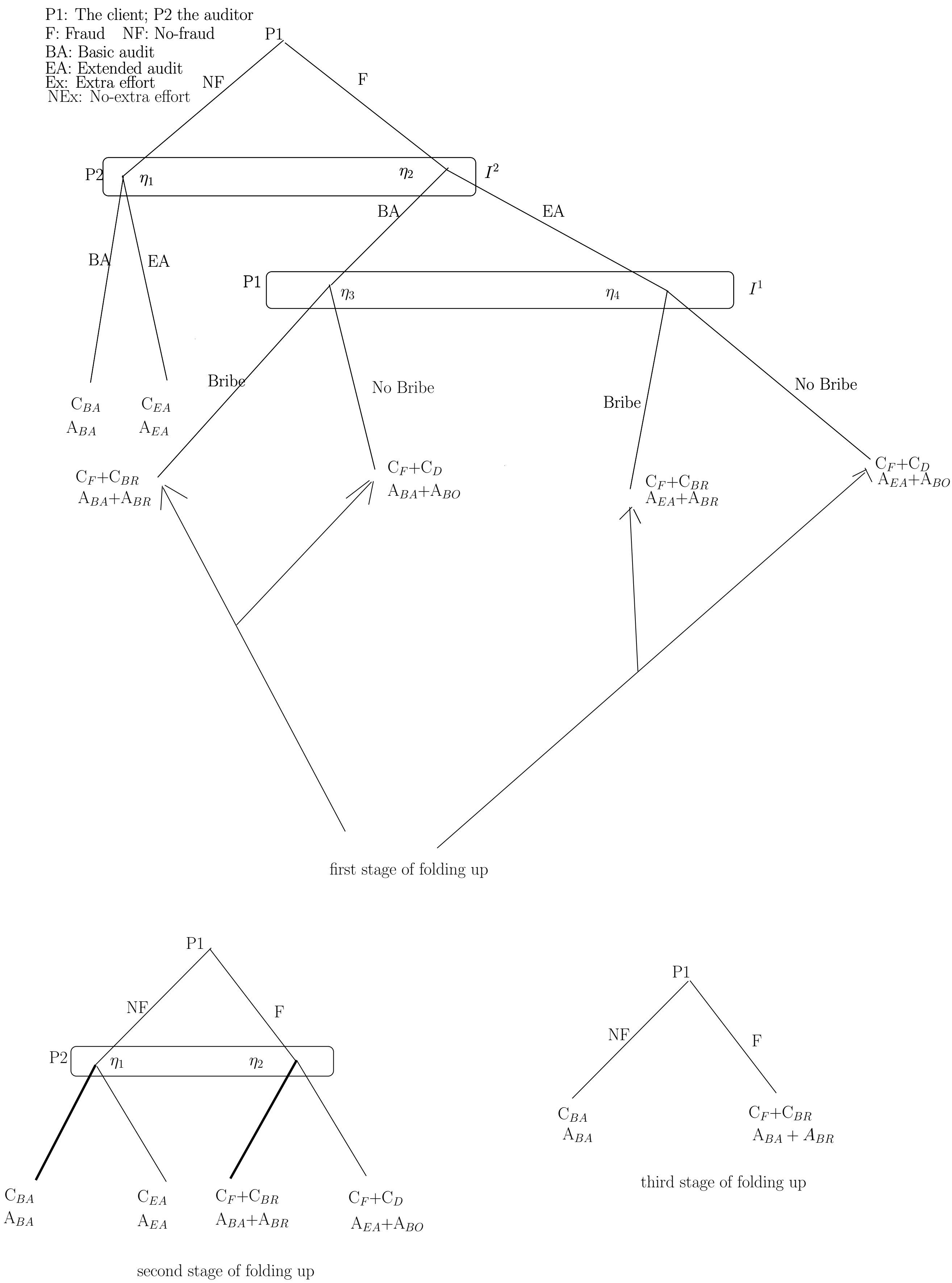


The assumptions are the same as in the previous Figures with one change:
We now assume, $A_{BR} \neq A_{BO}$

For $A_{BR} > A_{BO}$
NE+PBE: (F, Bribe; BA, Accept, Ex)
NE: (NF, Bribe; BA, Reject, Ex)
NE: (NF, No Bribe; BA, Reject, Ex)

