Plea Bargaining and Investigation Effort: Inquisitorial Criminal Procedure as a Three-Player Game

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Abstract:

We study the impact of plea bargaining on decision errors and operating costs of the inquisitorial justice system. Scholars and legal professionals are divided over whether such plea deals are compatible with the inquisitorial tradition. In this paper, we stylize inquisitorial criminal procedure as a sequential game with two benevolent investigators, judge and prosecutor. Both agents are subject to private investigation costs and seek a correct decision over a defendant of uncertain guilt. Our analysis shows that the introduction of plea deals in courtroom helps to overcome the problem of effort coordination between the two investigating agents. All equilibria that involve a conviction also adhere to the '*beyond reasonable doubt*'-conviction threshold. Moreover, we demonstrate that plea bargaining reduces the frequency of wrongful convictions (type I errors) in inquisitorial procedures.

JEL-Classification: K14, K41, D82

Keywords: screening, free-riding, litigation, court errors

1. INTRODUCTION

Criminal procedure needs to be swift to combat crime. Effective deterrence relies on the expectation that unlawful behavior is sanctioned in due time, and the rule of law requires that accusations against an individual should be dropped immediately when they cannot be substantiated with evidence. The plea bargain between the prosecutor and the defendant, a legal practice where the defendant pleads guilty in exchange for a reduced punishment, is often claimed to serve that purpose. Law and economics scholars have stressed many favorable implications of these plea deals, such as saved resources by the prosecutorial office and shorter trials (see Lewisch 2000). The most remarkable feature of plea bargaining, however, is its self-selection property: as guilty and innocent defendants have different expectations about their prospects in court, a plea deal could be offered that (some of) the guilty defendants accept while all innocent individuals reject it (see, e.g., Baker and Mezzetti 2001). About 90 percent of convictions in the United States involve a guilty plea by the defendant (see US Department of Justice 2021).

Although plea bargaining has become more common in legal justice systems around the world, it is often regarded as alien to the inquisitorial law tradition.[1] In contrast to adversarial procedures where mainly the parties are responsible for fact-finding, the

[1] Scholars in inquisitorial legal systems argue that any (negotiated) punishment requires the determination of guilt by the state, and this determination needs to be justified by the evaluation of the evidence of the case ('nulla poena sine culpa'). Consequently, any guilty plea that saves court resources due to avoided investigations or a reduction in the defendant´s rights is regarded as a violation of this principle (see, e.g., Landau 2011).

inquisitorial trial is primarily run by the judge as the neutral decision-maker. The judge is obliged to establish the truth. The case of Germany, a country that was once called "the land without plea bargaining" (Langbein 1979) with a strong inquisitorial tradition, is particularly illustrative.[2] Klaus Tolksdorf, the former president of the German Federal Court of Justice, called the increasing use of plea deals as "devastating for the reputation of justice" (Frankfurter Allgemeine Zeitung 2009). Other scholars claim that 'informal' deals will promote guilty pleas by defendants without sufficient evidence (see Jahn and Kudlich 2016). A recent government review of plea bargaining in Germany did reveal frequent violations of the legal requirements due to 'informal' deals, a lack of oversight by prosecutors and judges, and degraded safeguards for the defendant (see Altenhain et al. 2020).

In this paper, we study the impact of plea bargaining on decision errors and operating costs of the inquisitorial justice system. Distinct from the previous literature, we stylize inquisitorial procedures as a sequential game with two benevolent agents, judge and prosecutor, who are subject to private effort costs. Plea bargains are initiated by the judge in courtroom. Our analysis shows that the introduction of plea deals helps to dissolve the problem of effort coordination between the two investigating agents. In contrast to the widespread concerns in the legal debate, we also demonstrate that plea bargaining reduces the frequency of wrongful convictions (type I errors) in inquisitorial procedures.

[2] Many inquisitorial countries, such as France, have introduced plea deals alongside other adversarial elements into their procedures. Such deals typically occur before trial to save resources, but these agreements are later validated by the judge. In Germany, the legislator attempted not to interfere with the inquisitorial doctrine, i.e. plea deals are to be negotiated during trial (§257c StPO), and the agreement does not relieve the judge of his obligation to examine the evidence.

The paper is organized as follows: in chapter 2, we provide a review over the related literature and introduce our model setup in chapter 3. Chapter 4 then provides an analysis of the identified sequential equilibria of the game. We discuss our findings and the implications for legal policy in Chapter 5, and chapter 6 concludes.

2. RELATED LITERATURE

Researchers have shown a strong interest in the institution of plea bargaining both due to its strong prevalence particularly in the U.S. criminal justice system and its obvious resemblance to pre-trial settlements in civil procedure. From the law and economics discipline, plea bargaining has often received a rather favorable, "upbeat assessment" (Garoupa and Stephen, 2008, p. 326) for it imposes a price on crime and allows prosecutors to effectively reduce their caseload (for an overview, see Lewisch 2000).

Since the landmark article of Grossman and Katz (1983) and later refinements by Reinganum (1988) and Baker and Mezzetti (2001), the plea bargain has been interpreted as an efficient screening device for the prosecutor, enabling her to distinguish the guilty from the innocent defendants. Plea bargaining may thus save scarce prosecutorial resources. Moreover, Reinganum (1988) showed that the large discretion of the prosecutor to extend case-specific bargains to defendants is particularly desirable when previous screening by the police force is rather poor. Tsur (2016) demonstrated that all plea bargaining equilibria in the interaction of a benevolent prosecutor with strategic defendants and juries show the same conviction threshold and thus fit the principle of equality before the law. Despite these favorable features, many researchers have questioned the underlying model assumptions, such as benevolent preferences of the prosecutor (see, e.g. Bibas 2004, Garoupa 2012), her ability to interpret new information in an unbiased manner (see, e.g. Burke 2007, Christmann 2021) and risk-neutral behavior by the defendants (see Kobayashi and Lott 1996).

Plea bargaining appears to be deeply rooted in adversarial criminal justice systems.[3] According to scholars of comparative criminal law, the strengths of the adversarial system are the superior incentives of the litigants to reveal private information to the court (see, among others, Tirole and Detrawipont 1999, Froeb and Kobayashi 2001, Spier 2007, pp. 313). For example, the information asymmetry between the informed defendant and the uninformed prosecutor will continuously diminish in the course of the proceedings, but litigation expenditures increase. Given this trade-off between accuracy of the deal and cost-savings, both parties are motivated to find the best timing for the plea bargain (see Garoupa and Stephen, 2008). Many researchers argue that incentives for information collection in inquisitorial legal systems are rather low: Kim (2013) points out that, in contrast to the parties themselves, the effort of the uninformed inquisitorial judge has to be less effective in extracting truthful information. This induces more decision errors by the court. The incentive problem becomes even more pronounced when one acknowledges that the inquisitorial system relies on two benevolent representatives of society, the judge as inquisitor and the prosecutor as his aide. Considering judge and prosecutor as economic

[3] In addition to its widespread use in the US, two out of three pleas in England and Wales involve a guilty plea by the defendant (see UK Ministry of Justice 2019). However, mere guilty pleas may not be identical to real plea bargaining between the parties (see comments by Garoupa and Stephen 2008).

agents, Christmann and Kirstein (2020) show that coordination problems emerge as each of the two agents prefers to freeride on the other one´s effort. Emons and Fluet (2009) find that parties are also more tempted to distort the evidence in the inquisitorial setup than in an adversarial hearing.

Despite these disparities in legal doctrines, plea bargaining has become common in many inquisitorial justice systems (for an overview, see Hodgson 2015). Several legal scholars resent this development and regard such bargains as not compatible with the inquisitorial law tradition, as the criminal case is not at the discretion of the parties and the process of revealing the truth is to be governed by the impartial judge (see, among others, Wohlers 2010, Landau 2011, Rönnau 2018). In a comparative law setting, Adelstein and Miceli (2001) attempt to capture the traditional differences between the two paradigms by assuming that efficiency for adversarial systems is interpreted as a strong aversion to wrongful convictions while efficiency for the inquisitorial tradition implies a strong desire for convicting the guilty defendants. The authors thus conclude that plea bargaining is welfare-enhancing only for adversarial systems, as sentence discounts through bargains spare the guilty defendants in order to reduce the social costs of wrongful convictions. Some insightful country studies exist. Soubise (2018) finds that the introduction of plea bargaining in France in 1999 and 2004 lead to a significant increase in bureaucratization of proceedings. Although all deals have to be validated by a judge, a de facto close cooperation between judges and prosecutors increases the latter´s more dominant role in case disposition with little safeguards for the defendants. Although the Italian Code of Penal Procedure underwent a major reform to adversarial procedures including plea deals in 1988, Parlato

(2012) sees the Italian systems still as a mixture of adversarial and inquisitorial elements. Frommann (2009) even regards Italian plea bargaining to be particularly similar to plea deals in the German inquisitorial system. The author describes that in Italy, prosecutor and defendant have to conclude the plea bargain before the judge who is still obliged to formally determine the guilt of the defendant. The judge then reviews the legal requirements of the deal. Moreover, the defendant is always entitled to ask the judge directly for a reduced sentence without the agreement of the prosecutor. For Frommann (2009), both measures should prevent the prosecutor from overcharging or basing a deal offer an arbitrary grounds and provides sufficient independence for the judge.

