Profiling, screening and criminal recruitment

Cotton, Christopher and Li, Cheng

October 2013

Profiling, Screening and Criminal Recruitment

Christopher Cotton and Cheng Li*

Accepted for publication at the *Journal of Public Economic Theory*

October 2013

Abstract

We model major criminal activity as a game in which a law enforcement officer chooses the rate at which to screen different population groups, and a criminal organization (e.g. drug cartel, terrorist cell) chooses the observable characteristics of its recruits. Our model best describes smuggling or terrorism activities at borders, airports and other security checkpoints. The most effective law enforcement policy imposes only moderate restrictions on the officer's ability to profile. In contrast to models of decentralized crime, requiring equal treatment never improves the effectiveness of law enforcement.

Keywords: racial profiling, law enforcement, national security, smuggling, terrorism, crime
JEL: D02, H56, J78, K42

*This paper has benefited greatly from comments by two excellent referees, Chris Parmeter, Mehdi Shadmehr, Dan Mantero and Dave Kelly, as well as presentations at the University of Miami, the 23rd International Conference on Game Theory at Stony Brook, the 50th Anniversary Conference of the Public Choice Society, and the 1st International Workshop on Economic Analysis of Institutions at Xiamen University. Cotton: University of Miami School of Business Administration, Department of Economics, Coral Gables, FL 33124, cotton@business.miami.edu. Li: University of Miami School of Business Administration, Department of Economics, Coral Gables, FL 33124, c.li11@umiami.edu.

1 Introduction

"In making routine or spontaneous law enforcement decisions, such as ordinary traffic stops, federal law enforcement officers may *not* use race or ethnicity to any degree, except that officers may rely on race and ethnicity if a specific suspect description exists..."

"Given the incalculably high stakes involved in such investigations, federal law enforcement officers who are protecting national security or preventing catastrophic events (as well as airport security screeners) may consider race, ethnicity, alienage, and other relevant factors."

—U.S. Department of Justice fact sheet on racial profiling, June 17, 2003

Profiling in law enforcement activities refers to the use of an individual's race, ethnicity, or other observable characteristics by officers when determining whether to stop, search, screen, or otherwise engage in law enforcement. In 2003, the U.S. Department of Justice (DOJ) issued a policy banning profiling during most routine federal law enforcement activities, arguing that the ban improves the *fairness* and *effectiveness* of law enforcement. At the same time, the DOJ made explicit exceptions for officers at borders and airports, or otherwise involved with national security, arguing that such exceptions are necessary to protect national security and prevent catastrophic events. The national security exception has met with opposition from a number of civil rights organizations, legislators, and other advocates who argue that the ban on profiling should extend to all areas of law enforcement.[1]

The idea that banning profiling may improve the effectiveness of law enforcement in certain settings is consistent with the academic literature. Persico (2002) uses a model of vehicle search during traffic stops to consider an agency problem that arises between law enforcement officers concerned with catching existing criminal activity, and a society that is additionally concerned with deterring crime. He shows how a ban on profiling may align the search behavior of law enforcement with the deterrence objectives of society, and may better minimize crime. Persico (2002)'s model involves decentralized crime, with many individuals independently choosing whether to engage in criminal activity. It is an appropriate model for considering many types of crime, but may be less appropriate for considering settings in which criminal activity is centrally planned by criminal organizations.

At borders, airports and other security checkpoints, law enforcement is primarily concerned with preventing major crime such as smuggling and terrorism. Such crime tends to be centrally planned by strategic criminal organizations (e.g. terrorist cells, drug cartels) who recruit agents to carry contraband (e.g. drugs, weapons) through the security checkpoint.[2]

[1] According to the American Civil Liberty Union (ACLU), "Law enforcement based on general characteristics such as race, religion and national origin, rather than on the observation of an individual's behavior, is an inefficient and ineffective strategy for ensuring public safety"(ACLU 2004, p2), and it continues to call for the DOJ to "close the loophole for national security and border integrity investigation."

[2] Consider the case of the September 11, 2001 terrorist attacks in the U.S.. These attacks were planned and funded by al-Qaeda leadership including Osama bin Laden and Khalid Sheikh Mohammed, who did not

By strategically choosing whom to recruit, criminal organizations select the observable characteristics of those committing crime on their behalf.[3] As such, there is a strategic element to profiling that is absent in models that focus on decentralized crime.

Our paper develops a model of centralized crime in which a criminal organization chooses the observable characteristics of the recruits it uses to carry contraband through a checkpoint, and a law enforcement officer chooses the frequency with which to screen each of two distinct population groups that pass through the checkpoint. The organized nature of crime significantly affects how criminal activity responds to restrictions on the use of profiling by law enforcement. We show that limiting the use of profiling can always improve the effectiveness of law enforcement. Requiring equal treatment, however, is too restrictive and never improves effectiveness. The most effective policy requires law enforcement officers to treat the two population groups only marginally more fairly than they do without a restriction.

