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Search, Seizure and (False?) Arrest: An Analysis of Fourth Amendment Remedies when Police can Plant Evidence

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Abstract

The Fourth Amendment prohibits unreasonable searches and seizures in criminal investigations. The Supreme Court has interpreted this to require that police obtain a warrant prior to search and that illegally seized evidence be excluded from trial. A consensus has developed in the law and economics literature that tort liability for police officers is a superior means of deterring unreasonable searches. We argue that this conclusion depends on the assumption of truth-seeking police, and develop a game-theoretic model to compare the two remedies when some police officers (the bad type) are willing to plant evidence in order to obtain convictions, even though other police (the good type) are not (where this type is private information). We characterize the perfect Bayesian equilibria of the asymmetric-information game between the police and a court that seeks to minimize error costs in deciding whether to convict or acquit suspects. In this framework, we show that the exclusionary rule with a warrant requirement leads to superior outcomes (relative to tort liability) in terms of truth-finding function of courts, because the warrant requirement can reduce the scope for bad types of police to plant evidence.

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1) Introduction

The prosecution of criminal defendants is a process fraught with uncertainty, and requires a delicate balance between the search for the truth, and the protection of citizens' right to be free from unreasonable invasions of their privacy. An important legal safeguard in this context is the Fourth Amendment to the U.S. Constitution, which provides that "The right of the people to be secure in their persons, houses, papers, and effects, against unreasonable searches and seizures, shall not be violated, and no warrants shall issue, but upon probable cause…" (U.S. Const., Amendment IV). The Supreme Court has interpreted this amendment to require that police, when feasible, obtain a warrant prior to search, which a judge will only issue on a finding of probable cause (the "warrant requirement"), and further, that any illegally obtained evidence will be excluded from trial (the "exclusionary rule").[1]

Scholars have vigorously debated the desirability of these remedies for violations of the Fourth Amendment. A major focus of the debate has been on the relative merits of the warrant requirement and exclusionary rule on the one hand, and a reasonableness standard enforced by tort liability for the government or its agents on the other. Amar (1997, Chapter 1), for example, argues that the plain language of the Fourth Amendment does not *require* warrants, probable cause, or exclusion of evidence, but only that searches and seizures be *reasonable*. Further, the courts, in recognizing the impracticality of the warrant requirement in many contexts, have historically granted many exceptions to it (for example, use of metal detectors in airports). Finally, Amar claims on historical grounds that the Framers themselves envisioned tort liability (in the form of a civil action for trespass) rather than exclusion as the principal remedy for unlawful seizures of evidence.

Posner (1981) has also argued for replacement of the exclusionary rule with tort liability, based however on economic rather than textual or historical considerations. As noted above, the primary objective of rules against unreasonable search is to balance citizens' right to privacy against the goal of truth-seeking in criminal proceedings. Given this trade-off, economic efficiency requires that searches should be allowed up to the point where the expected probative value of the evidence being sought equals the harm to the victim of the search.[2] Under such a

[1] See, for example, *Weeks v. United States*, 232 U.S. 383n (1914); and *Mapp v. Ohio*, 367 U.S. 643 (1961), which extended these provisions to the states.

[2] Formally, if B is the harm to the victim in terms of impaired privacy, p is the probability that evidence will be discovered that is decisive for conviction, and L is the social loss of not convicting the defendant, then a search is

standard, claims of an unlawful search would involve an *ex post* judicial determination of whether this condition was met at the time the search was conducted, in the same way that negligence is determined after the occurrence of an accident, with liability being assessed if it was not.

According to this logic, the threat of tort liability forces the police to internalize the social costs and benefits of conducting a search. Some errors in their calculations will no doubt occur (just as some injurers are found negligent), but as long as they are acting in good faith (a point we expand on below), liability provides the correct incentives.[3] Exclusion of evidence does not offer any further protection of privacy rights but only serves the interests of guilty defendants, which, it is claimed, are not meant to be protected by the Fourth Amendment (Posner, 1981; Amar, 1997). Moreover, it is argued that the exclusionary rule coupled with the warrant requirement will likely deter too many searches.[4]

These arguments for the superiority of tort liability over the exclusionary rule, however, implicitly assume that police act in an essentially public-spirited manner. That is, police seek to uncover the truth in their role as evidence gatherers. At worst, they place too small a weight on the costs imposed on innocent suspects who are searched, and this overzealousness may result in Fourth Amendment violations. However, tort liability will induce them to internalize these social costs. Unfortunately, as suggested by a number of recent police scandals in major US cities, the motivations of police may not always be quite so benign.[5] In particular, when police seek to maximize the number of convictions they obtain, there may be some officers who have an incentive and opportunity to plant evidence on innocent suspects in an effort to frame them. Even

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justified on economic grounds (and hence is reasonable) if $B < pL$ (see Posner (1998, pp. 748-750), and *U.S. v. Carroll Towing*, 159 F.2d 169 (2d Cir. 1947), which established the so-called Hand test for negligence). For a more general economic analysis of the law of evidence, see Posner (1999).

[3] Of course, there are many practical problems with a system of tort liability. There may, for instance, be agency problems if individual officers are immune from liability. However, this could be corrected by subjecting officers to dismissal, loss of pay, or criminal sanctions for violations. Another problem is the difficulty in measuring the damages from an illegal search (Stuntz, 1991).

[4] To see why, note that if probable cause is interpreted to mean "more likely than not," then a search warrant will only be issued if $p>.5$, whereas the reasonableness standard would allow searches if $p>B/L$. Probable cause will therefore result in overdeterrence whenever $B/L<p<.5$, which will be true when the intrusion (B) is small but the value of the evidence (L) is large, a fairly common circumstance.

[5] These include the "Sheetrock" scandal in Dallas (e.g. P. Duggan, "'Sheetrock' Scandal Hits Dallas Police: Cases Dropped, Officers Probed after Cocaine 'Evidence' Turns out to be Fake" *Washington Post*, Jan. 18, 2002) and the "Ramparts" scandal in Los Angeles (e.g. M. Lait and S. Glover, "2 Ex-Officers Accused of Evidence Planting" *Los Angeles Times*, Oct. 21, 2000).

if this practice is rare, it can seriously compromise the ability of courts to distinguish the innocent from the guilty.

This paper analyzes Fourth Amendment remedies - comparing tort liability and the exclusionary rule – in circumstances where a subset of police officers are willing to plant evidence. We argue that a system based on tort liability is unlikely to deter such police misbehavior (as opposed to good faith errors). This is because, while the purported search that uncovered the "evidence" was presumably unreasonable before the fact (because the suspect is, after all, truly innocent), as a practical matter courts will generally not be able to distinguish planted from legitimate evidence after the fact. On the other hand, the exclusionary rule (and in particular, the warrant requirement) requires police to present some evidence of guilt to a presumably impartial judge *prio*r to conducting the search.[6] While this does not eliminate the possibility that evidence will be planted, it greatly reduces the threat of false convictions because the police will only be able to search a small subset of suspects whose probability of guilt surpasses the threshold required for the issue of a warrant.[7] In this way, the exclusionary rule enhances the ability of courts to convict the guilty and acquit the innocent while protecting the privacy rights of citizens.

The major contribution of this paper is thus to identify and analyze a set of circumstances in which the exclusionary rule (and in particular, the warrant requirement) leads to superior outcomes compared to a system that relies solely on tort liability as a remedy for Fourth Amendment violations. This result is important, firstly, because it challenges the consensus among law–and–economics scholars, and increasingly among scholars of constitutional criminal procedure, in favor of tort liability (Posner, 1981; Amar, 1997). Secondly, it provides a possible explanation of a long-standing puzzle in the economic approach to the law of evidence. Despite the apparently greater efficiency of tort liability (as claimed in the literature discussed above), the warrant requirement and exclusionary rule are well-established features of criminal procedure. Established for Federal criminal proceedings in 1914 (*Weeks*), the exclusionary rule remedy had been adopted by about half of US states by 1961, when it was made mandatory by

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[6] Of course, this assumes that judges are more trustworthy than police officers, a point emphasized by Stuntz (1991). Also, it is not crucial to this argument whether warrants are issued on the basis of probable cause, or based on the reasonableness standard discussed earlier; efficiency considerations would, however, favor the latter.
[7] Posner (1981, p. 54) notes that the exclusionary rule will not deter a different sort of police malfeasance: searches conducted purely for harassment. Such searches are not the subject of this paper (see the discussion in Section 6.3).