In Germany, the practice of plea deals ('*Absprachen*') had developed more informally and in very differing ways throughout courtrooms until the German legislator enacted the *'Law on Agreements in Criminal Proceedings'* in 2009. As part of the official government review, Altenhain et al. (2020) present a large comprehensive survey and review of case records on the current legal practice under the new law. The authors find that about 15 percent of all criminal cases (advocates report higher numbers, between 26 and 33 percent) are concluded by plea deals, and that the average reduction in punishment was stated to be about 20 to 25 percent. For the vast majority of examined cases, plea bargaining occurred prior to the hearing of evidence. Moreover, plea deals were usually proposed by the judge or, with a higher rate of success, by the defendant, but only rarely by prosecutors. The survey also revealed some worrisome findings: interviews indicated that some guilty pleas were made by defendants after the judge had threatened the defendant with the prospect of a much higher punishment if the deal offer was turned down (so-called '*Sanktionsschere*'). Moreover, defendants often waivered their right to appeal as part of the bargain. For the authors, it is also notable that the prosecutorial office rarely requested an official review of successful plea bargains, which may not be in line with their role as "guardians of the rule of law" (Altenhain et al. 2020, p.537).

Previous research has shown that the integration of plea bargaining into inquisitorial justice systems produces some difficulties. It remains an open question how the coordination of efforts by the two investigators in the inquisitorial tradition, prosecutor and judge, is affected by plea bargains. It has also been overlooked that, at least for the case of Germany, it is usually not the prosecutor who makes the initial deal offer.

3. THE INQUISITORIAL PROSECUTION MODEL

This model builds on the two player prosecution game by Christmann and Kirstein (2020) in which the authors study free-riding behavior between the judge (J) and the prosecutor (P) in the inquisitorial justice system. We introduce a third player to the game, the defendant (D), who may plead guilty to avoid a full trial. Thus, we study the impact of plea bargaining on the equilibrium strategies of the three players in the inquisitorial prosecution game.

The defendant is one of two types, as he is either guilty of a crime (g) or he is innocent (i). The type of the defendant is specified by nature (N) at the beginning of the game, and let γ be the ex-ante probability of a guilty defendant.[4] While the ex-ante probability is assumed common knowledge, only the defendant knows his true type. In this game, the defendant is accused of having committed a crime which is subject to the punishment F. Think of the value F as society´s response to the alleged unlawful behavior, and assume F increases with the severity of the crime. Thus, if the defendant is eventually convicted and sentenced, he receives the utility $-F$, otherwise his utility is set to zero. To avoid this punishment, the defendant may give in to a plea deal Σ at an earlier stage, and thus accept the bargained sentence without further court procedures. Following this logic, we believe that a plea deal may offer some "discount" (Lewisch 2000, p. 250) on the sentence to the defendant but it can never exceed the punishment F defined by law.[5] Nevertheless, the deal offer has to exceed mere litigation costs, otherwise proving one´s innocence in court would never be rational. Thus, we specify for the deal offer $T < \Sigma \leq \mathrm{F}$.

Society wants the guilty defendants to be convicted and punished while the innocent defendants should be acquitted and set free. Wrongful convictions (type I error) and wrongful acquittals (type II error) thus deviate from the goals of society, and should be avoided. We assume that the prosecutor and the judge adhere to these goals. If a truly guilty defendant is wrongfully acquitted, then each agent receives a disutility of H. If a truly innocent individual is sent to prison, then prosecutor and judge receive the disutility αH,

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[4] The ex-ante probability of a guilty defendant can be interpreted as the level of initial suspicion that a particular person committed the offence. It is determined by the capability of the police force to correctly identify and apprehend suspects.

[5] The study by Altenhain et al. (2020, p. 525) reports that plea bargains in Germany show an average discount of about 25 percent to the full trial outcome.

with $\alpha > 1$. Image the value α to be the number of wrongful acquittals of guilty defendants that are acceptable for society in order to avoid the wrongful conviction of a single innocent individual (see Tsur 2017, p. 198). We thus follow the general notion that wrongful convictions are regarded as more harmful by liberal societies. Consider the probability μ to be the belief of the judge upon trial that the defendant is actually guilty, then the judge will convict the defendant if $-(1-\mu)\alpha H \geq -\mu H$ applies. This gives the court´s decision standard ('*beyond reasonable doubt*')[6] for a conviction as $\mu \geq \frac{\alpha}{1+\alpha}$.

The prosecutor and the judge seek to determine the true type of the defendant. For this, each of the two players may investigate the evidence of the case. For simplicity, we assume that investigations perfectly reveal the defendant´s true type, but produce effort costs c_P for the prosecutor and c_J for the judge. Given that the prosecutorial office has superior resources and closely cooperates with the police forces at all times, we assume that the prosecutor can investigate the case at lower costs compared to the judge (i.e., $c_P < c_J$ holds). This captures the widely held perception of the prosecutorial office as the chief investigator (so-called '*Herrin des Ermittlungsverfahrens*')[7] in inquisitorial criminal systems. If the case actually moves to court, then all players bear additional trial costs T.

[6] While the expression '*beyond reasonable doubt*' is rooted in the adversarial doctrine, the presented rationale carries over to the inquisitorial tradition. Moreover, the German Federal Court of Justice repeatedly specified for criminal procedure that a conviction of the defendant requires the judicial evaluation of the evidence to achieve a sufficient level of certainty which, in the wording of the court, precludes reasonable doubts (see BGH 01.07.2008, 1 StR 654/07).

[7] In German criminal procedure, the prosecutorial office clearly dominates the investigations prior to the charge, monitors the police force and even supervises the adherence to the law during trial. Its famous nickname is also used by the Federal Court of Justice (see, e.g., BGH II BGs 335/99 [2009]).

However, whether the case was already investigated by the prosecutor or simply passed on to court without examination remains the private information of the prosecutor.[8] Furthermore, we assume that the prosecutor bears a reputational loss L when she loses a case that she chose to bring to court.[9] All players are assumed to be risk-neutral, and they maximize their expected utility.

The non-cooperative game consists of four stages, as illustrated by *Figure 1*: The investigations of the prosecutor (stage 1) and her decision to charge the defendant (stage 2), the potential plea deal (stage 3), and the judge who makes the final decision (stage 4).

First, nature determines whether the defendant is truly guilty or innocent. At stage 1, the prosecutor may either decide to investigate the evidence of the case, which means that she learns the defendant´s true type, or she may proceed without further investigations. Then she can drop charges and end the game, or she decides to take the case to court at stage 2. Prior to court proceedings, the judge offers a plea deal to the defendant at stage 3, which can either be accepted and the game ends, or the deal is rejected by the defendant and court proceedings commence. At stage 4, the judge observes the charge and the failure of plea bargaining. He may then either investigate the case himself, which leads

[8] While an agent will never declare that she has not examined the evidence of the case, it will be difficult to assess her true investigative effort only from the written report in the case file (the 'dossier') that is passed on to the judge.

[9] Note that the inquisitorial principle of compulsory prosecution for capital offences only requires the prosecutor to move to court if she regards the evidence to be sufficient to support the charge. In the world of our model, this still implies that she can decide to drop the case if the probability of guilt is rather low.

to a correct court decision, or decide about conviction or acquittal based on his beliefs about the defendant´s guilt.