The analysis begins by considering a benchmark in which officers are unconstrained in their ability to profile, and screen the two population groups at different rates. In this case, the unique Nash equilibrium of the game is in mixed strategies. The criminal organization mixes in such a way that its recruitment choice is unpredictable, and law enforcement divides its resources between the two population groups in a way that leaves the criminal organization indifferent between recruiting from each group. When the criminal organization finds it less costly to recruit from one population group, enforcement screens this group more heavily than the other group; the equilibrium involves profiling.[4]

We then restrict the use of profiling by law enforcement, requiring that it screen the two population groups more equally (or "more fairly") than it does without any restriction. Restricting profiling limits law enforcement to screening strategies for which it is always a best response for the criminal organization to recruit from the lower cost population. This means that the criminal recruitment strategy becomes more predictable. Law enforcement in turn responds by focusing as many resources as allowed (given the profiling restriction) on screening the recruited group. The most effective restriction requires law enforcement

engage in the acts of terrorism themselves. Total funding is estimated in excess of a half million dollars, meaning the support of al-Qaeda leadership was essential, and the individual hijackers were hand selected by bin Laden and Sheikh Mohammed (Wright 2006, Bergen 2001, 2006, The New York Times 2002). Similarly, drug cartels often recruit mules to transport drugs on their behalf. Bjerk and Mason (2011) provide an overview of this process.

[3]The idea that a criminal organization recruits operatives is similar to an assumption that an individual criminal may hire someone to commit a crime on his behalf. Such a model was proposed as an extension in Persico and Todd (2005). However, these authors focus on empirical tests of racial bias by law enforcement. Our focus is on how limiting the ability of law enforcement to strategically profile affects crime.

[4]Potential criminal agents in the low cost group may be less expensive or easier to recruit. They may require lower monetary payments, due to lower opportunity costs of engaging in crime or incarceration, or they may be more difficult for the criminal organization to find. In the data presented by Bjerk and Mason (2011) on smuggling arrests at the U.S.-Mexican border, American female smugglers were paid on average $507 more than non-American males to carry similar shipments of cocaine across the border. In many settings, we expect that the search effort and risks that arise during the recruitment process represent the most significant costs for the criminal organization (rather than any monetary payments to the recruits), and that other observable factors such as age, education, and socio-economic standing also play an important role. Deceiving a sixty-something Oxford educated physics professor into carrying drugs, for example, may require months of setup and execution (see Swann 2013), while recruiting an unemployed teen methamphetamine user from a poor neighborhood may take only a day (see The Associated Press 2012).

to screen the two population groups only marginally more fairly than it does without a restriction. This leads to more-predictable criminal activity, while maintaining the greatest amount of flexibility for law enforcement to capitalize on the increase in predictability and focus screening on the at risk group.

Compared to the case of no restriction, a restriction on the use of profiling results in a change in the criminal recruitment strategy that leads the law enforcement screening strategy to be more effective. This results in law enforcement being better off. At the same time, the criminal organization is also better off: the increased probability of its recruit being caught is dominated by the cost savings from focusing on the low cost recruits. In this way, restricting profiling leads to a Pareto improvement compared to the case of no restriction. Law enforcement is most effective when the profiling restriction requires only marginally more fair treatment than occurs without restriction. As the profiling rule becomes even more restrictive, law enforcement is forced to allocate screening resources less effectively, resulting in an increase in the utility of the criminal organization and a decrease in the utility of law enforcement (compared to the most effective profiling rule; there is still an increase compared to no restriction). Banning profiling and requiring that law enforcement screen both groups with equal probability fully depletes the potential screening benefits associated with criminal activity becoming more predictable, and maximizes the payoffs to the criminal organization. Requiring equal treatment is no better than unconstrained profiling at stopping crime. Banning profiling does not decrease crime and never improves the effectiveness of law enforcement.

With centrally planned crime, the benefits of restricting profiling come from strategic considerations related to a first mover advantage. A restriction on the use of profiling commits law enforcement to play a screening strategy that is inconsistent with the mixed strategy equilibrium of the game, but that improves the effectiveness of law enforcement. This is in contrast to models of decentralized crime, where the benefits of restricting profiling come through solving an agency problem, forcing law enforcement to screen in a way that more effectively deters crime (e.g. Persico 2002).[5]

As with other models in the literature, our framework is highly stylized, designed to build intuition about the effect of profiling rules rather than precisely calculate the impact that alternative rules have on crime rates and criminal activity. Despite this, our results have implications for policy. Our analysis largely supports the DOJ's policy of eliminating profiling in most law enforcement activities, but making an exception at borders, airports, and other screening activities related to national security. Where the DOJ argues that an exception needs to be made due to the high social costs of certain types of crime, our analysis illustrates that it is the type of crime (i.e., major, planned criminal activity) that necessitates the use of profiling by law enforcements at these locations. Where fully eliminating profiling can decrease *decentralized* criminal activity, our results show that this is not the case at borders, airports and other security checkpoints where law enforcement officers are most focused on combating major criminal activity planned by terrorist groups, drug cartels and other criminal organizations.

[5] In our model of centralized criminal activity, deterrence does not play a significant role; a change in policing causes a criminal organization to simply shift its recruitment efforts across groups without cutting back on crime. Without the deterrence concern, both law enforcement officers and society share the same objective of stopping existing criminal activity, and no agency problem needs to be overcome.

Section 2 reviews the literature. Section 3 describes the model of criminal recruitment and law enforcement. Section 4 solves for the equilibrium when law enforcement is unrestricted in its ability to screen two population groups at different rates. Section 5 solves for the equilibrium when law enforcement is restricted in its ability to profile. Section 6 compares outcomes under unrestricted and restricted profiling. There, we consider the impact of a rule requiring equal treatment of population groups, and we determine the most effective profiling rule. Section 7 considers a number of extensions, including introducing a more comprehensive definition of social welfare, endogenizing the size of the law enforcement budget, and explicitly modeling the criminal recruitment process. Section 8 concludes.