Mapp.[8] The widespread use of this approach and its longevity clearly stand in need of explanation from an economic standpoint.

The rest of the paper is organized as follows. Section 2 briefly reviews the related literature. Then, Section 3 presents the basic model, which consists of an asymmetric information game between police and the court. Police care only about maximizing the probability of a conviction less the cost of search, but they come in two types: "good" (those unwilling to plant evidence), and "bad" (those willing to plant evidence). After an arrest, the court seeks to deliver the correct verdict but is uncertain about the reliability of the evidence presented by the arresting officer. This creates a trade-off between type I and type II errors which, given the court's objective of minimizing error costs, defines the efficient "threshold of reasonable doubt." We initially characterize the equilibria of this model in the absence of remedies for Fourth Amendment violations. Then, in Section 4 we incorporate tort liability and show that this remedy provides no additional deterrence against planting evidence compared to the basic model. In contrast, Section 5 shows that an exclusionary rule with a warrant requirement does increase deterrence, thereby lowering the probability that an innocent defendant will be convicted and raising social welfare. Section 6 considers a number of extensions, while Section 7 discusses the implications and concludes.

2) Related Literature

There is a very large literature within legal scholarship that addresses Fourth Amendment jurisprudence (as discussed, for example, in Stuntz (1991) and Amar (1997)). There is also a substantial economic literature on civil procedure, but little formal modeling of issues in criminal procedure. Exceptions include Miceli (1991) on the optimal standard of proof in criminal trials, Schrag and Scotchmer (1994) on the effects of rules excluding character evidence from criminal trials, and Seidmann and Stein (2000) and Seidmann (2003) on the Fifth Amendment privilege against self-incrimination. On a related issue, Daughety and Reinganum (1995) examine the effects of rules excluding the admission of evidence about pretrial settlement negotiations in civil trials. The production of evidence by parties in trials has also been modeled, for instance, in Daughety and Reinganum (2000) and Sanchirico (2000), while the impact of plea bargaining on

[8] See Atkins and Rubin (2003, Appendix A, p. 174) for a list of these states. A number of other countries, including Canada, Australia, Germany and Italy, use a discretionary exclusionary rule (p. 161).

trial outcomes and social welfare has also attracted some attention (Grossman and Katz, 1983; Reinganum, 1988).

Also related is the literature on corruption and wrongful conduct by the police and other law enforcement agencies (e.g. Bowles and Garoupa, 1997), including models in which police may extract bribes from innocent parties in exchange for not making false arrests (e.g. Polinsky and Shavell, 2001). In the model of this paper, in contrast, police are motivated not by monetary gain *per se*, but by a desire for convictions. Benoit and Dubra (2003) develop a model that analyzes why police officers who engage in wrongful conduct may be protected by those who do not (for instance, through a refusal by the latter to testify against the former), which can explain, for example, why the "bad" types may be able to survive. Finally, Atkins and Rubin (2003) empirically investigate the effects of *Mapp* on crime rates, an issue not addressed in the current paper.

3) The Basic Model

This section describes the basic model of strategic interaction between two actors – a police officer (hereafter denoted P) and a criminal court (denoted C) – in the absence of either an exclusionary rule (ER) or a system of tort liability (TL) for Fourth Amendment violations (the game described here will be denoted Γ^0). The equilibria of Γ^0 are then derived and discussed. The notation employed in the model in this and subsequent sections is summarized in Table 1.

[Table 1 about here]

3.1) Description of the Game

The game Γ^0 is a dynamic game with asymmetric information; it can be divided into four stages – investigation, search, arrest and trial. The information asymmetry arises because P can be one of two types, where P's type is denoted $\theta \in$ {Good, Bad}. P is privately informed about her type (which is unobservable to C, and also to the other actors who are introduced in later sections). The two types of P differ not (as in standard asymmetric information games) in their payoffs (described below), but rather in the set of actions available to them. The "bad" type of P (denoted P_B) can "plant" evidence on suspects in order to "frame" them, whereas the "good" type of P (denoted P_G) is assumed not to have this option available. While C cannot observe a particular P's type, it is common knowledge that a fraction $\beta \in (0, 1)$ of the population from which P is drawn are of the "bad" type.

In the first stage of the game, P chooses whether or not to expend effort investigating a crime (in reality, the choice of whether to investigate may not be made by an individual police officer; the choice in this game can, however, be regarded as the choice of a level of effort to exert, with a low level being normalized to zero). The choice is denoted by $J \in \{0, 1\}$, where $J = 1$ if P investigates, and $J = 0$ if P does not. Regardless of her type, P incurs an effort cost $k > 0$ from investigating (and 0 cost from not doing so). If P investigates, "probable cause" (interpreted here as evidence of guilt that exceeds some given threshold) is found against a particular suspect with some probability $\varphi \in (0, 1)$. The event that probable cause is found is denoted F (so that $\Pr[F \mid J = 1] = \varphi$). Note that the terminology of "probable cause" is used here to reflect current Fourth Amendment jurisprudence; however, nothing in the formal analysis below would change if the evidence of guilt that exceeds some given threshold were interpreted instead as some form of "reasonableness" standard (this would presumably involve a lower threshold, and hence φ would be higher, but as long as the assumption A1-A3 below hold, the results would be unaffected).

The next stage of the game involves P deciding whether to search a suspect. If P has investigated at the previous stage and found probable cause against a particular suspect, then, if P searches that suspect, there is a probability g that dispositive evidence is found establishing that suspect's guilt. The event that this evidence is found is denoted G. Note that g is a *conditional* probability, conditioned on probable cause having previously been found against that particular suspect (i.e. $\Pr[G \mid F] = g$). However, P is not restricted to searching only suspects against whom probable cause exists. Rather, P can also choose to search any other potential suspect (even without having chosen to investigate in the first stage of the game). However, it is assumed that, prior to investigation, there is a continuum of potential suspects. Thus, the probability that P finds the guilty party by searching some individual chosen at random is zero (the probability that probable cause is found against such an individual is also assumed to be zero). Formally:

A1: $\Pr[G \mid J = 0] = \Pr[G \mid (J = 1) \text{ and } (\text{not } F)] = \Pr[F \mid J = 0] = 0$

The choice of whether to search is denoted $S \in \{0, 1\}$, where $S = 1$ if P searches, and $S = 0$ if P does not. A search involves an effort cost $s > 0$.

An important feature of this stage of the game is that P_B (but *not* P_G) can choose to plant evidence on a suspect. The choice of whether to arrest is denoted $R \in \{0, 1\}$, where $R = 1$ if P_B plants, and $R = 0$ if P_B does not plant. For P_B, planting evidence entails a positive effort cost denoted by ρ, where $\rho \in (0, s]$. That is, the planting of evidence requires some effort on the part of the bad type of police officer, but (weakly) less than would be entailed by a genuine search.

In the next stage, P decides whether to arrest a suspect. This can be a suspect against whom first probable cause, and then dispositive evidence of guilt, was found; however, P is also able to arrest any other potential suspect. The choice of whether to arrest is denoted $A \in \{0, 1\}$, where $A = 1$ if P arrests, and $A = 0$ if P does not arrest. If a suspect is arrested, then there is a trial; otherwise, the game ends. If there is a trial, C decides whether to convict or acquit the suspect (see below for a description of C's role; the timing of the game is summarized in Figure 1). Thus, the strategy set for P can be represented as follows: for P_G, the available strategies (denoted σ_G) can be summarized by a 3-tuple $\{J_G; S_G; A_G\}$, while for P_B, the available strategies (denoted σ_B) can be summarized by a 4-tuple $\{J_B; S_B; R_B; A_B\}$ (in each case, S, R, and A can be conditioned on factors such as the discovery of probable cause or of evidence of guilt).