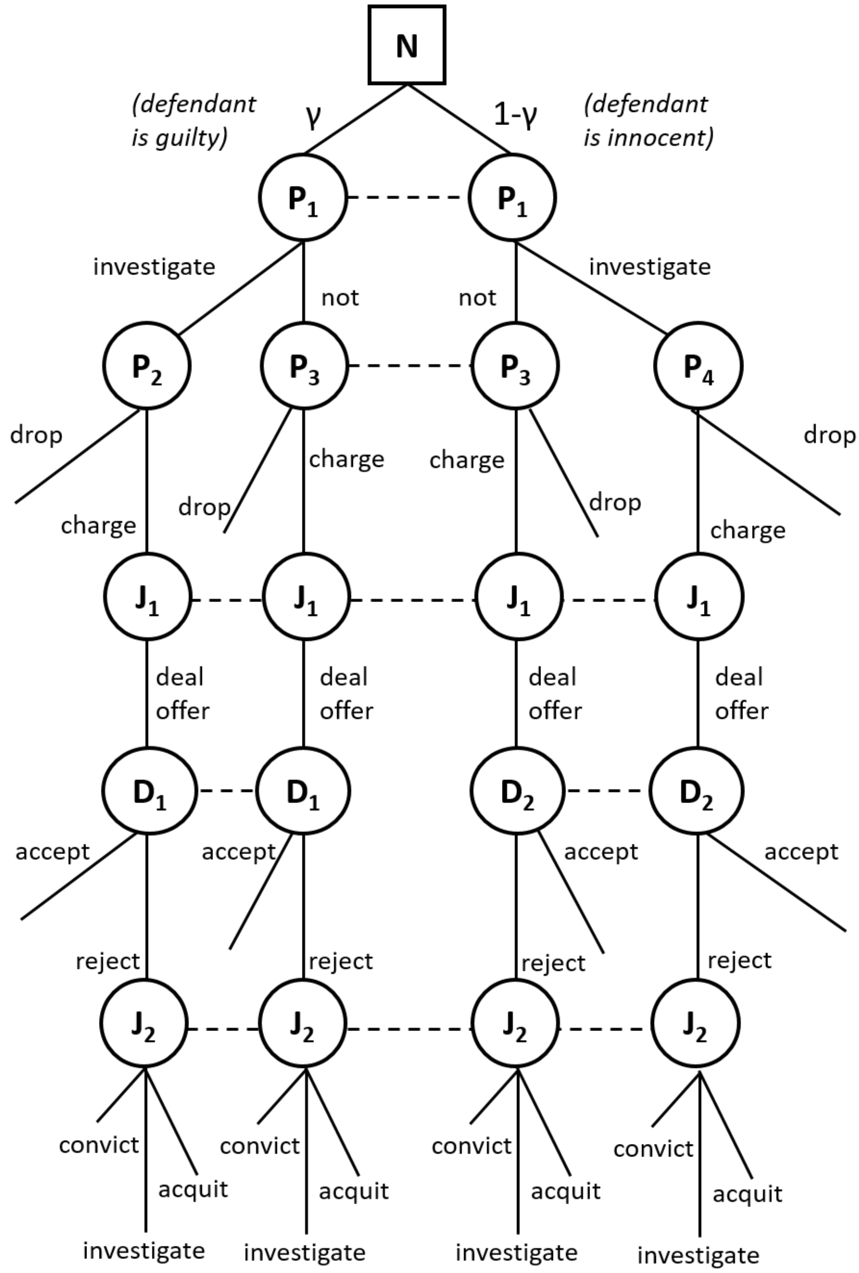

Figure 1. Inquisitorial prosecution game with plea deals.

4. EQUILIBRIA ANALYSIS

4.1. Equilibria in pure strategies

In the following, we study the strategic interaction between the two enforcement agents, judge and prosecutor, and the defendant in inquisitorial criminal procedure when plea bargaining is possible. We develop the strategic form of the game to identify all Nash Equilibria (NE), and then apply the narrower concept of Sequential Equilibrium (SE) to verify whether these equilibria are also plausible given the timing of the game.[10] For the sake of brevity, we use the following notation for the described actions: investigate case (*inv*), not investigate case (*n*), charge defendant (*ch*), drop case (*dr*), convict defendant (*co*), acquit defendant (*ac*), reject deal (*rej*) and accept deal (*acc*).

A Sequential Equilibrium (SE) in this game of asymmetric information consists of the strategy profile $\sigma^* = \{s_P, s_J, s_D\}$, with $s_P \in [(inv);(n,ch);(n,dr)]$, $s_J \in [(\Sigma,inv);(\Sigma,n,co);(\Sigma,n,ac)]$ and $s_D \in [(rej,rej);(rej,acc);(acc,rej);(acc,acc)]$, and the judicial beliefs $\mu_1(g\,|\,ch)$ and $\mu_2(g\,|\,ch \cap rej)$, when the assessment $(\sigma^*, \mu_1^*, \mu_2^*)$ is sequentially rational and consistent for every information set. This implies that each "player´s own strategy is optimal starting from *every* point in the [game] tree" (Kreps and Wilson, 1982, p. 863).

The plea bargaining literature particularly focuses on the self-selection properties of the equilibria. In this game, three pooling equilibria in pure strategies exist where both

[10] In Annex A1, we explain the elimination of dominated strategies. See Annex A2 for the strategic form.

types of defendants apply the same strategy. By the virtue of the SE, these outcomes hold even when the players′ beliefs consider mistakes by the other players that occur with a small probability.[11]

For low values of the prior γ, there exists one SE in pure strategies where the prosecutor drops the case without further investigations. For this equilibrium to hold, the probability of a guilty defendant must be so low that investigating the case is not favorable for the judge. As the ex-ante probability of guilt does not meet the decision standard for a conviction ($\gamma < \frac{\alpha}{1+\alpha}$), any filed case would then only lead to an acquittal.

Proposition 1. *The strategies* $\{(n,dr);(\Sigma>0,n,ac);(rej,rej)\}$ *are (i) a NE which constitutes (ii) a SE if also* $\gamma < \frac{\alpha}{1+\alpha}$, $\gamma < \frac{c_j}{H}$ *and beliefs* $\mu_1 = \gamma$ and $\mu_2 = \gamma$ *apply.*

Proof. See Appendix A3.

For intermediate probabilities of guilt, one SE in pure strategies exists where the Prosecutor investigates the case and charges the guilty defendants, all defendants accept the plea deal and the judge would convict the defendant if trial occurred. This equilibrium builds on the insight that the judge can rely on a high probability of guilty defendants if the case actually reaches court. Clearly, the investigating prosecutor would only charge the guilty defendants. But even if the prosecutor (or the defendant) 'trembles' and deviates from

[11] For the three pooling equilibria, the equilibrium path does not reach all information sets. The widespread concept of Perfect Bayesian Equilibrium, however, imposes little restrictions on rational beliefs about zero-probability events (see Fudenberg and Tirole, 1999, pp. 321). We apply the more refined concept of Sequential Equilibria here to identify credible outcomes.

the optimal strategy with small probability, it is simply less likely that two errors occur simultaneously, i.e. an innocent defendant is actually charged and also rejects the deal by mistake. Thus, the judge can almost with certainty believe in the guilt of the defendant if a case does actually reach court. Consequently, he decides for the conviction. In other words, the posterior belief of the judge satisfies the *'reasonable doubt'*-decision standard due to the investigative effort of the prosecutor ($\mu_2 > \frac{\alpha}{1+\alpha}$). Even though this is technically a pooling equilibrium, note that it implies that all guilty defendants plead guilty and no innocent individual is charged. We will explain in the discussion chapter that this SE is particularly remarkable and implies an increase in efficiency through plea bargaining.

Proposition 2.1. *(i) The strategies* $\{(inv);(\Sigma = F, n, co);(acc, acc)\}$ *constitute a SE if* $\gamma < 1 - \frac{c_P}{\alpha H}$, $\gamma > \frac{c_P}{H}$ *and beliefs* $\mu_1 = 1$ and $\mu_2 = 1$ *apply.*

Proof. See Appendix A4.

Note that an equilibrium where the judge always investigates the case and the prosecutor charges blindly cannot exist here: innocent defendants would almost never accept plea deals if they can expect the judge to examine the case.[12] If the innocent defendants rejected the deal, however, the judge would prefer to acquit the defendant. This would make the guilty defendant reject the deal as well, and then again require

[12] Except trivial deals between zero and the costs of trial. Then, of course, there is no reason why the judge should choose *(inv)*.

investigations by the judge. Plainly, a SE in pure strategies where the judge always investigates the case cannot exist.

For high values of the probability of a guilty defendant γ, one SE in pure strategies exists where the prosecutor charges, both enforcement agents do not investigate the case and all defendants accept the plea bargain. This equilibrium is obtained when the rational prosecutor prefers a 'blind' charge to further investigations and the probability of guilt exceeds the conviction threshold. This combination of strategies is only credible, however, when the high probability of guilt would convince the judge to convict any defendant without examining the evidence, otherwise the innocent defendant would never have accepted the plea bargain in the first place.

Proposition 3. *(i) The strategies* $\{(n,ch);(\Sigma=F,n,co);(acc,acc)\}$ *constitute a SE if also* $\gamma>1-\frac{c_P}{\alpha H}$, $\gamma>\frac{\alpha}{1+\alpha}$, $\gamma>1-\frac{c_J}{\alpha H}$ *and beliefs* $\mu_1=\gamma$ *and* $\mu_2=\gamma$ *apply.*

Proof. See Appendix A5.

4.2. Mixed strategies

In addition to the three pooling equilibria in pure strategies, one equilibria in mixed strategies should be discussed in more detail. There exists a semi-separating equilibria where all three players randomize: some guilty defendants accept the plea deal while the remaining guilty and all innocent defendants reject it, the judge investigates the case with positive probability, and the prosecutor randomizes between investigating the case or a 'blind' charge.