2 Literature

We develop a game theoretic model of criminal and law enforcement behavior. It is related to early models of crime that first use economic methods to analyze the decision to engage in crime and consider the interaction between criminal activity and law enforcement strategies (e.g. Becker 1968, Ehrlich 1973).[6] There are no observable differences between population groups, and criminal profiling based on race or other characteristics plays no role in these early models. The most related paper to ours is Persico (2002), which we discuss in detail in the introduction. Like us, Persico (2002) focuses on how rules limiting racial profiling change law enforcement strategies and criminal activity, and shows how such rules can reduce crime. Where Persico (2002) models decentralized crime, with individuals independently deciding whether to engage in crime, we model centralized crime, with a strategic criminal organization deciding whom to recruit to attempt a crime on its behalf. In contrast to Persico (2002), we show that banning the use of profiling by law enforcement in such a setting never improves the effectiveness of law enforcement.

Other papers in the literature on racial profiling focus on deriving empirical tests for identifying racial bias in law enforcement activities. In contrast to Persico (2002) and our own paper, they do not focus on how profiling rules prevent crime. Knowles, Persico and Todd (2001) develop a model of criminal activity and law enforcement in traffic stops. They show that in equilibrium, even unbiased law enforcement officers screen one population group at a higher rate.[7] Therefore, simply showing that officers screen one population group at

[6] Becker (1968) applies the theory of rational behavior to the study of crime and develops a model of the decision to commit offenses. Ehrlich (1973) generalizes Becker's model to allow an individual to allocate resources to legal and illegal activities. He also finds empirical evidence that law enforcement deters all crimes and there is a strong positive correlation between income inequality and crimes against property.

[7] Knowles, Persico and Todd (2001) show that unbiased law enforcement officers choose a screening strategy that equalizes the marginal benefit of searching different population groups; a law enforcement officer is just as likely to make an arrest when he searches a white motorist or pedestrian as when he searches a black motorist or pedestrian. The arrest rate is equal across population groups *because* the population groups are searched at different rates. Our analysis, in the case in which law enforcement is unconstrained in its ability to profile, clearly illustrates this point. In equilibrium, the criminal organization in our model is indifferent between recruiting a type A (high recruitment cost) operative or a type B (low recruitment cost) operative. This is precisely because law enforcement screens the type B population at a higher rate. The crime rate within the population groups respond rationally to the asymmetries in the law enforcement search rate. Therefore, in equilibrium, the low-cost group is screened more frequently even though they are no more likely to commit a crime in equilibrium. Some analysis either does not recognize or ignores the fact that the crime rate responds to changes in law enforcement. See for example Gelman, Fagan and Kiss

a higher rate does not establish officer bias. They identify a hit-rate test for racial bias: if the rate at which a crime is discovered during a search differs across groups, then it suggests officers are racially biased.[8] A number of papers extend Knowles, Persico and Todd (2001) in a variety of directions.[9] Most notably, Persico and Todd (2005) consider the possibility that criminals can pay a cost to change their appearance or recruit a member of another population group to attempt a crime on their behalf. Although this is similar to our assumption that a criminal organization chooses the observable characteristics of its recruits, there are a number of factors that distinguish our work and theirs. First, in Persico and Todd (2005) there are many criminal actors independently choosing their criminal activity and recruitment strategies, compared to our model in which criminal strategy is centrally planned by a criminal organization. Second, the focus is on two separate aspects of law enforcement. Persico and Todd (2005) focus on developing empirical tests for racial biases in law enforcement profiling strategies, but do not consider most effective restrictions to the use of profiling. We focus on determining the impact that restricting or eliminating profiling will have on criminal behavior and overall crime.

Finally, our paper is related to papers involving government investment in security at potential terrorism targets. Bier, Oliveros and Samuelson (2007) shows that a government may want to visibly under-protect some targets in order to draw the terrorists' attention away from other (possibly more valuable) alternatives. This is similar to the government in our paper committing to a profiling rule that leads to the over-screening of some and the under-screening of other population groups (from the perspective of the equilibrium strategy), and ensures that the criminal organization recruits from the under-screened group, which although under-screened compared to the equilibrium strategy is still screened with a higher probability than the other group. See also, Bernhardt and Polborn (2010), Lakdawalla and Zanjani (2005) and Bier (2007).

3 Model

A mass one of individuals passes through a checkpoint operated by a government law enforcement officer. Portion λ of the individuals are type $t = A$ and portion $1 - \lambda$ are type $t = B$. An individual's type may represent ethnic or racial characteristics, citizenship, or other observable differences between two population groups.

A criminal organization may recruit a single criminal operative to carry something illegal (e.g. drugs, bomb) through the checkpoint. The criminal organization can recruit either a type $t = A$ or type $t = B$ operative. Recruiting a type t operative costs the criminal organization r_t, where $0 \leq r_B < r_A < 1$. This means that a type A operative is more

(2007, p813) who show that minorities are screened more frequently than whites, "even after controlling for . . . race-specific estimates of crime participation." This is consistent with equilibrium behavior, even with unbiased law enforcement officers, in both Knowles, Persico and Todd (2001) and our analysis.