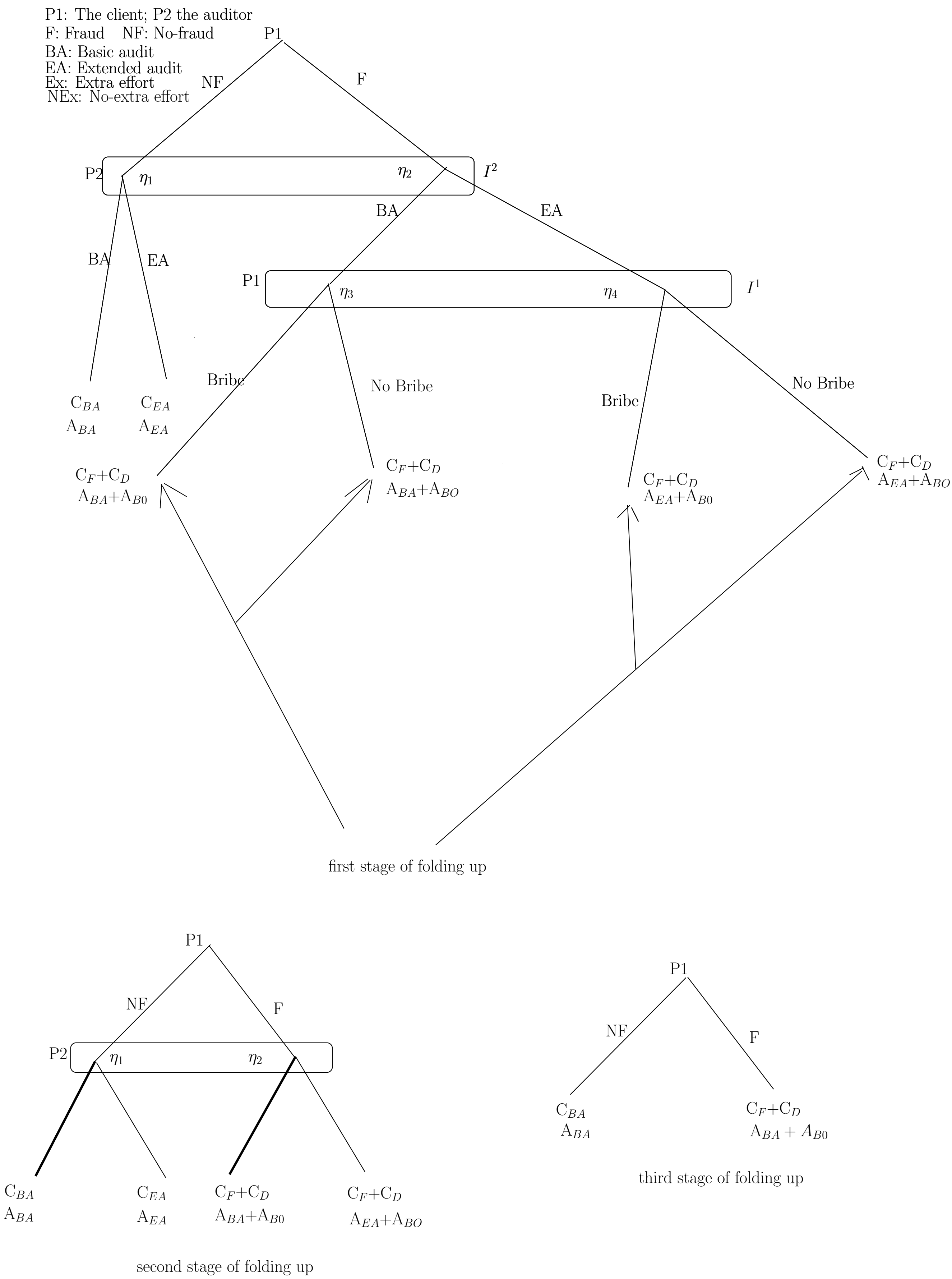
For $A_{BR} < A_{BO}$
NE+PBE: (NF, Bribe; BA, Reject, Ex)
NE+PBE: (NF, No Bribe; BA, Reject, Ex)

Figure 7



The folding up process to establidsh the PBE for the case $A_{BR} > A_{BO}$.

Figure 8



The folding up pocess to establish the PBE for the case $A_{BR} < A_{BO}$.

Figure 9

7 The dependence of the firm's and auditor's strategic behaviours on the size of payoffs

Our model shows that if the Bribe exceeds the Bonus ($A_{BR} > A_{BO}$) three Nash equilibria arise. Unlike the case where $A_{BR} = A_{BO}$, here the two equilibria which involve the pure strategies 'No Fraud' and 'Reject' are decisions which are not consistent with the players' beliefs when the latter are updated using available information. Rather it is the decision by the auditor to accept the bribe and the decision by the client to commit fraud in light of this that forms a PBE.

We show that what is crucial to this decision is that in backward induction the auditor prefers to accept the bribe as the payoff that results from doing so is always larger that the payoffs in all other subgames. Hence compared to the case where the Bribe equals the Bonus, this is a cut off point where *the auditor is no longer indifferent between accepting or rejecting a bribe*, and the client updates his beliefs given this accordingly.

The question is the range over which overall payoffs are critical to this PBE given the domain of values for the different payoffs for the auditor and the client as set out in Section 3. We examine this below.