Proposition 4. *P plays* (inv) *with probability* $\phi_P^* = 1 - \frac{(H - c_J)\big(c_P - (1-\gamma)(T+L)\big)}{c_J(1-\gamma)L\big(F - \Sigma + T\big)/F}$ *and* (n, ch) *otherwise, J plays* $(\Sigma > T, inv)$ *with probability* $\phi_J^* = \frac{\Sigma - T}{F}$ *and* $(\Sigma > T, n, ac)$ *otherwise, and D plays* (rej, rej) *with probability* $\phi_G^* = \frac{c_P - (1-\gamma)(T+L)}{\gamma L(F - \Sigma + T)/F}$ *and* (acc, rej) *otherwise, and this applies for* $\gamma > \frac{c_J}{H}$ *and* $1 - \frac{c_P}{T+L} < \gamma < \frac{T + L - c_P}{T + L(\Sigma - T)/F}$. *This strategy combination constitutes a SE with judicial beliefs* $\mu_1(g \mid ch) = \frac{\gamma}{\gamma + (1-\gamma)(1-\phi_P)}$ and $\mu_2 = \frac{c_J}{H}$.

This mixed-strategy equilibrium is instructive to understand the strategic interaction between the three players. For this equilibrium to exist, the two following conditions have to be met. The ex-ante probability γ muss be sufficiently high to justify any judicial effort, $\gamma > \frac{c_J}{H}$. Moreover, the probability γ lies in an intermediate interval: if $1 - \frac{c_P}{T+L} < \gamma$ holds, the prosecutor will charge blindly if the judge examines the case with certainty in court. The more often the judge decides to convict the defendant blindly and reduce his effort in investigations, thus ϕ_J gets lower, the more the upper boundary for the prosecutor´s mixed strategy is relaxed, $\gamma < \frac{T + L - c_P}{T + \phi_J L}$, and this strict preference for blind charges declines. Note that besides *Proposition 2*, no further pooling equilibrium (that is, all defendants either accept or reject the plea offer) can exist in any mixed-strategy combination by the other players.[13] Trivially, also no separating equilibrium can exist where the defendant always reveals his true type.[14]

Concerning the defendant, his bargaining behavior is fully dependent on his expectation about the outcome of trial. Thus, only the judge is in a position to make the (guilty) defendant indifferent between accepting or rejecting the plea bargain. Clearly, it is in the interest of the judge that innocent defendants do never accept the deal offer. Given his three pure strategies (Σ, inv), (Σ, n, co) and (Σ, n, ac), the mixing judge has two options.[15] Randomizing between investigations and a 'blind' conviction can never make the guilty defendant indifferent as we assumed that the deal offer Σ cannot exceed the punishment imposed by law ($\Sigma < F$) and trial costs are positive. Thus, the mixing judge has to randomize between the strategies (Σ, inv) and (Σ, n, ac). Offering a deal Σ with $\Sigma = \phi_J F + T$ would then turn the guilty defendant indifferent between accepting or rejecting the deal, if the judge investigates the case with probability ϕ_J but otherwise acquits the defendant. Clearly, no innocent defendant would accept such a deal as he can expect to be acquitted either way. Solving for ϕ_J yields the mixing strategy for the judge with $\phi_J^* = \frac{\Sigma - T}{F}$, and $\phi_J^* \in (0;1)$ for

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[13] If the defendant played (rej, rej), the judge would optimally respond with (inv). However, it always preferable for him to lower Σ at the earlier stage to make some guilty defendants accept the offer and save trial costs. This cannot be a pooling solution. If the defendant plays (acc,acc), the prosecutor would always play (inv) and the judge (n,co) which is the SE in pure strategies of Proposition 2.

[14] If the defendant played (acc, rej), the judge would optimally respond with (n, acq) with contradicts the behavior of the guilty defendant. If the defendant played (rej, acc), the judge would optimally respond with (n, co) with contradicts the behavior of the guilty defendant. Note that Σ=0 is not preferable for the judge.

[15] Note that a third option, mixing between a blind conviction and a blind charge, is never in the interest of the judge as long as the alternative *(inv)* exists.

$\Sigma > T$ and $\Sigma < T + F$. Evidently, a higher deal offer requires a higher probability of judicial investigations into the case, $\partial \phi_J^* / \partial \Sigma > 0$. As a consequence, a rational judge may thus reduce his own costly effort on the equilibrium path by lowering the plea offer Σ before trial.

Now consider the judge. Both the guilty defendant and the prosecutor can affect his choice between investigations and 'blind' acquittal. Interestingly enough, both players affect the belief of the judge about the probability of a guilty defendant in opposing ways. On the one hand, the more plea deals are accepted by guilty defendants, the lower their share in the cases that are tried in court. On the other hand, the more cases are investigated by the prosecutor, the more charges against the innocent are dropped and the share of guilty defendants in court increases. As we established above that $\Sigma = \phi_J F + T$ must hold for the guilty defendant in equilibrium, the judge can only be made indifferent between his strategies (Σ, inv) and (Σ, n, ac). For the judicial belief μ_2 about the defendant´s guilt in court this requires $\mu_2 = \frac{c_J}{H}$.[16] Let ϕ_P be the probability that the prosecutor herself examines the evidence, and assume ϕ_G describes the probability that the guilty defendant rejects the deal offer. Observing the charge and the rejection of the deal offer by the defendant, the judge updates his beliefs with $\mu = \frac{\phi_G \gamma}{\phi_G \gamma + (1-\gamma)(1-\phi_P)}$. Consequently, the judge is made indifferent by the other two players if $\frac{c_J}{H} = \frac{\phi_G \gamma}{\phi_G \gamma + (1-\gamma)(1-\phi_P)}$ holds. Solved for the mixing

[16] Note that this posterior belief does not contradict the '*reasonable doubt*'-decision standard as the judge mixes between acquittal and investigations, i.e. a possible conviction is still substantiated by further judicial investigations.

strategy of the defendant, we find $\phi_G^* = \frac{c_J(1-\gamma)(1-\phi_P)}{\gamma(H-c_J)}$, with $\phi_G^* \in (0;1)$ for $\phi_P < 1$ and $\gamma > c_J/H$.[17] Not surprisingly, this gives $\partial\phi_G^*/\partial\phi_P < 0$. The guilty defendant has to accept more plea deals when the prosecutor is more likely to investigate the evidence and thereby improve the selection of cases for trial.

Concerning the prosecutor, the guilty defendant and the judge can make her indifferent between investigations and charging without examining the evidence. If the prosecutor investigates the evidence to the case, she incurs effort costs c_P, and moves to costly trial only when the guilty defendants reject the plea deal. Then, if the judge decides to acquit the defendant, this creates a type II error with costs *H*. However, if she decides against investigations and charges all defendants, four outcomes are possible depending on whether the guilty defendant rejects the deal and whether the judge investigates the case himself. These considerations give the following condition to hold in order to make the prosecutor indifferent between her two strategies:

$$\begin{aligned} -c_P - \phi_G\gamma\left(T+(1-\phi_J)H\right) &= \phi_G\phi_J\left(-T-(1-\gamma)L\right)+\phi_G(1-\phi_J)\left(-T-\gamma H-L\right) \\ &\quad +(1-\phi_G)\phi_J\left(-(1-\gamma)(T+L)\right)+(1-\phi_G)(1-\phi_J)\left(-(1-\gamma)(T+L)\right) \end{aligned}$$

Again solved for ϕ_G, this gives $\phi_G^* = \frac{c_P-(1-\gamma)(T+L)}{\gamma(1-\phi_J)L}$ with $\gamma > \frac{T+L-c_P}{T+L}$, $\gamma < \frac{T+L-c_P}{T+\phi_J L}$ and $\phi_J \in (0;1)$. In order for the guilty defendant to play a mixed strategy, the prosecutor must prefer a blind charge to investigation whenever the judge would investigate the case.

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17 Note that this condition also implies that there is no equilibrium in mixed strategies if the prosecutor always investigates the case.

Moreover, the probability of judicial investigations is positive, but lower than one. This is straightforward: if the judge always investigated, the prosecutor would just prefer the blind charge. We find $\partial\phi_G^* / \partial\phi_J > 0$. That is, in order to make the prosecutor indifferent, more deals are rejected by the guilty defendants when the judge is more likely to look into the case. In other words, the guilty defendant has to reject more deals and thereby keep the risk of trial to the prosecutor steady when an increase in judicial investigations otherwise results in less wrongful acquittals of guilty defendants in court.

Equating both expressions for ϕ_G, we determine the optimal mixing strategy for the prosecutor with $\phi_P^* = 1 - \frac{(H - c_J)\left(c_P - (1-\gamma)(T+L)\right)}{c_J(1-\gamma)(1-\phi_J)L}$. As best responses, the judge randomizes optimally between investigations and acquittal with $\phi_J^* = \frac{\Sigma - T}{F}$, the guilty defendant reject the deal with probability $\phi_G^* = \frac{c_P - (1-\gamma)(T+L)}{\gamma L((F - \Sigma + T)/F)}$, and the innocent defendant rejects all deal offer. This concludes the proof to *Proposition 4*.