[8] An alternative test is developed by Anwar and Fang (2006). See also Ayres (2002).

[9] Hernández-Murillo and Knowles (2004) adapt Knowles, Persico and Todd (2001) to test for racial bias when the data does not distinguish between discretionary and non-discretionary law enforcement searches. Persico and Todd (2006) consider the possibility that searches do not always uncover illegal activities and show that the hit rate test is still valid. Antonovics and Knight (2009) show that law enforcement officers are less likely to search people of their own race.

expensive, time-consuming, or otherwise difficult to recruit.[10] Alternatively, the criminal organization may choose not to recruit an operative, and the game ends with all players receiving payoff 0.

The law enforcement officer cannot immediately distinguish whether an individual passing through his checkpoint is a criminal operative. To learn whether individuals are operatives, the officer can search or otherwise screen people as they pass through the checkpoint. The officer perfectly observes whether any individual he screens is an operative, at which point the operative is detained, the officer earns payoff v, and the criminal organization gets payoff 0. If the officer does not screen the operative, then the operative passes through the checkpoint undetected, and the officer gets payoff 0, and the criminal organization gets payoff normalized to 1.

The officer is limited in his screening capacity, unable to screen more than $\bar{s}$ portion of the population. This may be due to limited budgets, staff, or other available resources. The officer chooses the portion of each population group to screen, with a denoting the portion of type A individuals who are screened and b denoting the portion of type B individuals screened. The total portion of the population who are screened is denoted $s(a, b) \equiv \lambda a + (1 - \lambda)b$, where the officer is constrained to choose a and b such that $s \leq \bar{s}$. In Section 7, we endogenize the budget and assume that a government official determines the resources $\bar{s}$ available for law enforcement at an earlier stage of the game.

The criminal organization's recruitment strategy may be represented by a pair of probabilities (q_A, q_B), where q_j denote the probability the organization recruits an operative from group $j \in \{A, B\}$ and $q_A + q_B = 1$. Law enforcement chooses its screening strategy (a, b) subject to $\bar{s}$. We solve for the Nash equilibrium of the simultaneous move game in which both law enforcement and the criminal organization choose their strategies at the same time.[11]

We are concerned with minimizing the amount of successful criminal activity, represented by function $\mathcal{C}$.

$$\mathcal{C} = q_A(1 - a) + q_B(1 - b), \tag{1}$$

The "effectiveness of law enforcement" may be represented by $1 - \mathcal{C}$. Denote the expected payoff of law enforcement by u_{LE}, and the expected payoff of the criminal organization by u_C.

$$u_{LE} = (q_A\ a + q_B\ b)v, \tag{2}$$

$$u_C = \mathcal{C} - q_A r_A - q_B r_B. \tag{3}$$

3.1 Fairness and profiling rules

Define $\delta \equiv |b - a|$. This is the difference between the rate of screening of the type B population and the rate of screening of the type A population by law enforcement.

[10]By assuming simply that the criminal organization can recruit type A and B operatives at fixed costs r_A and r_B, we effectively abstract from the preferences of individual criminal operatives. Our simplifying assumption makes it easier to develop intuition, but is not necessary for our results. In Section 7, we explicitly model operative behavior in the criminal recruitment process, and we show how our results hold up under reasonable alternative assumptions about the recruitment process.

[11]This is equivalent to a sequential game with imperfect information, where one of the players chooses its strategy first and the second mover chooses its strategy without observing the strategy selected by the first mover.

We apply the concept of fairness in screening games directly from Persico (2002).

Definition 3.1 *Fairness of law enforcement:*

- *Law enforcement screening strategy* (a, b) *is* ***more fair*** *than alternative screening strategy* (a', b') *if* $|b - a| < |b' - a'|$.

- *The* ***most fair*** *screening strategy is* $a = b$.

That is, the lower is δ, the more fair the law enforcement strategy. The most fair strategy involves equal treatment of two population groups, with $\delta = 0$.

There may exist a limit to how unfair law enforcement may make their screening strategy. This may be an exogenous limitation imposed by a DOJ order, a judicial ruling or politicians passing legislation in response to popular pressure. Or, the limit may be strategically selected by the government in the initial stage of the game.

Let $\bar{\delta} \geq 0$ denote a limit to how unfair a permissible law enforcement screening strategy may be. Under limit $\bar{\delta}$, the officer is restricted to choosing a strategy (a, b) such that $\delta \leq \bar{\delta}$. When $\bar{\delta} = 0$, the officer is constrained to choose $a = b$. If there does not exist a restriction (which we denote by $\bar{\delta} \geq 1$), then law enforcement is free to choose any screening strategy in the second stage of the game, conditional on satisfying the resource constraint $\bar{s}$. We refer to a limit $\bar{\delta}$ as a "profiling rule."

Definition 3.2 *Effectiveness of law enforcement:*

- *Profiling rule* $\bar{\delta}$ *is* ***more effective*** *than alternative* $\bar{\delta}'$ *if in equilibrium* $\mathcal{C}$ *is lower under* $\bar{\delta}$ *than under* $\bar{\delta}'$.