[Figure 1 about here]

Clearly, there are many feasible strategies for each type of P. Many of these, however, are strictly dominated. For example, consider the following strategy for P_G: $\{J = 1; S = 0; A = 0\}$ (i.e. investigating, but never searching or arresting). This gives a payoff of $-k$, and so is strictly dominated by $\{J = 0; S = 0; A = 0\}$ i.e. a strategy of not entering, which gives a payoff of 0. Similarly, consider the following strategy for P_B: $\{J = 1; S = 0; R = 1; A = 1\}$ (i.e. investigating, and then always planting and arresting). P_B's payoff can be raised by k by switching to $\{J = 0; S = 0; R = 1; A = 1\}$ i.e. planting and arresting without investigating. In addition to eliminating strictly dominated strategies, the following (innocuous) restriction on P's strategies is imposed: any strategy that involves arresting a suspect when no evidence (whether real or planted) exists is ruled out. Allowing strategies of this type would not change any of the equilibria derived below, as C can infer from a trial where there is no (real or purported) evidence against the suspect that the suspect is innocent, and would thus always acquit.

Imposing this restriction, and eliminating strictly dominated strategies, essentially leaves the following strategies for P_G:

$\{J = 0; S = 0; A = 0\}$ (i.e. not entering the game)

$\{J = 1; S = 1 \mid F, S = 0 \mid \text{not } F; A = 1 \mid F \text{ and } G, A = 0 \text{ otherwise}\}$ (i.e. investigating, searching only if probable cause is found, and arresting only if evidence of guilt is found).

P_B can play counterparts of these strategies – i.e.

$\{J = 0; S = 0; R = 0; A = 0\}$

$\{J = 1; S = 1 \mid F, S = 0 \mid \text{not F}; R = 0; A = 1 \mid \text{F and G}, A = 0 \text{ otherwise}\}$

and can also play:

$\{J = 0; S = 0; R = 1; A = 1\}$ (i.e. plant evidence and arrest)

These are the strategies that will be considered in deriving the equilibria below.

P's payoff can be expressed as:

$$u = I - Jk - Ss - R\rho \qquad (1)$$

where $I = 1$ if a conviction is obtained and $I = 0$ if not (this applies whether or not there is a trial – i.e. if there is no trial, or if there is a trial and the suspect is acquitted, then $I = 0$).[9] Because the payoff from a conviction is normalized to 1, the costs of investigation, search and planting are measured *relative* to the (gross) payoff from obtaining a conviction. It should also be borne in mind that R is always zero for P_G given the assumptions about the available strategy sets. Thus, the basic assumptions here are simply that P cares about obtaining convictions, and (negatively) about the effort costs of investigation and search.

Some restrictions on the cost parameters are required to focus attention on the "interesting" cases. Suppose that P_G plays the strategy $\sigma_G = \{J = 1; S = 1 \mid F, S = 0 \mid \text{not F}; A = 1 \mid \text{F and G}, A = 0 \text{ otherwise}\}$ (i.e. investigating, searching only if probable cause is found, and arresting only if evidence of guilt is found). Then, the *ex ante* probability of obtaining a conviction is φg. Assuming that P is risk-neutral (which does not affect any of the basic results), the expected payoff is:

$$\varphi g - k - \varphi s \qquad (2)$$

when C convicts. Unless this is positive, P_G will never choose to investigate, even when conviction is anticipated if evidence is found against a suspect. Thus, it is assumed that:

A2: $\varphi(g - s) - k > 0$

Note also that $\varphi(g - s) - k < 1$, as φ and g are both probabilities.

Similarly, the model is uninteresting if P_B never has an incentive to plant evidence (even when C is expected to convict). Suppose that P_B plays the strategy $\sigma_B = \{J = 0; S = 0; R = 1; A = 1\}$, and C convicts. Then, P_B receives a payoff of $(1 - \rho)$. For P_B to play strategy σ_B, not only

[9] A cost to P of arresting a suspect who is subsequently acquitted could be incorporated into the analysis without affecting the basic results.

must it be true that $\rho < 1$, but ρ must also be sufficiently small that P_B has no incentive to deviate and play P_G's strategy (of undertaking a genuine investigation rather than planting evidence). Thus, it is assumed that:

A3: $\rho < 1 - (\varphi(g - s) - k)$

C's strategy set consists simply of the decision to convict or acquit the suspect, in the event that there is a trial: i.e. σ_C = {Convict, Acquit}. Recall that C does not observe P's type; thus, if there is a trial, C must form some belief about P's type (and hence about the suspect's guilt). This belief is denoted by μ, where $\mu = \Pr[\theta = \text{Good}]$. Recall that the prior belief is based on the knowledge that the fraction of good types in the population of police officers is $1 - \beta$; the updated belief is formed using Bayes' Rule whenever possible. C's payoff reflects a desire to reach the correct verdict (i.e. to convict guilty suspects and acquit innocent ones), combined with a tradeoff between Type I and Type II errors. If there is a trial, C's payoff is:

$$u_C = \begin{cases} 0 \text{ if (innocent, acquit) or (guilty, convict)} \\ -q \text{ if (innocent, convict)} \\ -(1-q) \text{ if (guilty, acquit)} \end{cases} \tag{3}$$

(this follows the formulation in Feddersen and Pesendorfer (1998), and has previously been used in the literature – e.g. Dharmapala and McAdams (2003); Seidmann (2003)).

The parameter q captures the disutility from wrongly convicting an innocent suspect; the higher is q, the greater the disutility. Thus, q reflects the threshold of "reasonable doubt" that is required for conviction; it is assumed that $q \in (1/2, 1)$. Given a belief μ that the suspect is guilty, the expected payoff to C from convicting is $\mu(q - 1)$, whereas the expected payoff to acquitting is $q(\mu - 1)$, Hence, this payoff function implies that C will convict whenever $\mu > q$ (as a tiebreaking assumption, suppose that C acquits when indifferent). If a trial does not take place, then (because it is implicitly assumed that a crime has taken place, so that the lack of a trial implies that the perpetrator has not been found) C is assumed to receive an arbitrary strictly negative payoff, equal to $-v$ (where $v > 0$).

Note that it is possible to consider the above payoff function as characterizing not only C's utility, but also as representing one aspect of social welfare (as in Grossman and Katz (1983) and Reinganum (1988), where social welfare is equated with the payoff of the jury). That is, the court's tradeoff between Type I and Type II errors can be viewed as representing society's preferences over these two kinds of miscarriages of justice. Of course, a full welfare analysis would have to consider other kinds of costs and benefits (such as the level of crime, resources expended on trials, the utility of the police) that are beyond the scope of this paper. Thus, we generally refer to the court's payoff, rather than to social welfare; however, the broader interpretation should be borne in mind.

3.2) Equilibria

In the game described above, there always exists what we term a "passive" pooling equilibrium, where neither type of P investigates. This is supported by out-of-equilibrium beliefs that would lead C to acquit, in the event that a trial was to occur. Formally:

Proposition 1: Γ^0 has a "passive" perfect Bayesian pooling equilibrium, where the equilibrium strategies are:

$\sigma_G^* = \{J = 0; S = 0; A = 0\}$

$\sigma_B^* = \{J = 0; S = 0; R = 0; A = 0\}$

σ_C^* = Acquit

C's beliefs are $\mu^* \in [0, q]$, and equilibrium payoffs are:

$u_G^* = u_B^* = 0$ and $u_C^* = - v$

Proof: To show that this is an equilibrium: given the equilibrium strategy profile for P, there is no trial in equilibrium, so C's beliefs are unconstrained by Bayes' Rule. Thus, $\mu^* \in [0, q]$ is admissible. Given these beliefs, C's payoff is maximized by acquitting if a trial occurs (recall that C convicts whenever $\mu > q$). Given C's beliefs and equilibrium strategy, suppose that P_G deviates by investigating, thereby incurring a cost of either k or, if the investigation leads to a search, $(k+s)$. As C acquits, and $k > 0$ and $s > 0$, P_G's deviation payoff will be strictly negative, whereas $u_G = 0$ in equilibrium. Given C's beliefs and equilibrium strategy, suppose that P_B deviates by planting evidence, thereby incurring a cost of ρ. As C acquits, and $\rho > 0$, P_B's deviation payoff will be strictly negative, whereas $u_B = 0$ (a similar argument holds if P_B deviates by investigating rather than planting). Thus, this is an equilibrium. ***End of Proof.***