As the judge has the discretionary power over the offered plea deal Σ in the game, he will make lower offers in order to save own effort costs. In this mixed strategy equilibrium, this behavior shows a favorable implication. Less investigations by the judge make more guilty defendants accept the deal ($\partial\phi_G^* / \partial\phi_J > 0$) and this induces more investigations by the prosecutor ($\partial\phi_G^* / \partial\phi_P < 0$). As we initially assumed that the prosecutorial office has a cost advantage over the judge in running investigations, this shift of effort may be a favorable implication, but at the cost of lower sentences. Thus, a negative impact of plea deals on the deterrence of crime can be concluded at least for the mixed strategy equilibrium.[18]

5. DISCUSSION

5.1 Plea Bargaining eliminates freeriding of the prosecutor

In contrast to adversarial criminal procedure where the judge has a rather passive role, the inquisitorial regime relies on two investigators, judge and prosecutor. Christmann and Kirstein (2020) demonstrated that this setting gives rise to a coordination problem: although both agents are motived to convict only the guilty defendants, each player prefers that the other one bears the effort of investigations. This dilemma resembles the well-known battle-of-the-sexes game where two equilibria coexist, and each agent is the investigator in one of them and the other one freerides. Assuming that the prosecutorial office has a cost advantage over the judge due to its better resources and closer contact to the police force, efficiency would require the prosecutor to be the investigator.

Our analysis shows that allowing for plea bargaining between judge and defendant in the inquisitorial setting eliminates this freeriding dilemma in pure strategies. Simply put, the rational prosecutor can no longer hope that the judge does all the work. Given plea bargaining, an outcome where the prosecutor charges blindly and the judge always

[18] In the literature, greater deterrence is caused by either a higher probability of conviction of criminals or higher expected punishments (see, e.g., Miceli 1996). A negative impact on deterrence is thus straightforward when the bargained sentences are lower. Moreover, lower deterrence could be interpreted as a higher prevalence of crime in our model, i.e. the prior γ increases. For the discussed mixed strategy equilibrium, this would lead c.p. to higher rates of accepted deals by the guilty defendants, but a steady conviction rate in court.

investigates the case is no longer sequentially rational: if the judge examines the evidence, only the guilty defendants would accept the deal while all the innocent move to trial. If only the innocent proceed to trial, however, no investigation is needed. This dilemma makes the threat of investigations by the judge no longer credible.[19] It is due to this credibility problem that the only surviving SE here is the one where the prosecutor runs the investigation (see *Proposition 2*). In other words, the introduction of plea bargaining solves the above discussed coordination problem between the two agents. Under the assumption of lower prosecutorial costs, this shift of effort to the prosecutor is also increasing efficiency. Furthermore, a negative effect on the deterrence of crime is not to be expected, given that the equilibrium deal equals the punishment specified by law. This remarkable result is further strengthened by the resistance of the equilibrium to small decision errors of the players. Applying the more restrictive concept of Selten´s perfectness (see Kreps and Wilson, 1982), we find that the equilibrium strategies will also be chosen if each player considers small probability decision errors ('*trembles*') of the others in the course of the game and if updated beliefs reflect such trembles. The only (minor) restriction is that the ex-ante probability of a guilty defendant must be more than just marginally above the lower threshold for the prosecutor, $\gamma \gg \frac{c_P}{H}$, so that the prosecutor is not very close to being indifferent between investigations or just dropping the case.

[19] This clearly resembles the major finding of Baker and Mezzetti (2001) for an adversarial setting.

Proposition 2.2. *For a given plea deal* $\Sigma = F$ *in the reduced 3x3x4 game, the strategies* $\{(inv);(n,co);(acc,acc)\}$ *and beliefs* $\mu_1 = 1$ and $\mu_2 = 1$ *constitute a (trembling-hand) perfect equilibrium if* $\gamma < 1 - \frac{c_P}{\alpha H}$ *and* $\gamma \gg \frac{c_P}{H}$ *hold.*

Proof. See Appendix A6.

Furthermore, all equilibria that involve convictions adhere to the decision standard of *'reasonable doubt'*. We thus extend the finding of Tsur (2017) to inquisitorial criminal procedure. It is also noteworthy to point out that this positive effect is not driven by the well-known self-selection mechanism of plea bargaining, given that the equilibrium is a pooling one.

From the perspective of society, the introduction of plea bargaining to inquisitorial criminal procedure thus shows some positive effects. *Figure 2* provides an overview over decision and operating costs, and the differences to a setup without plea deals.

Equilibrium	Error Costs (error type)	Operating Costs	Free-Riding	'Beyond Reasonable Doubt'	Gain through deals
(n,dr),(Σ,n,ac),(rej,rej)	γH (type II error)	0	No	No	No
(inv),(Σ,n,co),(acc,acc)	0	c_P	No	Yes	Yes
(n,ch),(Σ,n,co),(acc,acc)	$(1-\gamma)\alpha H$ (type I error)	0	No	Yes	Yes

Figure 2. Error and Operating Costs in Pure Strategy Equilibria.

Trivially, cases with a low ex-ante probability of guilt are never taken to court and therefore plea bargaining does have no impact on efficiency. For intermediate values of the prior, operating costs are lower because cases are solved by plea bargaining and not in court.

In addition, prosecutorial investigations ensure that only the guilty defendants are subject to the (negotiated) sentence. If the probability of guilt is high, again decision errors may occur as both agents choose not to look into the evidence. As plea bargains nevertheless save trial costs at the same level of errors, this is still (slightly) preferable to procedures without plea deals. Note that such low error and operating costs only hold for equilibria in pure strategies.

5.2 No wrongful convictions in the mixed strategy outcome

In addition to the SE in pure strategies, the equilibrium in mixed strategies shows some different, and less favorable, implications. Most importantly, criminal cases may not be investigated at all with positive probability. Furthermore, costly trials occur, and some guilty defendants will be wrongfully acquitted by the judge (type II error). It should be noted, however, that wrongful convictions (type I error) are fully avoided even in the mixed strategy equilibrium. All innocent defendants reject the deal, and even in court they are never convicted.[20]

The absence of type I errors even in the mixed strategy equilibrium stands out in comparison to inquisitorial procedures without plea bargaining (see Christmann and Kirstein 2020). Here the prosecutor randomizes between investigations and blind charges to make the judge indifferent, which strictly increases the posterior belief of the judge about the probability of facing a guilty defendant in court. In the end, the judge becomes

[20] Be reminded that the judge randomizes between 'acquittal' and 'investigate', and investigations reveal the true type of the defendant with certainty.

indifferent between investigating the case or convicting the defendant right away, and the latter strategy produces some wrongful convictions. This is different when plea bargaining is introduced. As a countervailing force to the randomizing prosecutor, some guilty defendants may accept the deal and thus decrease the posterior belief of the judge. Moreover, the guilty defendant can never be made indifferent about accepting or rejecting the deal when the judge randomizes between blind conviction or investigation. In either case, the guilty defendant would get sentenced, and prefers any deal ($\Sigma \leq F$) to save at least the costs of trial. In the plea bargaining setup, the equilibrium posterior belief about the defendant´s guilt is thus lower and the judge is turned indifferent between investigations and a blind acquittal. From this it follows that under the standard assumptions in the literature, such as risk-neutrality and equal beliefs about court outcome (see Kobayashi and Lott 1996, Shavell 1982), the innocent defendant will not be convicted either way. As the guilty defendants are sentenced only after judicial investigations, this again satisfies the '*reasonable doubt*'-decision standard.

One may argue that the result of zero type I errors is based on the assumption that judicial investigations verify the defendant´s true type with certainty. However, type I errors did occur under this strong assumption in the setup without plea bargaining (see Christmann and Kirstein 2020), so our analysis still reveals a systematic change in the production of wrongful convictions once plea bargaining is introduced. In this regard, one may say that the allegedly strong aversion of adversarial legal systems to type I errors (see Adelstein and Miceli 2001) is transferred into inquisitorial procedure. The elimination of wrongful convictions comes at a cost, namely the creation of wrongful acquittals. In the game without plea bargaining, type II errors did not occur in mixed strategies.

5.3 Deal offers upfront increase decision-errors

In most (adversarial) models of plea bargaining, it is the prosecutor who makes the deal offer at the beginning of the game. In the previous analysis, we applied a setup with deals occurring at trial for two reasons: first, many scholars from the inquisitorial tradition reject the idea that deals are made outside courts as this leaves the prosecution of criminals to the discretion of the parties (see, e.g., Landau, 2011, p. 540). Second, Altenhain et al. (2020) report at least for German inquisitorial criminal procedures that deal offers are rarely made by prosecutors.