- *Profiling rule* $\bar{\delta}$ *is the* ***most effective*** *rule if there does not exist an alternative* $\bar{\delta}'$ *such that* $\mathcal{C}$ *is lower than under* $\bar{\delta}$.

3.2 Note of our assumptions

The model builds on Persico (2002). The most important difference between our framework and his is our assumption that crime is planned by a criminal organization, rather than decided on an individual basis. Because of this, our model is more applicable to planned criminal activity at borders and other security checkpoints. By assuming simply that the criminal organization can recruit type A and B operatives at fixed costs r_A and r_B, we abstract from the preferences of individual criminal operatives. Our simplifying assumption makes it easier to develop intuition, but is not necessary for our results. In Section 7, we explicitly model operative behavior in the criminal recruitment process.

Other deviations from Persico (2002) are more minor. Although we assume a single criminal organization and recruit, it would be straightforward to consider a setting in which there are multiple criminal organizations and where criminal organizations can recruit multiple operatives. Such a model will be equivalent to the one we analyze if recruitment costs are common to all organizations and if the total number of criminals is finite. Even in more general models, we expect our qualitative results to hold. Similarly, the model formally includes only a single representative law enforcement officer. We could extend the model to allow multiple officers with a common objective without changing the main results.

4 Equilibrium with Unrestricted Profiling

The analysis begins by deriving the equilibrium strategies when there is no restriction on the use of profiling by law enforcement or (equivalently) when the restriction does not bind, e.g. $\bar{\delta} \geq 1$.

Prior to choosing their strategies, both law enforcement and the criminal organization observe $\bar{s}$. The screening capacity $\bar{s}$ serves as a budget constraint in law enforcement's choice of strategy (a, b), where $\lambda a + (1 - \lambda)b \leq \bar{s}$.

Law enforcement expected payoff is given by (2) and the criminal organization's expected payoff is given by (3). In equilibrium, each player's strategy must maximize its expected payoff (i.e., must be a best response) given the equilibrium strategy of the other player.

First, we consider the possibility that no criminal activity occurs in equilibrium. For this to be the case, it must be a best response for the criminal organization to refrain from crime given law enforcement's screening strategy (a, b). This requires that $a \geq 1 - r_A$ and $b \geq 1 - r_B$. If either inequality does not hold, the criminal organization has an incentive to recruit rather than refrain from crime. The minimum law enforcement budget necessary for law enforcement to satisfy both inequalities is denoted by the "no crime" budget $\bar{s}_{nc}$, where

$$\bar{s}_{nc} = \lambda(1 - r_A) + (1 - \lambda)(1 - r_B) = 1 - \lambda r_A - (1 - \lambda)r_B. \tag{4}$$

The first lemma establishes that the equilibrium never involves criminal activity whenever the law enforcement budget is at least $\bar{s}_{nc}$, and always involves criminal activity otherwise.

Lemma 4.1 *In the game with unrestricted profiling:*

- *When $\bar{s} < \bar{s}_{nc}$, all equilibria involve crime (i.e., $q_A > 0$ and/or $q_B > 0$).*
- *When $\bar{s} \geq \bar{s}_{nc}$ all equilibria involve no crime (i.e., $q_A = q_B = 0$).*

Second, we consider the possibility that the law enforcement budget is sufficiently small (or the difference in criminal recruitment costs $(r_A - r_B)$ sufficiently large) that it can have no impact on criminal behavior. When this is the case, the criminal organization always prefers to recruit from the low cost population B, and the presence of law enforcement does not alter its behavior. For all $\bar{s} \leq (1 - \lambda)(r_A - r_B)$, it is always a best response for the criminal organization to recruit from the type B population, independent of the screening strategy of law enforcement.

Throughout the rest of the analysis, we restrict attention to the case in which $(1-\lambda)(r_A - r_B) < \bar{s} < \bar{s}_{nc}$. This is the most realistic case. We do not believe an environment in which law enforcement effectively deters all crime is realistic, nor do we believe an environment in which law enforcement has no impact on criminal behavior is realistic. The case of moderate $\bar{s}$ is also most interesting from a theoretical perspective; it is here where small changes in profiling rules can significantly change behavior. Because of this, we impose the following assumptions:

(A1) The law enforcement budget is not sufficient to deter all crime in equilibrium:

$$\bar{s} < \bar{s}_{nc}.$$

(A2) The law enforcement budget is sufficient to impact criminal behavior:

$$(1-\lambda)(r_A - r_B) < \bar{s}.$$

We formally describe the equilibrium for the relevant case in which $(1-\lambda)(r_A - r_B) < \bar{s} < \bar{s}_{nc}$ in the following lemma.

Proposition 4.2 *In the unique equilibrium under unconstrained profiling and (A1) and (A2), the criminal organization mixes in its recruitment strategy, and law enforcement screens across both population groups:*

$$q_A = \lambda, \qquad q_B = 1-\lambda;$$
$$a = \bar{s} - (1-\lambda)(r_A - r_B), \qquad b = \bar{s} + \lambda(r_A - r_B).$$

The equilibrium of the game with no restriction on profiling is in mixed strategies. The criminal organization mixes between recruiting from the type A and type B populations in such a way that it is a best response for law enforcement to devote resources to screening both population groups. Law enforcement divides its resources in such a way that it is a best response for the criminal organization to mix in its recruitment efforts.