Now, suppose that both types of P enter the game. Then, under the assumptions made above, P_B will always plant evidence, while P_G will investigate and only pursue an arrest if evidence of guilt is found. Thus, there will be two kinds of cases brought to trial – those in which P is of the good type and the suspect is guilty, and those in which P is of the bad type, and the suspect is innocent. The court thus has to infer the probability that a given suspect is guilty. Note that the court cannot simply use the prior belief that a fraction $(1 - \beta)$ of police officers are of the good type, as there is some probability that P_G does not find probable cause and/or evidence of guilt, and so never arrests a suspect. The *ex ante* probability that P_G ends up making an arrest is φg, so the fraction of police officers who are of the good type and make an arrest is $(1 - \beta)\varphi g$. In contrast, P_B always arrests someone, so the fraction of bad types who make arrests is simply β. Thus, when C is faced with a P who has arrested a suspect and is testifying at trial, the inferred probability that P is of the good type (and hence that the suspect is guilty) will be:

$$\frac{(1-\beta)\varphi g}{(1-\beta)\varphi g+\beta} \tag{4}$$

If this inferred probability exceeds q, then C will convict; otherwise, C will acquit. If C convicts, then a different kind of pooling equilibrium – one where both types of P enter the game – can be sustained. This "active" pooling equilibrium requires that the following condition:

Condition 1: $\dfrac{(1-\beta)\varphi g}{(1-\beta)\varphi g+\beta} > q$

is satisfied. Thus,

Proposition 2: Suppose that assumptions A1-A3 and Condition 1 hold. Then, Γ^0 has an "active" perfect Bayesian pooling equilibrium, where the equilibrium strategies are:

$\sigma_G^* = \{J = 1;\ S = 1|\text{F},\ S = 0|\text{not F};\ A = 1|\text{G},\ A = 0|\text{not G}\}$

$\sigma_B^* = \{J = 0;\ S = 0;\ R = 1;\ A = 1\}$

$\sigma_C^* = \text{Convict}$

C's beliefs are

$$\mu^* = \frac{(1-\beta)\varphi g}{(1-\beta)\varphi g+\beta}$$

and the equilibrium (expected) payoffs are:

$u_G^* = \varphi(g - s) - k$

$u_B^* = 1 - \rho$

$$u_C^* = \frac{-\beta q}{(1-\beta)\varphi g+\beta}$$

Proof: Given the equilibrium strategy profile for P, the belief μ^* is clearly correct (see the argument in the text). Given μ^*, from Eq. (3), C's expected payoff is given by:

$u_C^* = \Pr[\text{defendant is guilty}].0 + \Pr[\text{defendant is innocent}].(-q)$

$$= \frac{\beta}{(1-\beta)\varphi g + \beta}(-q)$$

which gives the equilibrium expected payoff u_C* above i.e. $u_C^* = -(1-\mu^*)q$. Thus, σ_C = Convict is optimal for C because the payoff from acquitting is

$$u_C = \Pr[\text{defendant is guilty}].(-(1-q)) + \Pr[\text{defendant is innocent}].(0)$$
$$= -(1-q)\mu^*$$

Condition 1 (i.e. $\mu^* > q$) implies that this is lower than u_C*.

In equilibrium, P_G incurs the investigation cost k (as $J = 1$), and has probability φg of obtaining a conviction, while the search cost s is incurred with probability φ; this gives the equilibrium u_G*. P_B obtains a conviction with probability 1, while incurring only the planting cost ρ; this gives the equilibrium u_B*. Given C's beliefs μ* and strategy σ_C*, it is optimal for each type of P to play the equilibrium strategy. Consider a deviation by P_G to a strategy $\sigma_G = \{J = 0; S = 0; A = 0\}$; this would lead to a payoff $u_G = 0$, whereas the payoff from playing σ_G* is $\varphi(g - s) - k > 0$ (by A2). Consider a deviation by P_B to a strategy $\sigma_B = \{J = 0; S = 0; R = 0; A = 0\}$; this would lead to a payoff of $u_B = 0$, whereas the payoff from playing u_B* is $1 - \rho > 0$ (by A3). A deviation by P_B to P_G's strategy (i.e. $\sigma_B = \{J = 1; S = 1|F, S = 0|\text{not F}; R = 0; A = 1|G, A = 0|\text{not G}\}$) would also not be profitable, as $1 - \rho > \varphi(g - s) - k$ (by A3). Thus, this is an equilibrium. ***End of Proof.***

In this equilibrium, C is willing to convict all defendants, even while inferring that a certain fraction of them (those who are arrested by P's of the bad type) are factually innocent.

Finally, we show that there exist no separating equilibria (i.e. the court is never able to distinguish between the two types of police, given the information available):

Proposition 3: Given the assumptions above, there exists no separating equilibrium of Γ^0.

Proof: Consider a candidate-equilibrium where P_G enters and P_B does not:

$$\sigma_G = \{J = 1; S = 1|F, S = 0|\text{not F}; A = 1|G, A = 0|\text{not G}\}$$
$$\sigma_B = \{J = 0; S = 0; R = 0; A = 0\}$$

Given these strategies for P, C will infer that $\mu = 1$, and hence will play σ_C = Convict. But, this is not an equilibrium, as P_B has an incentive to deviate to $\sigma_B = \{J = 0; S = 0; R = 1; A = 1\}$, thereby receiving a payoff of $(1 - \rho)$, which (by A3) is greater than the 0 payoff in the candidate-equilibrium.

Consider a candidate-equilibrium where P_B enters and P_G does not:

$$\sigma_G = \{J = 0; S = 0; A = 0\}$$

$$\sigma_B = \{J = 0; S = 0; R = 1; A = 1\}$$

Given these strategies for P, C will infer that $\mu = 0$, and hence will play σ_C = Acquit. But, this is not an equilibrium, as P_B has an incentive to deviate to $\sigma_B = \{J = 0; S = 0; R = 0; A = 0\}$, thereby receiving a payoff of 0, whereas the payoff in the candidate-equilibrium is $-\rho < 0$. Hence, there can be no separating equilibrium. ***End of Proof.***

The intuition for the lack of a separating equilibrium is simply that, whenever a good type of P is willing to enter, entry is even more beneficial from the point of view of a bad type (recalling that the latter does not incur the investigation costs k, nor the difference between ρ and s). Thus, it is impossible for the good type of P to distinguish herself from the bad type.

4) Introducing Tort Liability

In this section, we consider the imposition of tort liability on police officers for searches without probable cause. As discussed earlier, tort liability is the favored remedy for unlawful searches of many commentators on the Fourth Amendment, including Posner (1981) and Amar (1997). The introduction of tort liability involves adding another player, a civil court, denoted T. A suspect who has been searched can (costlessly) seek damages by filing suit. Note, however, that under the assumptions made above, P_G never searches without probable cause (as the *ex ante* probability of success is zero).[10] Thus, if a suspect has been searched but not arrested, it can be inferred by T that P was of the good type, and no damages will be awarded. Hence, we assume that only those suspects who are arrested (regardless of whether they are convicted) bring suit. T then decides whether to hold P liable or not: the strategy set is {Liable, Not liable}. If T determines that P is liable, then damages of $D > 1$ are assessed against P (we ignore any wealth constraints, and assume that D is paid personally by P). T's payoff if there is a trial is analogous to C's payoff:

[10] Of course, this rules out an important class of cases where police may harass innocent individuals without seeking to frame them. In such instances, as Amar (1997) points out, the warrant requirement and exclusionary rule are irrelevant, while tort liability may deter the misconduct. The focus here, however, is not on this class of cases.

$$u_T = \begin{cases} 0 \text{ if (liable, violation) or (not liable, no violation)} \\ -t \text{ if (liable, no violation)} \\ -(1-t) \text{ if (not liable, violation)} \end{cases} \tag{5}$$

Here, $t \in [1/2, 1)$ captures the tradeoff between Type I and Type II errors in the sanctioning of police. Because civil trials only require a preponderance of evidence rather than a reasonable doubt standard, we would expect that $t < q$ (however, this is not essential to the results below).