Generally, our findings are more sensitive to the timing of the deal offer than to which agent proposes the deal offer. Judge and prosecutor largely share the same preferences in our setup, and full trial procedures are not launched for the three SEs in pure strategies.[21] Thus, it has no effect on outcome if we assumed the prosecutor to make the take-it-or-leave-it deal offer at decision node J_1. If we, however, assumed that the plea offer is made by the prosecutor at the beginning of the game, so before node P_1, then part of the outcome changes. *Proposition 1* stills holds, as the defendants anticipate that, upon a rejected deal, the prosecutor would drop the case due to its unlikely merit. Moreover, *Proposition 3* is also valid as the high ex-ante probability of a guilty defendant makes it

[21] The only difference in preferences between the two agents is the prosecutor´s aversion to losing in court.

sequentially rational to conclude the case with a 'blind' conviction. Then, all defendants accept the deal. Surprisingly, *Proposition 2* no longer holds.

Corollary 1. *If the prosecutor offers the plea deal before decision node* P_1 *(and instead of* J_1*), then a pooling equilibrium where both types of defendants accept a deal with* $\Sigma > T$ *cannot exist for* $\frac{c_P}{H} < \gamma < 1 - \frac{c_P}{\alpha H}$.

To see this, note that a pooling solution where all defendants accept the deal, i.e. *(acc,acc)* is played, would require that no investigations occur and that the judge chooses blind convictions on the equilibrium path. If at least one agent can be expected to investigate the evidence upon a rejected deal, then the innocent defendants would deviate and never accept the bargain. If a deal offer of a case in this range of $\frac{c_P}{H} < \gamma < 1 - \frac{c_P}{\alpha H}$ were rejected, the prosecutor (or the judge) will prefer to investigate the case. This effectively rules out *Proposition 2*. Be reminded that, in the original setting, only the guilty defendants were brought to court for the plea bargain as prosecutorial investigations had occurred beforehand. Also, if both types of defendants rejected the deal and one enforcement agent shows no effort, investigating the case would always be a best response for the other agent. Thus, the equilibrium cannot be pooling. More precisely, neither a pooling nor a separating equilibrium[22] can exist in the amended setting for the aforementioned values of the ex-ante probability.

[22] In line with the literature, it is not surprising that perfect separation cannot be obtained, as this would eliminate the need for judge and prosecutor to investigate the case.

We conclude that shifting the plea bargaining phase to the beginning of this inquisitorial setup shows a negative impact for intermediate values of the prior. More precisely, it rules out the one SE where investigations are certan and the evidence is always examined at lowest costs.[23] What remains then is the well-known semiseparating equilibrium in mixed strategies (see Baker and Mezzetti 2001), and its higher error and operating costs. Given our inquisitorial setting with two benevolent enforcers, allowing plea bargaining in courtroom and after the prosecutor´s decision to charge helps to overcome the established commitment problem of the prosecutor, and induces more prosecutorial effort into the case.

6. CONCLUDING REMARKS

Applying a sequential prosecution game with two benevolent investigators, the prosecutor and the judge, and a defendant of unknown guilt, we find the following general pattern. For a low ex-ante probability of guilt, the case is dropped by the prosecutor. For intermediate values of the prior, the prosecutor will always investigate the case, she charges only the guilty individuals and plea deals are accepted. If the ex-ante probability of a guilty defendant is high, the defendant faces a conviction without further investigations and will always accept a plea deal. All equilibria that involve a conviction adhere to the '*reasonable*

[23] In this intermediate interval of the prior, neither a pooling equilibrium nor a separating equilibrium can exist: if one enforcement agent examines the case, the defendants separate. If the defendants separate, then the enforcement agents exert no effort.

doubt'-decision standard. Comparing these findings to procedures without plea bargaining, some more remarks are in order.

First, the prosecutor can no longer hope to freeride on the certain investigative effort of the judge for intermediate ex-ante probabilities of a guilty defendant. Given no investigations by the prosecutor, the strategy by the judge to examine the case himself is no longer a best response when plea deals are allowed: if the judge investigated the case, only the innocent defendants would reject a deal, and then investigations would be pointless. As a consequence, the prosecutor will exert effort in the first place and thus only select the guilty defendants for trial. If we assume that effort costs are lower for the prosecutorial office, this is an efficient outcome. As the judge firmly believes in the guilt of these defendants, the offered plea deals do not require a sentencing discount which might degrade deterrence. Moreover, this sequential equilibrium is robust even to small decision errors ('trembles') by the other players.

Second, offering a plea bargain to the defendant at trial, i.e. after the case was taken to court by the prosecutor, avoids the traditional commitment problem in the literature. If the deal offer was extended (and potentially accepted) by the defendant before the case is brought to court, all equilibria could only be semiseparating in nature. This follows the rationale that any perfect separation would prevent the prosecutor from taking the remaining cases to court in such a setup, and then guilty individuals will try to mimic the innocent ones by rejecting the deal. The established practice of some countries in continental Europe, like Germany and Italy, to allow deals only in courtroom and after the prosecutor´s decision is sunk thus avoids this commitment problem and the associated error and operating costs.

Third, the introduction of plea bargaining leads to a significant reduction in wrongful convictions (type I errors). To see this, we focus on the mixed strategy equilibrium for the intermediate values of the prior. Even when all players randomize between their strategies, only wrongful acquittals (type II errors) can occur in equilibrium. As some deals are now accepted by the guilty defendants, the judge will then be turned indifferent between investigating the case or acquitting the defendant. Neither strategy involves a type I court error. In this regard one can say that plea bargaining transfers the preference of adversarial systems to avoid wrongful convictions to inquisitorial procedures. This comes at the costs of more wrongful acquittals. This mixed strategy equilibrium also shows that judges who offer larger sentencing discounts to defendants thereby effectively shift the investigation effort to the prosecutor.

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9. ANNEX

A1 Elimination of redundancies and dominated strategies

The strategic form of the prosecution game is specified by the three players, the set of strategy combinations, and the set of payoffs that the players attach to each strategy combination. This gives a 16x3x4 tri-matrix at first, but this can be further simplified:

First we discuss the strategies of P which contain "not" to investigate as their first entry:

- If P decides, after having not examined the case at P_1, to drop the case (at P_3), then the expected payoffs of both parties amount to $-\gamma H$ each, regardless of what P plans to do at her other two decision nodes, and also regardless of J's plan or D´s reaction. Hence, these four strategies of the type (not, x, drop, y), where x and y are either drop or charge, can be summarized without loss of information to one strategy pattern which we label "not, drop (*n, dr*)."

- A similar line of argument covers the four strategies in which P plans to hand over the case to J without having it examined initially, i.e., when P chooses not to investigate at P_1, and charge at P_3. Regardless of what P plans for her other information sets, four rows in each if the four 16x3 matrices show identical entries. Hence, we combine these four strategies of P without loss of information into one, labeled "not, charge, (*n, ch*)."

Finally, we discuss the eight strategies of P that stipulate an investigation at P_1. After P has investigated the case, the parties' payoffs do not depend anymore on what P would have planned to choose at her information set P_3 (the one that is reached after not investigating the case). Hence, P has only four relevant types of strategies, depending on the decisions made at P_2 and P_4. The payoffs of those four types of investigation strategies depend on the decision of the judge, and are displayed in the tables below for the given strategy of D. The letter x represents the possible decisions at P_3. To show which investigative strategies are dominated, we added the non-investigative strategy type (n, dr) where P does not investigate and always drops the case.

D plays (rej, rej)	J investigates	J convicts	J acquits
(inv, ch, x, ch)	$-c_P-T-(1-\gamma)L$	$-c_P-T-(1-\gamma)\alpha H$	$-c_P-T-L-\gamma H$
(inv, ch, x, dr) = "(inv)"	$-c_P-\gamma T$	$-c_P-\gamma T$	$-c_P-\gamma T-\gamma L-\gamma H$
(inv, dr, x, ch)	$-c_P-\gamma H-(1-\gamma)(L+T)$	$-c_P-\gamma H-(1-\gamma)(\alpha H+T)$	$-c_P-\gamma H-(1-\gamma)(L+T)$
(inv, dr, x, dr)	$-c_P-\gamma H$	$-c_P-\gamma H$	$-c_P-\gamma H$
"(n, dr)"	$(-\gamma H)$	$(-\gamma H)$	$-\gamma H$

D plays (acc, acc)	J investigates	J convicts	J acquits
(inv, ch, x, ch)	$-c_P-(1-\gamma)\alpha H$		
(inv, ch, x, dr) = "(inv)"	$-c_P$		
(inv, dr, x, ch)	$-c_P-\gamma H-(1-\gamma)\alpha H$		
(inv, dr, x, dr)	$-c_P-\gamma H$		

D plays (acc, rej)	J investigates	J convicts	J acquits
(inv, ch, x, ch)	$-c_P-(1-\gamma)(T+L)$	$-c_P-(1-\gamma)(T+\alpha H)$	$-c_P-(1-\gamma)(T+L)$
(inv, ch, x, dr) = "(inv)"	$-c_P$		
(inv, dr, x, ch)	$-c_P-\gamma H-(1-\gamma)(L+T)$	$-c_P-\gamma H-(1-\gamma)(\alpha H+T)$	$-c_P-\gamma H-(1-\gamma)(T+L)$
(inv, dr, x, dr)	$-c_P-\gamma H$		

D plays (rej, acc)	J investigates	J convicts	J acquits
(inv, ch, x, ch)	$-c_P-\gamma T-(1-\gamma)\alpha H$	$-c_P-\gamma T-(1-\gamma)\alpha H$	$-c_P-\gamma(T+H+L)$

			$-(1-\gamma)\alpha H$
(inv, ch, x, dr) = "(inv)"	$-c_P-\gamma T$	$-c_P-\gamma T$	$-c_P-\gamma(H+T+L)$
(inv, dr, x, ch)	$-c_P-\gamma H-(1-\gamma)\alpha H$	$-c_P-\gamma H-(1-\gamma)\alpha H$	$-c_P-\gamma H-(1-\gamma)\alpha H$
(inv, dr, x, dr)	$-c_P-\gamma H$		
"(n, dr)"	$-\gamma H$	$-\gamma H$	$-\gamma H$

Figure A1. Elimination of dominated strategies.