The intuition for why no pure strategy equilibrium exists is straightforward. If the criminal organization is sufficiently likely to recruit from one population group, then law enforcement has an incentive to focus its screening efforts on the overly-recruited group. But then, given law enforcement's focus on that group, the criminal organization has an incentive to deviate to recruit from the group that is less heavily screened.

This equilibrium is unique under (A1) and (A2), which restrict attention to the most interesting range of parameter values. If (A1) is violated, then the law enforcement budget is sufficiently large that the only equilibrium involves no crime. If (A2) is violated, then the law enforcement budget is sufficiently small that the only equilibrium involves law enforcement focusing all of its budget on screening the type B population, and the criminal organization recruiting from the type B population.[12]

We calculate the amount of criminal activity and player payoffs for any $\bar{s}$ satisfying (A1) and (A2).

Corollary 4.3 *Under unconstrained profiling and (A1) and (A2), in the unique equilibrium*

$$\mathcal{C} = 1 - \bar{s},$$
$$u_{LE} = \bar{s}\ v,$$
$$u_C = 1 - \bar{s} - \lambda\ r_A - (1-\lambda)\ r_B.$$

[12]When $\bar{s} < (1-\lambda)(r_A - r_B)$, the unique equilibrium involves the criminal organization recruiting only from the type B population. When $\bar{s} = (1-\lambda)(r_A - r_B)$, there exists a continuum of equilibria, one equilibrium for each $q_B \in (1-\lambda, 1]$; the criminal organization recruits a type B operative with sufficiently high probability. In each of the equilibrium, law enforcement concentrates all screening on the type B population.

5 Equilibrium with Restricted Profiling

In this section, we consider a setting in which society may commit to a profiling rule $\bar{\delta}$ that limits the behavior of law enforcement. The analysis here incorporates the additional constraint that $|b-a| \leq \bar{\delta}$. When $\bar{\delta}$ is sufficiently large, it does not bind and therefore has no effect on equilibrium behavior. In the unconstrained game $\delta = |b-a| = r_A - r_B$. Any $\bar{\delta} \geq r_A - r_B$ is not binding and is equivalent to the case of unrestricted profiling considered in the previous section. In this section, we therefore limit attention to $\bar{\delta} < r_A - r_B$.

As was also the case with no restriction on profiling, a sufficiently high $\bar{s}$ means that law enforcement is able to completely eliminate crime. This is the case when law enforcement can afford to simultaneously set $a \geq 1 - r_A$ and $b \geq 1 - r_B$, while also maintaining the fairness restriction $|b-a| \leq \bar{\delta}$. The minimum $\bar{s}$ for which this is possible is

$$\bar{s}'_{nc} = \lambda(1 - r_B - \bar{\delta}) + (1-\lambda)(1-r_B) = 1 - r_B - \lambda\bar{\delta}. \tag{5}$$

The following lemma establishes that the equilibrium involves no criminal activity whenever the $\bar{s} \geq \bar{s}'_{nc}$, and involves criminal activity otherwise.

Lemma 5.1 *In the game with limited profiling:*

- *When $\bar{s} < \bar{s}'_{nc}$, all equilibria involve crime (i.e., $q_A > 0$, $q_B > 0$, or both).*
- *When $\bar{s} \geq \bar{s}'_{nc}$ all equilibria involve no crime (i.e., $q_A = q_B = 0$).*

For smaller values of $\bar{s}$, the criminal organization recruits only from the type B population, and law enforcement devotes as many resources as possible to screening this population group. When $\bar{s} \leq (1-\lambda)\bar{\delta}$, this is because the law enforcement budget is so low that even if all resources were devoted to screen the type B population, the criminal organization would still prefer to recruit from the low cost group (this is restricted profiling equivalent to the case ruled out by (A2) in the unconstrained game). When $(1-\lambda)\bar{\delta} < \bar{s} < \bar{s}'_{nc}$, law enforcement could impact the criminal organizations recruitment strategy if it was allowed to focus more of its budget screening population B. However, profiling rule $\bar{\delta}$ restricts law enforcement to play a screening strategy for which it is a best response for the criminal organization to always recruit from the type B population.

Proposition 5.2 *In the unique equilibrium under profiling rule $\bar{\delta} \in [0, r_A - r_B)$, and (A1) and (A2), the criminal organization always recruits from population B, and law enforcement screens population as much as possible subject to budget $\bar{s}$ and profiling rule $\bar{\delta}$:*

$$q_A = 0, \qquad q_B = 1;$$
$$a = \bar{s} - (1-\lambda)\bar{\delta}, \qquad b = \bar{s} + \lambda\bar{\delta}.$$

Any profiling rule $\bar{\delta} < r_A - r_B$ prevents law enforcement from playing the equilibrium screening strategy in the unconstrained game. Given the criminal organization's focus on population B, law enforcement would like to shift its resources to screen population B as frequently as possible, but is prevented from doing so by the profiling rule.

We calculate the equilibrium probability that the criminal act is successful and player payoffs for any $\bar{s}$ that satisfies (A1) and (A2). We use superscript $\bar{\delta}$ to denote the outcome under a binding profiling rule.