As we assume that all criminal defendants file suit, the only circumstances in which no suits are filed are when there are no arrests and hence no violations (either there are no searches, or the only searches are carried out by the good type of P). Thus, when there is no suit, T's payoff can be assumed to be 0 (again, this is not crucial to the results). If a suit is filed, T forms a belief by inferring the probability that a Fourth Amendment violation occurred (i.e. that P searched unreasonably). Because P_G never has an incentive to commit such a violation, this probability is equal to the probability that P is of the bad type. This is simply the complement of C's belief μ (and so will be denoted using the same notation). Of course, in equilibrium, the beliefs of C and T have to be mutually consistent. Note that T will find P liable whenever the belief that P is of the bad type exceeds the threshold t: i.e. $(1-\mu) > t$. The game with the added tort liability stage will be denoted Γ^{TL}.

In analyzing Γ^{TL}, the first point to note is that a passive pooling equilibrium exists. In this equilibrium, C believes it is sufficiently likely that P is of the bad type that it is willing to acquit all defendants; in anticipation of this outcome, neither type of P enters. Because the prospect of acquittal deters entry by P, there are no searches. Hence, there is no possibility of unreasonable searches, and no civil suits are filed against the police. Consequently, the beliefs and actions of T (off the equilibrium path) do not affect the equilibrium specified in Proposition 1:

Proposition 1´: Γ^{TL} has a "passive" perfect Bayesian pooling equilibrium, identical to that characterized in Proposition 1; this exists regardless of T's beliefs and strategy

Proof: Straightforward.

Now suppose that Condition 1 is satisfied. That is, C believes that it is sufficiently likely that P is of the good type that it is optimal to convict all defendants. This induces both types of P to enter, and leads to the equilibrium specified in Proposition 2 above. When we add a civil court T to the model, suits will be filed by all defendants. Faced with deciding the outcome of a suit against a police officer, T will infer the probability that the officer is of the bad type. Given the strategies of each type of P in the Proposition 1 equilibrium, T's inference will be that P is bad with probability $1 - \mu$. C would only have convicted the defendant if $\mu > q$, however, which implies that $\mu > ½$ (recalling that $q > ½$ by assumption). This of course implies that $1 - \mu > ½$, and (as $t \geq ½$ by assumption) that $1 - \mu < t$. That is, in any equilibrium where C is willing to convict (and hence P willing to enter), T's optimal strategy will be to find the police officer not liable. Hence, the equilibrium outcomes are essentially unchanged from those of Proposition 2:

Proposition 2′: Suppose that assumptions A1-A3 and Condition 1 hold. Then, Γ^{TL} has an "active" perfect Bayesian pooling equilibrium, where the equilibrium strategies are:

$\sigma_G* = \{J = 1; S = 1|F, S = 0|\text{not F}; A = 1|G, A = 0|\text{not G}\}$

$\sigma_B* = \{J = 0; S = 0; R = 1; A = 1\}$

σ_C* = Convict

σ_T* = Not liable

C and T hold beliefs

$$\mu^* = \frac{(1-\beta)\varphi g}{(1-\beta)\varphi g + \beta}$$

and the equilibrium payoffs are:

$u_G* = \varphi g - k - \varphi s$

$u_B* = 1 - \rho$

$$u_C^* = \frac{-\beta q}{(1-\beta)\varphi g + \beta}$$

$$u_T^* = \frac{-\beta(1-t)}{(1-\beta)\varphi g + \beta}$$

Proof: Analogous to that for Proposition 2. Note that $\mu^* > q > ½$ implies that $1 - \mu^* < ½$, so that $1 - \mu^* < t$. Hence, it is optimal for T to find P not liable, given the strategies σ_G*, σ_B*, and σ_C* To show this, consider a deviation by T to the alternative strategy, σ_T = Liable; given u_T, the expected utility of "Not liable" is

$$-t\mu^* - (1 - \mu^* - t)$$

while the expected utility of "Liable" is $-t\mu^*$. As $1 - \mu^* < t$, the expected utility from playing "Not liable" is higher. Note also that T's equilibrium beliefs are correct given these strategies.

Given σ_C* and σ_T*, P's strategy is optimal, while given the correct beliefs and P's strategy, C's strategy is optimal (see Proof of Proposition 2). Thus, this is an equilibrium. ***End of Proof.***

Finally, as the creation of a tort liability regime does not in itself lead to any new information about police characteristics becoming available, there is no separating equilibrium:

Proposition 3´: Given the assumptions above, there exists no separating equilibrium of Γ^{TL}.

Proof: Straightforward.

To summarize, the equilibrium outcomes of the game with tort liability are essentially identical to those in the basic game analyzed earlier. The introduction of tort liability makes no difference in our model because the only circumstances in which a police officer would be found liable are those in which C would not be willing to convict in any event. Under such conditions, police of both types are deterred from entering because C will not convict, and the existence of a tort liability system does not provide any additional deterrence of wrongful conduct by bad types of P.

5) Introducing the Exclusionary Rule

This section returns to the basic game of Section 3, denoted Γ^0, and introduces an alternative procedural regime that involves two new elements. The first is that, between the first and second stages of the game, P has the option of applying (costlessly) to a judge for a search warrant. This involves introducing a judge or magistrate as a new player, but for the sake of simplicity, he or she is assumed to be a nonstrategic player. The judge can observe whether or not probable cause was found in stage 1 against the suspect whom P seeks to search, and is assumed to issue a warrant if and only if probable cause was found. The second element is that, in the fourth stage of the game (the criminal trial), the court excludes any evidence that was (actually or allegedly) found in the absence of a search warrant. While this is admittedly a simplification, it is assumed that exclusion amounts to the acquittal of the defendant. These modifications to Γ^0 are intended to represent in stylized form the major features of the line of Fourth Amendment jurisprudence established by *Mapp*, and this regime will be referred to as the exclusionary rule (ER) and denoted Γ^{ER} (although, as discussed in Section 6 below, the warrant requirement is more crucial to the results than the exclusion of evidence *per se*). Under this regime, there is assumed to be no possibility of tort actions against P by suspects.

These changes to the game entail that P now faces a new choice of whether to apply for a search warrant or not. However, it turns out that, for both types of P, failing to apply when probable cause is found is always strictly dominated. Since failing to obtain a search warrant implies that the suspect is never convicted, any strategy for P that involves investigating and *not* applying for a search warrant is strictly dominated by a strategy that involves not investigating at all (as this saves the investigation cost k). Applying for a warrant when there has been no investigation, or when an investigation has failed to find probable cause, is pointless, given that magistrates can observe this, and never issue warrants in such circumstances. Thus, it can be assumed, without affecting the results, that a police officer always applies for a search warrant if and only if probable cause is found. It is important to stress that, because of the assumption that the magistrate who issues warrants can observe or verify whether or not probable cause was found, P cannot falsify the evidence used to obtain a search warrant. Moreover, there is no possibility of collusion between P and the magistrate. The effects of relaxing these assumptions are discussed in Section 6 below.

The court C also faces a new decision regarding whether to exclude evidence. It will be assumed, however, that it always does so if a search warrant is not produced at trial (and, moreover, a warrant cannot be successfully falsified by P). This assumption is made without loss of generality in this framework – it turns out that the only circumstances in which evidence would be excluded are those in which the court would disregard the evidence in any case because it is unreliable (i.e. has too high a probability of having been planted by a bad P). This is a consequence of the assumption that no good P ever commits a Fourth Amendment violation; as discussed earlier (as well as in Section 6 below), relaxing this assumption would only strengthen the paper's results. Finally, the assumption of a nonstrategic magistrate is also without substantial loss of generality, as the most natural assumption concerning her objective function – that it is identical to that of C – would lead to essentially the same behavior as postulated above.

The new game Γ^{ER}, like those analyzed previously, has a passive pooling equilibrium where neither type of P enters. Recall that in the equilibrium of Proposition 1, C's beliefs lead to a strategy of always acquitting, and the prospect of acquittal is sufficient to deter P from entering. In these circumstances, remedies for Fourth Amendment violations are irrelevant, and so this class of equilibria continues to exist under both a tort liability regime and an exclusionary rule regime:

Proposition 1′′: Γ^{ER} has a "passive" perfect Bayesian pooling equilibrium, identical to that characterized in Proposition 1

Proof: See proof of Proposition 1.