(i) The domain of the values for A_{BR} and A_{BO} as we need:

$$A_{BA} + A_{BR} > A_{BA} + A_{BO} > 0 > A_{BA} + A_L.$$

Hence $A_{BR} > A_{BO}$ is a binding restriction.

(ii) *Because the auditor plays last, it is always in his interests to choose a basic audit over an extended one*, since irrespective of whether the client plays No Fraud or Fraud, the choice of BA gives a higher payoff than EA. The inequality that ensures this is a range of values such that

$$0 > A_{BA} > A_{EA}$$

(iii) The costs of bribery to the client, C_{BR}, depends on his disposable funds and the expected gain from the fraud, C_F. The bribe that will be paid to the auditor, (i.e. $A_{BR} = -C_{BR}$)) has an upper ceiling C_F. Hence the condition is:

$$A_{BR} = -C_{BR} < C_F.$$

Therefore we expect that large frauds will result to large bribes which are more likely to be accepted as they exceed A_{BO}.

We now return to the question of whether the size of the possible litigation costs and fines, A_L, matters. The answer is no because the bribe as well as the bonus take positive values while $A_L < 0$ reduces the overall payoffs of the auditor. We see from Figure 7 that if the auditor is faced by a client who offers a bribe that he rejects, he will then exert sufficient effort to detect it as $A_{BA} + A_{BO} > 0 > A_{BA} + A_L$. The perception of a possible A_L cost always moves the auditor in the direction of a thorough investigation, regardless its size.

There may be exceptions. Suppose that we add to A_{BA} a cost c for the extra effort exerted for uncovering a fraud after its existence is signalled by the fact that the client is offering a bribe. If the bonus is smaller that this cost, then the size of A_L may become binding. If

A_L is sufficiently close to zero, then $c + A_{BO} < A_L < 0$. However, the costs of uncovering a fraud, after its existence has been revealed through the offer of bribe, will be small, so $c + A_{BO} > A_L$. A small c also means that $c + A_{BA} > A_{EA}$ and the auditor will still prefer a basic audit to an extended one.

For the client to choose to play bribe, $C_F + C_{BR}$ needs to be greater than $C_F + C_D$. Clearly this always holds as the range of the former is positive and the range of the latter negative.

(iv) It is required that $C_F + C_{BR}$ is greater that the payoff C_{BA} when he has not committed fraud and he is found by the auditor to be in the clear following a basic audit.

Hence the inequality

$$C_F + C_{BR} > C_{BA}$$

is binding for (F, Bribe; BA, Accept, Ex) to be a PBE when $A_{BR} > A_{BO}$.

In other words, the existence of a reputation mechanism is also relevant for the client. If it is weak the above inequality prevails. On the other hand, if the reputation payoff for the client, following an unqualified report, is large after a basic audit, then this may exceed the net payoff from fraud.

As we mentioned in (ii) above, because he plays last it is always in the interests of the auditor to choose a basic audit over an extended one, i.e. he prefers A_{BA} to A_{EA}. Clearly the existence of a premium payoff, $C_{EA} > C_{BA}$, in the case where the client receives a clean bill of health following an extended audit, plays no role as this choice between C_{EA} and C_{BA} is not available to the client. This means that while it may not be observable by the market whether the auditor chose a basic or an extended audit so that the client is awarded with the appropriate payoff [9], this plays no role in the outcome. The decision of which strategy to play (BA or EA) is made by the auditor, not the client.

If the Bonus exceeds the Bribe ($A_{BO} > A_{BR}$) two Nash equilibria arise. Both are PBE, and both involve No Fraud and a Reject of the Bribe as decisions which are consistent to the players' beliefs as the later are updated using available information. The pair of strategies (F, Bribe; BA, Accept, Ex) is no longer a Nash equilibrium as P2 can improve his payoff by choosing "Reject" instead of "Accept" given P1's strategy choice "F, Bribe". What is binding is:

(i) The domain of the values for A_{BR} and A_{BO} as we need:

$$A_{BA} + A_{BO} > A_{BA} + A_{BR} > 0 > A_{BA} + A_L.$$

Clearly given what we have mentioned in (iii) above this is more likely to be the case either when the size of the fraud is small, in which case this lowers the upper ceiling of A_{BR}, and/or when reputation is very important in the economy and hence A_{BO} is large. However the size of penalties does not factor in as a binding restriction as A_L is negative.

As mentioned above because the auditor plays last, it is always in his interests to choose a basic audit over an extended one, since irrespective of whether the client plays No Fraud or Fraud, the choice of BA gives a higher payoff than EA. As we have explained, now that the Bonus exceeds the Bribe the auditor is not indifferent between accepting or rejecting

[9] See Knechel, 2013, p. A3-A4.

a bribe. This time he will choose Reject, and the client updates his beliefs given this accordingly.