Corollary 5.3 *Under profiling rule $\bar{\delta} \in [0, r_A - r_B)$, and (A1) and (A2), in the unique equilibrium*

$$\mathcal{C}^{\bar{\delta}} = 1 - \bar{s} - \lambda\, \bar{\delta},$$
$$u_{LE}^{\bar{\delta}} = (\bar{s} + \lambda\, \bar{\delta})\, v,$$
$$u_C^{\bar{\delta}} = 1 - \bar{s} - \lambda\, \bar{\delta} - r_B.$$

Conditional on $\bar{\delta} < r_A - r_B$, the probability of successful criminal activity and the payoffs of the criminal organization are strictly decreasing in $\bar{\delta}$, while the payoffs to law enforcement is strictly increasing in $\bar{\delta}$. This means that weaker restrictions on the use of profiling are more effective at reducing crime compared to more strict rules. This does not, however, imply that no restriction on profiling is most effective, as we show in the following section.

6 Impact of Restricting Profiling

A binding profiling rule $\bar{\delta} \in [0, r_A, r_B)$ prevents law enforcement from playing the equilibrium screening strategy in the unconstrained game. It commits law enforcement to screen population A too much and population B too little, relative to the equilibrium outcome in the unconstrained game. The criminal organization's best response to screening population B too little involves always recruiting from that group, and never from the relatively over-searched population A. Given the criminal recruitment strategy, law enforcement would like to shift its resources to screen group B as frequently as possible, but is prevented from doing so by the profiling rule. In this sense, the profiling rule serves as a commitment device, committing law enforcement to search population B less frequently than it prefers at the time it chooses a screening strategy.

The commitment to an out-of-equilibrium screening strategy may improve the effectiveness of law enforcement. A profiling rule leads the criminal organization to focus its recruitment efforts on a single population group, making it more predictable and easier for law enforcement to target. As long as the profiling rule is not too restrictive, law enforcement continues to screen the type B (recruited) population more frequently than the type A population, and on average criminal activity is caught more often than in the unconstrained game.

When no profiling is allowed (i.e., $\bar{\delta} = 0$), there are no realized benefits from being able to better predict the observable characteristics of criminal recruits. This is because even though law enforcement correctly predicts a type B criminal recruit, it is not allowed to screen the type B population any more often than the type A population, and on average criminal activity is caught equally as frequently as in the unconstrained game.[13] $\bar{\delta} = 0$ is restrictive enough that any potential benefits from restricting profiling are completely offset by the loss of officer flexibility when choosing a screening strategy.

[13]To see this, note that law enforcement's budget constraint implies that $a = b = \bar{s}$. In this case, the criminal organization only recruits from population group B. Therefore, with equal treatment, the probability of catching the operative is $b = \bar{s}$. From Proposition 4.2, we know that in the game with unconstrained profiling, both the criminal organization and law enforcement play mixed strategies. Therefore, in the game with unconstrained profiling, the probability of catching the operative is $aq_A + bq_B = \lambda(\bar{s} - (1-\lambda)(r_A - r_B)) + (1-\lambda)(\bar{s} + \lambda((r_A - r_B)) = \bar{s}$. As a result, equal treatment leads to the same probability of catching the operative as in the game with unconstrained profiling.

Theorem 6.1 *If $\bar{\delta} \in (0, r_A - r_B)$, then*

$$\mathcal{C}^{\bar{\delta}} < \mathcal{C}, \;\; u_{LE}^{\bar{\delta}} > u_{LE}, \;\; \textit{and} \;\; u_C^{\bar{\delta}} > u_C.$$

If $\bar{\delta} = 0$, then

$$\mathcal{C}^{\bar{\delta}} = \mathcal{C}, \;\; u_{LE}^{\bar{\delta}} = u_{LE}, \;\; \textit{and} \;\; u_C^{\bar{\delta}} > u_C.$$

As the theorem shows, limiting (but not banning) the use of profiling by law enforcement results in a Pareto improvement. The limit on the use of profiling improves the effectiveness of law enforcement, leading to less successful criminal activity. This decreases crime and improves the payoffs of law enforcement. The criminal organization is hurt by lower criminal success rates, but this harm is more than offset by the reduced recruitment costs from focusing on the type B population. The benefits to the criminal organization from a profiling rule are strictly increasing in severity of that rule. For high $\bar{\delta}$ (i.e., a weak rule that barely limits law enforcement behavior), the benefits to the criminal organization are small. The criminal organization is best off with a ban on profiling, where both recruitment costs and law enforcement effectiveness are minimized. This is in contrast to the relationship between the severity of the profiling rule and the effectiveness of law enforcement. $\mathcal{C}$ is minimized and u_{LE} is maximized when $\bar{\delta}$ just barely binds, with $\mathcal{C}$ strictly increasing and u_{LE} strictly decreasing as $\bar{\delta}$ falls to zero. Under a profiling ban (i.e., $\bar{\delta} = 0$), $\mathcal{C}$ achieves its maximum and u_{LE} achieve its minimum values. Crime is the same under a complete ban on profiling and in the case of unrestricted profiling. Interestingly, only the criminal organization benefits from a ban on profiling.[14]

Corollary 6.2 *Requiring equal treatment never increases the effectiveness of law enforcement compared to unconstrained profiling. Any other profiling rule is more effective than $\bar{\delta} = 0$.*

6.1 Most effective profiling rule

The effectiveness of law enforcement is strictly increasing in $\bar{\delta} < r_A - r_B$. This means that the most effective profiling rule involves $\bar{\delta}$ only marginally below $r_A - r_B$. That is, $\mathcal{C}$ is minimized when the government imposes a profiling rule requiring the law enforcement officer to treat the two population groups only marginally more fairly than he does without a profiling rule. A marginal increase in fairness is enough to incentivize the criminal organization to always recruit an operative from group B, and allows law enforcement to continue screening this group at a relatively high rate. This significantly increases the probability of catching an operative.