Now consider the case where both types of P enter. The most important change caused by the ER regime is that P_B can no longer follow a strategy of not investigating, and then planting. Were this approach followed, no search warrant could be produced at trial, and so the (purported) evidence would be excluded and the defendant acquitted. To obtain a conviction, P_B must investigate (and therefore expend effort at cost k). If probable cause is not found, a warrant cannot be obtained, and there is no benefit to planting evidence on a suspect. On the other hand, if probable cause is found, then a search warrant is obtained (recalling that the magistrate cannot distinguish between P_B and P_G *per se*). Once the warrant is issued, however, P_B has an incentive to always plant evidence on the suspect against whom the warrant was obtained. This incentive arises most clearly when $\rho < s$ (i.e. the effort costs of planting are strictly lower than those of carrying out a genuine search). However, if C is anticipated to convict, the incentive exists even when $\rho = s$, because planting enables P_B to obtain convictions against *every* suspect against whom probable cause is found, rather than simply those who are actually guilty.

Consider the inference problem faced by C when a trial occurs. The probability that P_G will end up making an arrest is (as before) $(1-\beta)\varphi g$. The probability that P_B will make an arrest, however, is lower than in Γ^0, as an arrest in Γ^{ER} requires that probable cause has been found. Thus, the probability that P_B will make an arrest is $\beta\varphi$. Consequently, the probability that a given police officer is of the good type is given by the expression:

$$\frac{(1-\beta)\varphi g}{(1-\beta)\varphi g+\beta\varphi} \tag{6}$$

If this probability exceeds q – i.e. if the following condition

Condition 2: $\dfrac{(1-\beta)\varphi g}{(1-\beta)\varphi g+\beta\varphi} > q$

is satisfied, then C will always convict. These beliefs thus sustain an equilibrium in which both types of P enter: this is the active pooling equilibrium of the game under the ER regime.

Proposition 2′′: Suppose that assumptions A1-A3 and Condition 2 hold. Then, Γ^{ER} has an "active" perfect Bayesian pooling equilibrium, where the equilibrium strategies are:

$\sigma_G{}^* = \{J = 1; S = 1|F, S = 0|\text{not F}; A = 1|G, A = 0|\text{not G}\}$

$\sigma_B{}^* = \{J = 1; S = 0; R = 1|F, S = 0|\text{not F}; A = 1\}$

$\sigma_C{}^*$ = Convict

C's beliefs are

$$\mu^* = \frac{(1-\beta)\varphi g}{(1-\beta)\varphi g + \beta\varphi}$$

and the equilibrium payoffs are:

$u_G{}^* = \varphi(g - s) - k$

$u_B{}^* = \varphi(1 - \rho) - k$

$$u_C{}^* = \frac{-\beta\varphi q}{(1-\beta)\varphi g + \beta\varphi}$$

Proof: Given the equilibrium strategy profile for P, the belief μ^* is clearly correct (see the argument in the text). Given μ^*, from Eq. (3), C's expected payoff is given by:

$u_C{}^*$ = Pr[defendant is guilty].0 + Pr[defendant is innocent].$(-q)$

$$= \frac{\beta\varphi}{(1-\beta)\varphi g + \beta\varphi}(-q)$$

which gives the equilibrium expected payoff $u_C{}^*$ above i.e. $u_C{}^* = -(1 - \mu^*)q$. Thus, σ_C = Convict is optimal for C because the payoff from acquitting is

u_C = Pr[defendant is guilty].$(-(1 - q))$ + Pr[defendant is innocent].(0)

$= -(1 - q)\mu^*$

Condition 2 (i.e. $\mu^* > q$) implies that this is lower than $u_C{}^*$.

In equilibrium, P_G incurs the investigation cost k (as $J = 1$), and has probability φg of obtaining a conviction, while the search cost s is incurred with probability φ; this gives the equilibrium $u_G{}^*$. P_B also incurs the investigation cost k (as $J = 1$), and obtains a conviction with probability φ (i.e. whenever probable cause is found), while incurring the planting cost ρ (also with probability φ); this gives the equilibrium $u_B{}^*$. Given C's beliefs μ^* and strategy $\sigma_C{}^*$, it is optimal for each type of P to play the equilibrium strategy. Consider a deviation by P_G to a strategy $\sigma_G = \{J = 0; S = 0; A = 0\}$; this would lead to a payoff $u_G = 0$, whereas the payoff from playing $\sigma_G{}^*$ is $\varphi(g - s) - k > 0$ (by A2). Consider a deviation by P_B to a strategy $\sigma_B = \{J = 0; S = 0; R = 0; A = 0\}$; this would lead to a payoff of $u_B = 0$, whereas the payoff from playing u_B^* is $\varphi(1-\rho) - k > 0$ (by A2, because $\varphi(1-\rho) - k > \varphi(g-s) - k$). A deviation by P_B to P_G's strategy (i.e. $\sigma_B = \{J = 1; S = 1|F, S = 0|\text{not F}; R = 0; A = 1|G, A = 0|\text{not G}\}$) would also not be profitable, as $\varphi(1-\rho) - k > \varphi(g-s) - k$ (as $\rho \leq s$ and $g < 1$ by assumption). Thus, this is an equilibrium. ***End of Proof.***

The intuition here is very similar to that for Proposition 2. What is noteworthy, however, is that the ER regime substantially reduces the scope for P_B to plant evidence, and forces bad police to incur investigation costs that could be avoided in the basic game, and under TL. However, ER does not lead to any separating equilibria:

Proposition 3´´: Given the assumptions above, there exists no separating equilibrium of Γ^{ER}.

Proof: Analogous to proof of Proposition 3.

The intuition here (as before) is that whenever entry is profitable for P_G, it will also be profitable for P_B (as the latter incurs a (weakly) lower cost of planting, ρ, relative to the former's cost of search s, and also because P_B has a higher *ex ante* probability of obtaining a conviction than does P_G). As P_G has no credible means of distinguishing itself from P_B, a separating equilibrium is impossible (however, see Section 6 for an analysis of the situation where costs of investigation differ for the two types).

Having characterized the equilibrium outcomes in three games – Γ^0, Γ^{TL}, and Γ^{ER} – it remains to compare the properties of these equilibria. The existence of the same passive pooling equilibrium in each of these games makes it difficult to compare the outcomes of instituting different Fourth Amendment remedies.[11] However, one approach is to focus on the active pooling equilibria in each regime. It is only in these equilibria that any police investigations, arrests and trials occur at all, and so these equilibria may be argued to be more relevant (since in practice investigations, arrests and trials are all observed, and would presumably continue to be observed under any realistic institutional structure). The results in Section 4 showed that the TL regime leads to identical outcomes to the basic game Γ^0 (where there is no Fourth Amendment

[11] Comparing Condition 1 and Condition 2, it is clear that the latter is satisfied for a larger subset of the parameter space than is the former. Thus, it could be argued that an active pooling equilibrium can be supported more easily under ER than under TL. However, whether this is a benefit from the standpoint of C (and of society) depends crucially on the value of the arbitrary parameter v, and so cannot be determined with any confidence.

remedy). Thus, the (active pooling equilibrium) outcomes of Γ^0 and Γ^{TL} can be considered together, and contrasted with the (active pooling equilibrium) outcome of Γ^{ER}.

Let u_C^0, u_C^{TL} and u_C^{ER} denote the equilibrium expected payoff of C in the active pooling equilibria of Γ^0, Γ^{TL}, and Γ^{ER}, respectively. Then:

Proposition 4: Restricting attention to equilibria where arrests are made (i.e. to active pooling equilibria), $u_C^{ER} > u_C^0 = u_C^{TL}$ (i.e. the court's payoff is strictly higher in Γ^{ER} than in Γ^0 or Γ^{TL}).