Remember that T < H applies. The grey shaded cells identify the best strategy of P for a given decision by J and D. This clearly shows that the six strategies of the types (inv, ch, x, ch), (inv, dr, x, ch) and (inv, dr, x, dr) are never optimal for P and thus are always dominated by one of the other strategies: either by (inv, ch, x, dr) if the judge investigates himself or charges blindly, or simply by the non-investigative strategies of type (n, dr). For the purpose of finding Nash equilibria in pure strategies, we can eliminate dominated strategies, since they will never be best responses. We thus only keep the strategies (inv, ch, x, dr), which for the sake of brevity we label as "investigate (inv)" from here.

Thus, the strategic form can be reduced to a 3x3x4 tri-matrix for a given plea deal Σ, indicating the payoffs of the players.

A2 Reduced strategic form of the game

For each cell, the first row describes the payoff of the judge, the second row the defendant´s payoff and the third row the payoff of the prosecutor.

D plays (rej, rej)		Judge		
		investigate ***inv***	not, convict ***n, co***	not, acquit ***n, ac***
Prosecutor	Investigate ***inv***	$-\gamma T-\gamma c_J$ $-\gamma(F+T)$ $-\gamma T-c_P$	$-\gamma T$ $-\gamma(F+T)$ $-\gamma T-c_P$	$-\gamma(H+T)$ $-\gamma T$ $-\gamma(H+T)-c_P$
	not, charge ***n, ch***	$-T-c_J$ $-\gamma F-T$ $-T-(1-\gamma)L$	$-T-(1-\gamma)\alpha H$ $-F-T$ $-T-(1-\gamma)\alpha H$	$-T-\gamma H$ $-T$ $-T-\gamma H-L$
	not, drop ***n, dr***	$-\gamma H$ 0 $-\gamma H$	$-\gamma H$ 0 $-\gamma H$	$-\gamma H$ 0 $-\gamma H$

D plays (acc, acc)		Judge		
		investigate ***inv***	not, convict ***n, co***	not, acquit ***n, ac***
Prosecutor	Investigate ***inv***	0 $-\gamma\Sigma$ $-c_P$	0 $-\gamma\Sigma$ $-c_P$	0 $-\gamma\Sigma$ $-c_P$
	not, charge ***n, ch***	$-(1-\gamma)\alpha H$ $-\Sigma$ $-(1-\gamma)\alpha H$	$-(1-\gamma)\alpha H$ $-\Sigma$ $-(1-\gamma)\alpha H$	$-(1-\gamma)\alpha H$ $-\Sigma$ $-(1-\gamma)\alpha H$
	not, drop ***n, dr***	$-\gamma H$ 0 $-\gamma H$	$-\gamma H$ 0 $-\gamma H$	$-\gamma H$ 0 $-\gamma H$

D plays (acc, rej)		Judge		
		investigate ***inv***	not, convict ***n, co***	not, acquit ***n, ac***
Prosecutor	Investigate ***inv***	0 $-\gamma\Sigma$ $-c_P$	0 $-\gamma\Sigma$ $-c_P$	0 $-\gamma\Sigma$ $-c_P$
	not, charge ***n, ch***	$-(1-\gamma)(T+c_J)$ $-\gamma\Sigma-(1-\gamma)T$ $-(1-\gamma)(T+L)$	$-(1-\gamma)(T+\alpha H)$ $-\gamma\Sigma-(1-\gamma)(T+F)$ $-(1-\gamma)(T+\alpha H)$	$-(1-\gamma)T$ $-\gamma\Sigma-(1-\gamma)T$ $-(1-\gamma)(T+L)$
	not, drop ***n, dr***	$-\gamma H$ 0 $-\gamma H$	$-\gamma H$ 0 $-\gamma H$	$-\gamma H$ 0 $-\gamma H$

D plays (rej, acc)		Judge		
		investigate ***inv***	not, convict ***n, co***	not, acquit ***n, ac***
Prosecutor	Investigate ***inv***	$-\gamma(T+c_J)$ $-\gamma(F+T)$ $-c_P-\gamma T$	$-\gamma T$ $-\gamma(F+T)$ $-c_P-\gamma T$	$-\gamma(T+H)$ $-\gamma T$ $-c_P-\gamma(T+H+L)$
	not, charge ***n, ch***	$-\gamma(T+c_P)-(1-\gamma)\alpha H$ $-\gamma(F+T)-(1-\gamma)\Sigma$ $-\gamma T-(1-\gamma)\alpha H$	$-\gamma T-(1-\gamma)\alpha H$ $-\gamma(F+T)-(1-\gamma)\Sigma$ $-\gamma T-(1-\gamma)\alpha H$	$-\gamma(T+H)-(1-\gamma)\alpha H$ $-\gamma T-(1-\gamma)\Sigma$ $-\gamma(H+T+L)-(1-\gamma)\alpha H$
	not, drop ***n, dr***	$-\gamma H$ 0 $-\gamma H$	$-\gamma H$ 0 $-\gamma H$	$-\gamma H$ 0 $-\gamma H$

Figure A2. Strategic form of the game.

A3 Proof of Proposition 1.

(i) If a deal is always rejected and the Judge acquits the defendant, the prosecutor´s best response is to save effort and drop the case in the first place. If the prosecutor drops the case, all choices of the judge and the defendants are best responses, given that the case never reaches court. (ii) For (n, ac) being a best response of the judge in the subgame where P charges the defendant, given the beliefs μ_2, J must prefer acquittal to conviction which requires $-(1-\mu_2)\alpha H - T > -\mu_2 H - T \Leftrightarrow \mu_2 < \frac{\alpha}{1+\alpha}$ and J does not investigate the case $-c_J - T < -\mu_2 H - T \Leftrightarrow \mu_2 < \frac{c_J}{H}$. This belief is consistent in the tradition of KREPS and WILSON (1982): Given that the players 'tremble' in their strategies with a small probability ε, implying that at each information set, the equilibrium strategy by the player is actually played with probability $1-\varepsilon$, and the other strategy with probability ε. This yields the belief $\mu_2(g \mid ch \cap rej) = \frac{\gamma\varepsilon(1-\varepsilon)}{\gamma\varepsilon(1-\varepsilon)+(1-\gamma)\varepsilon(1-\varepsilon)} = \gamma$. The same rationale yields $\mu_1(g \mid ch) = \frac{\gamma\varepsilon}{\gamma\varepsilon + (1-\gamma)\varepsilon} = \gamma$. The belief is thus consistent with the strategies if $\gamma < \frac{\alpha}{1+\alpha}$ and $\gamma < \frac{c_J}{H}$. Consequently, (rej, rej) is optimal for the defendants due to T < Σ. ■

A4 Proof of Proposition 2.1.

For P to choose (inv), investigations are preferable to a blind charge, $-(1-\gamma)\alpha H < -c_P \Leftrightarrow 1 - \frac{c_P}{\alpha H} > \gamma$, and also to dropping the case, $-c_p > -\gamma H \Leftrightarrow \gamma > \frac{c_P}{H}$. Clearly, this justifies $\mu_1 = 1$. For the judge to choose (n,co) over the two alternatives, if his information set is reached, this requires a belief μ_2 which satisfies $\mu_2(g \mid ch \cap rej) > 1 - \frac{c_J}{\alpha H}$ and $\mu_2(g \mid ch \cap rej) > \frac{\alpha}{\alpha+1}$. This belief is consistent: Given that the players 'tremble' in their strategies with a small probability ε, implying that at each information set, the equilibrium strategy by the player is actually played with probability $1-\varepsilon$, and the other strategy with probability ε. This yields the belief $\mu_2\left(g \mid ch \cap rej\right) = \frac{\gamma(1-\varepsilon)\varepsilon}{\gamma(1-\varepsilon)\varepsilon + (1-\gamma)(2\varepsilon^2)}$, which is consistent in the limit $\frac{\gamma(1-\varepsilon)}{\gamma(1-\varepsilon)+2\varepsilon(1-\gamma)} \xrightarrow[\varepsilon \to 0]{} 1$. Note that the belief also meets the above established two requirements if ε is positive, but sufficiently small. Given (n, co), the defendants will always accept the deal. ■

A5 Proof of Proposition 3.