Inequalities (ii) and (iii) will need to hold as above.

Interestingly, if $A_{BR} < A_{BO}$, backward induction shows that the client is indifferent between choosing Bribe or No Bribe as the payoff in either case is $C_F + C_D$ (Figure 9). The client will always choose to play No Fraud as the payoff for doing so, C_{BA}, exceeds $C_F + C_D$. Clearly this always holds as the former is positive and the latter is negative.

8 Concluding remarks

The cornerstones of our model are the introduction of the concept of "auditor reputation" and the reward A_{BO} that comes with it depending on the country's social norms. Our analysis above suggests that the size of this reputational reward is critical in ensuring ethical behaviour on both sides. The importance that society attaches to honest behaviour is monetized in the form of the auditor's ability to command higher client fees through a high quality reputation. In other words, A_{BO}, is the premium in audit fees that the auditor commands over rivals with a lower reputation for quality. This depends on the market's propensity to reward higher quality and integrity in the process and outcomes of auditing; i.e. its size depends on the "environment" in the society where the market operates and the framing of bonuses as such.

Regarding penalties, we have found their size is not binding in establishing Nash and PBE solutions irrespective of whether the size of the bribe to the auditor exceeds, is equal to, or less than that of the bonus. On the other hand, C_D, the penalty faced by a client for dishonest behaviour is third party determined (e.g. set by a financial regulator) and assumed to be greater than C_F. To a large extent reporting fraud in a society is, like the bonus, dependent on the environment in that society as regards the cultural norms determining the willingness by companies, charities, pubic sector organisations and whistle-blowers to uncover and report fraud.

In practice, fraud detection itself is dependent to a large extent on market participants other than the auditors. According to Dyck et. al. (2010), it is employees, non-financial market regulators and media that report a combined 43% of detected fraud, while auditors only account for 10%, which is fractionally larger than the percent detected by financial regulators at 7%. As discussed, if auditors fail to detect or report fraud which is subsequently detected by others, the auditor will "pay" in terms of regulatory fines and litigation costs as subsumed in A_L.

The findings of our model yield the policy implication that it is important to try to frame the payoffs to the auditors in the form of bonuses rather than fines. A policy which is based on fines is not going to be as effective in ensuring honest reporting from the clients.

Appendix: General remarks on classification of games, strategies and equilibrium concepts.

We recall a few definitions and concepts. For more detailed information see, for example, Glycopantis (2016). A finite game tree consists of (i) an initial node, (ii) a finite set of nodes, belonging to the players' information sets, from which action can be taken, and (iii) a finite number of terminal nodes listing the payoffs of players. A (directed) path takes the play of the game from the initial node to a terminal node of the tree in a unique manner. No two paths can ever intersect. A subgame consists of a root, a node, from which a connected set of edges follow to terminal nodes.

A *pure strategy* of a player maps each of his information sets into the actions available at that set. *Mixed strategies* are defined to be probability distributions over pure strategies. *Behavioural strategies* attach a probability distribution to the moves from each information set; these probabilities are attached independently.

A behavioural strategy means when a player enters an information set he carries with him a piece of paper, specific to this set, telling him that he must spin a wheel to decide which move he will make. The wheel is the same for all nodes in this information set. Behavioural strategies can also be mixed. A pure strategy is also a behavioural strategy.

A Nash equilibrium (NE) consists of a set of players' strategies such that nobody can change his strategy unilaterally, that is while everybody else keep theirs constant, and improve his payoff. In the analysis of the graphs we obtain optimal pure strategies in the sense of Nash.

A perfect Bayesian equilibrium (PBE) consists of a set of players' optimal behavioural strategies, and consistent with these, a set of beliefs which attach a probability distribution to the nodes of each information set. Consistency requires that the decision from an information set is optimal given the particular player's beliefs about the nodes of this set and the strategies from all other sets. Beliefs are formed from updating, using the available information. If the optimal play of the game enters an information set then updating of beliefs must be Bayesian. Otherwise appropriate beliefs are assigned arbitrarily to the nodes of the set.

A player P is said to have *perfect recall* if he never forgets what he once knew. A game is said to be of *perfect recall* if every player has perfect recall. Otherwise the game is said to be of *of imperfect recall*, (Glycopantis, 2014). It is characterized by 'absent-mindedness' of the players.

Games of imperfect recall are contrasted with games having imperfect information. In the latter there is no loss of information. The nodes of an information set are simply indistinguishable. The game in these notes is of imperfect information but of perfect recall.

A (directed) path takes the play of the game from the initial node to a terminal node of the tree in a unique manner. I.e. no two paths can ever intersect.

In the games examined in this paper we are looking for NE and the players' beliefs which lead to PBEs.

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