Proof: From Propositions 2 and 2′:

$$u_C^0 = u_C^{TL} \frac{-\beta q}{(1-\beta)\varphi g + \beta}$$

From Proposition 2′′:

$$u_C^{ER} = \frac{-\beta\varphi q}{(1-\beta)\varphi g + \beta\varphi}$$

Consider $u_C^{ER} - u_C^0$:

$$\begin{aligned}
u_C^{ER} - u_C^0 &= \frac{-\beta\varphi q}{(1-\beta)\varphi g + \beta\varphi} - \frac{-\beta q}{(1-\beta)\varphi g + \beta} \\
&= \frac{(1-\beta)\varphi g\beta q - \beta^2\varphi q + \beta^2\varphi q - (1-\beta)\varphi^2 g\beta q}{[(1-\beta)\varphi g + \beta\varphi][(1-\beta)\varphi g + \beta]} \\
&= \frac{(1-\beta)\varphi g\beta q[1-\varphi]}{[(1-\beta)\varphi g + \beta\varphi][(1-\beta)\varphi g + \beta]} \\
&> 0
\end{aligned}$$

(by the definitions of the parameters given earlier). ***End of Proof.***

This implies that the ER regime leads to a higher level of welfare for C. As discussed earlier, C's payoff can be interpreted as a proxy for social welfare (at least for the welfare derived by society from accuracy in criminal trials), and so it could be argued that the ER regime leads to a higher level of social welfare, in this particular respect. This constitutes the paper's main result, and shows that there exist circumstances in which the ER regime may be superior (from the standpoint of accuracy in criminal adjudication) to a TL regime.

6) Extensions

6.1) Heterogeneous Costs of Investigation

The preceding analysis has assumed that both types of P face the same effort cost k of undertaking an investigation. This appears reasonable as a basic assumption, because there does not seem to be any compelling reason why one type is likely to find investigation more or less costly than the other. However, it may be argued that in some circumstances the good type may not only be a better police officer in terms of being unwilling to plant evidence, but may also be superior in terms of investigative skills (for instance, the bad type's willingness to plant may arise from an inability to solve crimes through legitimate methods). While such an argument is not necessarily compelling in general, it is nonetheless of some interest to analyze the case where the bad type faces a higher effort cost of investigation than does the good type.

Let k_G and k_B be the investigation costs of P_G and P_B, respectively, and suppose that $k_G < k_B$. Furthermore, suppose that assumptions A2 and A3 hold for $k = k_G$ (so that it is optimal for P_G to enter when it is anticipated that C will convict). For k_B, the following assumption is made:

A4: $k_B > 1$

A4 implies that it is never optimal for P_B to enter and investigate (even if C is anticipated to convict). Note that A4 is slightly stronger than required, but it is simpler to formulate the assumption in this way.

The assumptions above entail that k_G and k_B are *sufficiently* different (for sufficiently small differences in these costs, the results derived in previous sections would be unchanged). Even when they hold, however, the equilibria of Γ^0 and Γ^{TL} derived in Sections 3 and 4 are unaffected by the heterogeneity in investigation costs. Recall that in these equilibria, P_B's equilibrium behavior involves either not entering, or entering and not investigating ($J = 0$ in all cases). Thus, the investigation cost is not incurred in equilibrium. Under the assumption of heterogeneous costs made here, deviation to any strategy that involves investigation ($J = 1$) becomes even less profitable for P_B than under the assumptions made in Sections 3 and 4; however, equilibrium behavior is unaffected. Thus, the results concerning Γ^0 and Γ^{TL} are robust to assuming that P_B's investigations costs are higher.

This robustness does not apply, however, to Γ^{ER}. Recall that the active pooling equilibrium of Γ^{ER} involves P_B investigating (and hence incurring the effort cost of doing so). Thus, when k_G and k_B are sufficiently different, P_B will no longer be willing to pool with P_G, and instead will prefer not to enter (as, under the ER regime, entry requires that the investigation costs be expended in order to obtain a warrant and secure a conviction). In these circumstances, the active pooling equilibrium of Γ^{ER} no longer exists; instead, there exists a perfectly separating equilibrium in which P_G enters while P_B does not:

Proposition 5: Suppose that A1 holds, that A2 and A3 apply to k_G, and that A4 applies to k_B; then, there exists a perfectly separating equilibrium of Γ^{ER}, where the equilibrium strategies are:

$$\sigma_G^* = \{J = 1;\ S = 1|\mathrm{F},\ S = 0|\text{not F};\ A = 1|\mathrm{G},\ A = 0|\text{not G}\}$$

$$\sigma_B^* = \{J = 0;\ S = 0;\ R = 0;\ A = 0\}$$

$$\sigma_C^* = \text{Convict}$$

C's beliefs are $\mu^* = 1$, and the equilibrium payoffs are:

$$u_G^* = \varphi(g - s) - k_G$$

$$u_B^* = 0$$

$$u_C^* = 0$$

Proof: Given P's strategy, C's beliefs are clearly correct (i.e. only P_G enters, so any defendant who is arrested and tried is guilty). Given these beliefs, it is optimal for C to convict: the equilibrium expected payoff is 0, while the expected payoff from acquitting is $-(1 - q) < 0$. Given C's beliefs and strategy, P's equilibrium strategy is optimal. Suppose P_G were to deviate to a strategy that involves not entering: $\{J = 0;\ S = 0;\ A = 0\}$. This would give a payoff of 0, whereas the equilibrium payoff is $\varphi(g - s) - k_G > 0$ (by A2). Suppose P_B were to deviate by switching to a strategy that involves entering and planting (as in the Proposition 2´´ equilibrium): $\{J = 1;\ S = 0;\ R = 1|\mathrm{F},\ S = 0|\text{not F};\ A = 1\}$. This would give a payoff of $\varphi(1 - s) - k_B < 0$ (by A4), whereas the equilibrium payoff is 0. It is also not profitable for P_B to deviate by adopting P_G's strategy: $\{J = 1;\ S = 1|\mathrm{F},\ S = 0|\text{not F};\ R = 0;\ A = 1|\mathrm{G},\ A = 0|\text{not G}\}$. This would lead to a payoff of $\varphi(g - s) - k_B < 0$ (by A4). Thus, this is an equilibrium. ***End of Proof.***

In this equilibrium, C's payoff (and hence society's payoff from accuracy in criminal adjudication) is at the maximum possible level. Thus, the earlier conclusions concerning the superiority of the ER regime (in Section 5) are substantially reinforced when different types of P face heterogeneous costs. Moreover, in these circumstances, the informational assumptions required concerning the warrant process can be relaxed (relative to the assumptions of Section 5). Recall that the magistrate issuing search warrants was assumed in Section 5 to be able to observe whether or not probable cause was found. When k_G and k_B are sufficiently different, all that is required for the separating equilibrium is that the magistrate be able to observe whether or not an investigation occurred (the finding of probable cause, as well the cost incurred in the investigation can both be P's private information). Thus, heterogeneity in investigation costs substantially strengthens the case for the superiority of the ER regime; however, this superiority can be established (as in Section 5) even with an identical k, and (as noted above) there is no compelling reason why the heterogeneity assumptions made here would always be true.[12]

6.2) Criminal Liability for Planting Evidence

In the analysis so far, there has been no mention of the possibility that P_B may face criminal liability for planting evidence and framing suspects. These activities are of course illegal, and so this section considers the consequences of extending the model in this direction. Incorporating criminal liability into the model is straightforward, and involves essentially the same setup as the game with tort liability (Γ^{TL} in Section 4 above). The main difference is that the second court is now also a criminal court, and it is possible for the state to prosecute police officers for planting evidence on suspects. This court can be assumed to have the same payoff function as the civil court in Section 4 (given by Eq. (5)), except that it will generally require a *higher* standard of proof to convict the police officer than the civil court would require to award damages against the police officer for a Fourth Amendment violation. This means, however, that the results of Section 4 apply *a fortiori* to this case: if there is a sufficient likelihood of planting to convict P, then there would never be a sufficient likelihood of guilt to convict the suspect who is arrested by the same P. That is, the prospect of acquittal of the suspect will always be sufficient to deter P_B from entering and planting, so the existence of criminal liability for planting will not have any additional deterrent effect on this behavior. Consequently, none of the results derived above in Sections 3-5 would be affected by the existence of criminal liability for P for planting evidence.[13]

[12] Note however that, even if the cost differences went the other way (i.e. $k_G > k_B$), there could never be a "bad" separating equilibrium where P_B enters and plants while P_G does not enter; C would be certain to acquit in such circumstances, and, moreover (given criminal liability for planting), P_B's planting would be detected with certainty.

[13] Of course, in reality, it may be that there are circumstances in which P may be prosecuted successfully for planting evidence (e.g. if there is an unanticipated discovery of evidence of planting after the initial trial). However, the main point here is that, in this simplified framework, it is possible to ignore the effects of criminal liability.