(i) The strategies $\{(n,ch);(\Sigma = F, n, co);(acc,acc)\}$ *constitute a SE if also* $\gamma > 1 - \frac{c_P}{\alpha H}$, $\gamma > \frac{\alpha}{1+\alpha}$, $\gamma > 1 - \frac{c_J}{\alpha H}$ *and beliefs* $\mu_1 = \gamma$ *and* $\mu_2 = \gamma$ *apply.*

For P to choose (n,ch) as best response to (n, co) and (acc, acc), (i) the blind charge must be preferable to investigations $-(1-\gamma)\alpha H > -c_P \Leftrightarrow 1 - \frac{c_P}{\alpha H} < \gamma$ and (ii) the blind charge must be preferable to dropping the case altogether $-(1-\gamma)\alpha H > -\gamma H \Leftrightarrow \frac{\alpha}{1+\alpha} < \gamma$. Thus, belief $\mu_1 = \gamma$ is justified for the judge. Given (n, ch) and (acc, acc), J is indifferent between his three strategies, so strategy (n, co) is as good as his other options. Given (n, ch) and (n, co), D always prefers to accept the plea deal. For this Nash equilibrium to be sequentially rational, J must prefer a 'blind' conviction to investigations when his information set is reached, which requires $\mu_2\left(g \mid ch \cap rej\right) > 1 - \frac{c_J}{\alpha H}$. This belief is consistent: Given that the players 'tremble' in their strategies with a small probability ε, implying that at each information set, the equilibrium strategy by the player is actually played with probability $1-\varepsilon$, and the other strategy with probability ε. This yields the belief $\mu_2\left(g \mid ch \cap rej\right) = \frac{\gamma(1-\varepsilon)\varepsilon}{\gamma(1-\varepsilon)\varepsilon + (1-\gamma)(1-\varepsilon)\varepsilon} = \gamma$. We thus require $\gamma > 1 - \frac{c_J}{\alpha H}$.■

A6 Proof of Proposition 2.2.

A trembling-hand perfect (TH-perfect) equilibrium requires, in addition to the SE, the elimination of weakly dominated strategies, i.e. each equilibrium strategy of the players must be robust to minor errors by the other players (see Kreps and Wilson 1982, p. 864). We restrict our analysis to the reduced normal form game, given Σ and assume that each player expects the other player´s to choose the equilibrium strategy with probability $(1-\varepsilon)$ and the remaining n non-equilibrium strategies with probability (ε/n). The error probability ε is positive, but small. First, we illustrate this application with the judge who chooses the strategy (n, co). His expected payoff $\pi_J(n,co)$ then is

$$\pi_J(n,co) = (1-\varepsilon)\left[-\frac{\varepsilon}{3}\gamma T - \frac{\varepsilon}{3}\gamma T\right]$$
$$+\frac{\varepsilon}{2}\left[-(1-\varepsilon)(1-\gamma)\alpha H - \frac{\varepsilon}{3}(T+(1-\gamma)\alpha H - \frac{\varepsilon}{3}(1-\gamma)(T+\alpha H) - \frac{\varepsilon}{3}(\gamma T+(1-\gamma)\alpha H\right] + \frac{\varepsilon}{2}[-\gamma H],$$

which simplifies to $\pi_J(n,co) = -(1-\varepsilon)\frac{2}{3}\varepsilon\gamma T - \frac{\varepsilon}{2}\left[(1-\gamma)\alpha H + \frac{2}{3}\varepsilon T + \gamma H\right]$. For (inv), he expects $\pi_J(inv) = -(1-\varepsilon)\frac{2}{3}\varepsilon\gamma(T+c_J) - \frac{\varepsilon}{2}\left[(1-\frac{2}{3}\varepsilon)(1-\gamma)\alpha H + \frac{2}{3}\varepsilon(T+c_J) + \gamma H\right]$. For (n,ac), he then expects $\pi_J(n,ac) = -(1-\varepsilon)\frac{2}{3}\varepsilon\gamma(H+T) - \frac{\varepsilon}{2}\left[(1-\frac{2}{3}\varepsilon)(1-\gamma)\alpha H + \frac{2}{3}\varepsilon(T+\gamma H) + \gamma H\right]$.

We find that $\pi_J(n,co) > \pi_J(inv)$ if $\varepsilon < \frac{2\gamma c_J}{(1-\gamma)\alpha H + c_J(2\gamma-1)} > 0$ and that $\pi_J(n,co) > \pi_J(n,ac)$ if $\varepsilon < \frac{2\gamma H}{(1-\gamma)\alpha H + \gamma H} > 0$, which means that (n,co) is a TH-perfect strategy for the judge. The prosecutor chooses (inv) and expects the payoff $\pi_P(inv)$ with

$\pi_P(inv) = -c_P - \frac{2}{3}\varepsilon\gamma T - \frac{\varepsilon^2}{3}\gamma H - \frac{\varepsilon^2}{6}\gamma L$. If she chooses (n,ch), she expects

$\pi_P(n,ch) = -\left(1-\frac{2}{3}\varepsilon^2\right)(1-\gamma)\alpha H - \frac{2}{3}\varepsilon T - \frac{\varepsilon^2}{3}\left(\gamma H + (2-\gamma)L\right)$. For (n,dr), she expects $\pi_P(n,dr) = -\gamma H$. We find $\pi_P(inv) > \pi_P(n,dr)$ for $\gamma > \frac{c_P}{H\left(1-\frac{\varepsilon^2}{3}\right) - \frac{2}{3}\varepsilon T - \frac{\varepsilon^2}{6}L}$, and thus conclude that $\gamma \gg \frac{c_P}{H}$ must apply. Moreover, we find for $\pi_P(inv) > \pi_P(n,ch)$ the condition

$\gamma < \dfrac{\alpha H - c_P + \frac{2}{3}\varepsilon(T+\varepsilon L)}{\alpha H\left(1-\frac{2}{3}\varepsilon^2\right)+\varepsilon\left(\frac{2}{3}T+\frac{1}{2}\varepsilon L\right)}$. Compared to the threshold $\gamma < \dfrac{\alpha H - c_P}{\alpha H}$, the positive change in the numerator exceeds the change in the denominator for a given ε, thus the threshold becomes more relaxed. We conclude that (inv) is a TH-perfect strategy for the prosecutor for $\gamma \gg \dfrac{c_P}{H}$. For the defendant, the strategy (acc,acc) yields a payoff of

$\pi_D(acc,acc) = -(1-\varepsilon)\gamma\Sigma - \frac{\varepsilon}{2}\Sigma$. For (rej,rej) the payoff gives $\pi_D(rej,rej) = -(1-\varepsilon)\left[\left(1-\frac{1}{2}\varepsilon\right)\gamma F + \gamma T\right] - \frac{\varepsilon}{2}\left[T + (1-\varepsilon)F + \frac{\varepsilon}{2}\gamma F\right]$. Choosing (acc,rej) gives

$\pi_D(acc,rej) = -\left(1-\frac{\varepsilon}{2}\right)\gamma\Sigma - \frac{\varepsilon}{2}\left[(1-\gamma)T + (1-\varepsilon)(1-\gamma)F\right]$, and the strategy (rej,acc) yields

$\pi_D(rej,acc) = -\left(1-\frac{\varepsilon}{2}\right)\left[\gamma T + \left(1-\frac{\varepsilon}{2}\right)\gamma F\right] - \frac{\varepsilon}{2}(1-\gamma)\Sigma$. We find that $\pi_D(acc,acc) >$ $\pi_D(rej,rej)$ as the condition $(1-\varepsilon)\left[\left(1-\frac{1}{2}\varepsilon\right)F + T - \Sigma\right] > \frac{\varepsilon}{2}\left[\frac{\varepsilon}{2}\Sigma - T - (1-\varepsilon)F - \frac{\varepsilon}{2}\gamma F\right]$ always hold for F≥Σ, T>0 and small ε. Moreover, $\pi_D(acc,acc) > \pi_D(acc,rej)$ applies for $1 - \frac{\Sigma - T}{F} > \varepsilon$. Lastly, we find that $\pi_D(acc,acc) > \pi_D(rej,acc)$ as $\Sigma < T + \left(1-\frac{\varepsilon}{2}\right)F$ holds for T>0 and small ε. Thus, (acc,acc) is also a TH-perfect strategy. Given that the beliefs are consistent for small ε (see proof in A4) and all equilibrium strategies are TH-perfect, this combination of strategies and beliefs is a TH-perfect equilibrium.