6.3) Separating the Warrant Requirement from the Exclusionary Rule

In characterizing the alternative institutional structures associated with Fourth Amendment remedies, a TL regime has been contrasted with an ER regime. However, the latter has *combined* the warrant requirement and the exclusionary rule. This reflects current Fourth Amendment jurisprudence, but it is not conceptually necessary that the two be linked. Note that in Γ^{ER}, evidence is never excluded in equilibrium. Moreover, evidence would be excluded (off the equilibrium path) only in cases where C infers a sufficiently high likelihood that P is of the bad type (and hence that the evidence is unreliable because it has been planted). Thus, the exclusionary rule *per se* has no independent effect: C would discount the purported evidence even in the absence of a requirement to exclude it. This means that all the results relating to Γ^{ER} would be unaffected if the exclusionary rule itself did not exist, as long as a warrant requirement was in place.

In reality, of course, there are many reasons why reliable evidence may be excluded under an ER regime (such as mistakes by good types of P). Even if evidence is unreliable, moreover, juries may not always be able to infer this (due for example to cognitive biases or limited attention), and so it may be optimal to exclude the evidence. Abstracting from such considerations, however, the model of the ER regime in this paper yields a significant insight: the particular benefit of the ER regime identified here (that it can deter the planting of evidence by police because of the requirement that there is some auditing of the investigation prior to search, through the warrant process) is due primarily to the warrant requirement and not the exclusionary rule *per se*. Thus, it is possible to envisage a system in which the warrant requirement stands by itself. The warrant requirement itself does not of course include any remedy for warrantless searches, but courts could appropriately discount the value of evidence obtained without a warrant to take into account the possibility of it having been planted. In effect, acquittal becomes the remedy when this probability is sufficiently high. Alternatively, the warrant requirement could be combined with tort liability for police officers who carry out unreasonable searches, a regime that would also offer protection to individuals who may be harassed by the police by being targeted for search, but without being framed. All the results obtained in Sections 5 and 6.1 above for Γ^{ER} would also hold in these regimes.

7) Discussion and Conclusion

The discussion of Fourth Amendment remedies among law and economics scholars (and, increasingly, among constitutional criminal procedure scholars) has tended towards a consensus that a system of tort liability is superior on a number of grounds (such as efficiency and conformity with the intentions of the framers) to the current regime that combines a warrant requirement and an exclusionary rule (albeit with many exceptions). The aim of this paper has been to develop an asymmetric information model of the process of criminal investigation, search, arrest and trial that demonstrates that there are circumstances in which the latter regime is preferable according to the (widely accepted) criterion of accuracy in adjudication. In particular, when some subset of police officers are willing to plant evidence on suspects (rather than to pursue truth-seeking investigations), the use of the warrant requirement and exclusionary rule provides a mechanism for auditing police investigations at a stage prior to search. By reducing the opportunities to plant evidence, it reduces the incidence of false convictions due to planting (although this is not, of course, the kind of abuse it is designed to remedy).

The remainder of this section briefly discusses some caveats to the model and its conclusions. First, the model assumes that the "good" type of police cannot produce evidence (either about the facts of the case, or about their character) at trial to distinguish themselves from the "bad" type. While this may seem unrealistic, nonetheless, the model's basic conclusions hold as long as the types are indistinguishable *to some degree* from the perspective of the court; that is, the "good" type would always have to be able to distinguish itself *perfectly* to change the nature of the results.

The model also assumes that the judge who decides whether to issue warrants can accurately observe the results of the police investigation (or, in the heterogeneous-cost variant, at least whether an investigation occurred). If this were not the case, or if the judge were to collude with the police and always issue warrants, then the outcomes under the two remedies would be identical. However, as long as the judge has some ability to verify investigations, and some degree of independence, the basic conclusions of the model hold.

It has been assumed in the model that officers of the "good" type never carry out unreasonable searches. In reality, they may make good faith errors and thereby commit Fourth Amendment violations (without being involved in planting evidence). This could be incorporated into the model, but its effect is to reduce the payoff to the "good" type from investigating. Thus, it would reduce the fraction of "good" types who would enter in an active pooling equilibrium, and change the cutoff probability above which the court is willing to convict; however, the results would not be fundamentally altered. Even if the exclusionary rule were to deter good faith errors "excessively" (relative to tort liability), the accuracy-in-adjudication effect identified by the model would still operate.

In the comparison across the two Fourth Amendment remedies, the standard of reasonableness has been held fixed. If the tort liability regime involves a more socially efficient standard of reasonableness, then that would qualify some of the conclusions of the model. However, this would be an argument not for abandoning the warrant requirement and exclusionary rule, but rather for modifying the standard of evidence required for warrants to be issued.

It should be emphasized that this paper has not sought undertake a general social welfare analysis of the alternative remedies. This would require the incorporation of factors such as the effects on crime levels, the utility of police officers, and the administrative costs of the court system. Rather, the focus has been on one specific (and relatively uncontroversial) aspect of social welfare – the accuracy of courts' conviction and acquittal decisions.

Finally, it may be thought that the model takes too pessimistic a view of police motivation. Note, however, that the model assumes that the basic agency problem between the public and the police (of motivating police to expend effort to seek convictions, rather than to shirk) has been solved. The remaining problem arises from asymmetric information between police and the public regarding the details of police practices and the evidence against suspects (and it seems a reasonable assumption that such an information asymmetry exists). Thus, this model is in some respects *less* pessimistic about police motivation than some existing models of police corruption (e.g. Bowles and Garoupa, 1997; Polinsky and Shavell, 2001) that assume that police are motivated by monetary gain in seeking bribes from suspects. Moreover, the model's basic conclusions hold even if the fraction of police willing to plant evidence is very small. Note also, in conclusion, that the approach adopted here can be placed in the context of the "public choice" tradition in economics that models public officials as self-interested actors.

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Table 1: Notation

Symbol	Definition
A	Indicator variable (= 1 if P arrests, 0 otherwise)
C	Court (which tries the suspect, if one is arrested by P)
$D > 1$	Tort damages (potentially) assessed against P
F	The event that "probable cause" is found
G	The event that evidence of guilt is found, conditional on "probable cause" having been found
$g \in (0, 1)$	Probability of G
I	Indicator variable (= 1 if C convicts a suspect, 0 otherwise)
J	Indicator variable (= 1 if P investigates, 0 otherwise)
$k, k_G > 0, k_B > 1$	Cost (to P, P_G, P_B) of investigation
P, P_G, P_B	Police officer; good type; bad type
q	C's threshold of "reasonable doubt"
R	Indicator variable (= 1 if P_B plants, 0 otherwise)
S	Indicator variable (= 1 if P searches, 0 otherwise)
$s > 0$	Cost (to P) of search
T	Civil court (which tries the case against P for a Fourth Amendment violation, if such a suit is brought, and if P is subject to tort liability)
$t \in [1/2, 1)$	T's threshold for "preponderance of the evidence"
u, u_G, u_B	P's payoff; P_G's payoff; P_B's payoff
u_C	C's payoff
u_T	T's payoff
$v > 0$	Cost to C (negative of C's payoff) if no trial occurs
$\beta \in (0, 1)$	Fraction of bad P's
Γ^0	The game without any remedy for Fourth Amendment violations
Γ^{ER}	The game with a warrant requirement and exclusionary rule
Γ^{TL}	The game with tort liability for P
$\theta \in$ {Good, Bad}	P's type space
μ	C's belief about P's type (= Pr[θ = Good])
$\rho \in (0, s]$	Cost (to P_B) of planting
σ_B	P_B's strategy set: {J_B; S_B; R_B; A_B}
σ_C	C's strategy set: {Convict, Acquit}
σ_G	P_G's strategy set: {J_G; S_G; A_G}
$\varphi \in (0, 1)$	Probability of F

Figure 1: Timing of Γ^0

Stage 0	Nature chooses P's type $\theta \in$ {Good, Bad}
Stage 1	P chooses J (i.e. decides whether to investigate)
	If J = 1, nature chooses F (i.e. whether "probable cause" is found)
Stage 2	P chooses S (i.e. whether to search); P_B chooses R (i.e. whether to plant)
	If S = 1, nature chooses G (i.e. whether evidence of guilt is found)
Stage 3	P chooses A (i.e. whether to arrest)
Stage 4	If A = 1, a trial occurs and C chooses a verdict (from the set {Convict, Acquit})