Theorem 6.3 *The most effective profiling rule sets $\bar{\delta}$ marginally below $r_A - r_B$.*

The most effective profiling rule requires that officers screen population groups only marginally more fairly than they do in the absence of a profiling rule.

[14] Of course, this conclusion ignores the wellbeing of innocent people subject to additional search. We discuss this further in Section 7.

7 Additional considerations

In an Online Appendix, we provide detailed analyses of a number of model extensions. We only briefly summarize these extensions here.

First, we consider a measure of social welfare that accounts for fairness of the profiling strategy. Such a measure assumes welfare is increasing in fairness, and assures that banning profiling is better than no restriction. However, it does not guarantee that banning profiling is better than a less restrictive limit. This depends on how much society cares about fairness relative to preventing crime.

Second, we endogenize the law enforcement budget, assuming that is is selected by a government planner in an initial stage of play. Under this extension, the most effective profiling rule continues to involve only minimal restrictions on the use of profiling.

Third, we endogenize criminal recruitment costs. Throughout the paper, we assume fixed, exogenous costs of criminal recruitment. In the extensions, we first endogenize criminal wages. In equilibrium, recruitment costs depend on screening probabilities since a recruit's required payment is increasing in the probability of being caught. We then consider a framework in which the criminal organization chooses whether to use one of its members, or to search for a willing recruit from an outside population group. If it chooses to search, there is uncertainty about how long it will take before finding a willing recruit. In both of these extended versions, the qualitative results from our analysis continue to hold.

8 Conclusion

Where others study criminal profiling in the context of traffic stops and other settings of individual, decentralized criminal behavior, we incorporate criminal profiling into a model in which a centralized organization can respond to government profiling rules by changing the rate at which it recruits criminals from different population groups. Such a model is most applicable to major criminal acts such as smuggling and terrorism, which security officers at borders and other checkpoints intend to detect and deter. In models of decentralized criminal activity, restrictions on the use of profiling helps overcome an agency problem between law enforcement officers who are concerned about maximizing their arrest rates, and a society concerned about the overall crime rate. Our framework abstracts from such agency concerns, and focuses on the role of profiling rules as a commitment device. In our model of centralized criminal recruitment, a binding profiling rule commits law enforcement to play a strategy that is inconsistent with the unconstrained equilibrium, and this results in the criminal organization shifting its recruitment strategy to focus on a population group that is both easier to recruit and more likely to be caught. A restriction on the use of profiling effectively gives law enforcement a first mover advantage in the criminal recruitment and screening game, and improves the effectiveness of its policing efforts.

Unlike in a model of decentralized crime, in our model of centralized crime requiring equal treatment of the two population groups never improves the effectiveness of law enforcement. This is in contrast to Persico (2002) where equal treatment could be most effective. In our framework with strategic criminal recruitment, the most effective policy requires the officers to treat the different groups only moderately more fairly than they would without the rule, such a restriction incentivizes the criminal organization to focus its recruitment efforts on a single group, but doesn't significantly decrease the amount of resources law enforcement devotes to screening that group. Imposing a more restrictive constraint requires that law enforcement shift resources away from screening the group with an active criminal population to a group with no active recruitment. A more restrictive limit to the officers' ability to profile (including requiring equal treatment) leads to strictly less effective law enforcement and a higher rate of successful crime.

Appendix: Proofs

Proof to Lemma 4.1

Consider the possibility that the criminal organization does not engage in criminal activity in equilibrium. If either $a < 1 - r_A$ or $b < 1 - r_B$, then the criminal organization prefers to recruit an operative (and engage in criminal activity). Therefore, law enforcement must choose both $a \geq 1 - r_A$ and $b \geq 1 - r_B$, for which it is a best response for the criminal organization to not engage in criminal activity. The minimum $\bar{s}$ for which law enforcement is able to simultaneously satisfy both constraints is given by $\bar{s}_{nc}$ as defined by (4). For any capacity $\bar{s} \geq \bar{s}_{nc}$, law enforcement has the budget to fully eliminate crime. If it chooses $a \geq 1-r_A$ and $b \geq 1-r_B$, it is a best response for the criminal organization to forgo criminal activity. If the criminal organization forgoes criminal activity, any screening strategy is a best response for law enforcement. Therefore, there exists an equilibria for each screening strategy (a, b) such that $a \geq 1 - r_A$, $b \geq 1 - r_B$ and $\lambda a + (1 - \lambda)b \leq \bar{s}$, in which law enforcement plays (a, b) and the criminal organization refrains from crime.

To establish that these are the only equilibria when $\bar{s} \geq \bar{s}_{nc}$, we must establish that there does not exist an equilibrium in which law enforcement prefers to choose either $a < 1 - r_A$ or $b < 1 - r_B$. If law enforcement did this, then the criminal organization best response involves recruiting from the type A population. But, then law enforcement has an incentive to deviate in its screening strategy to shift resources to screening the type A population at the maximum feasible rate; contradicting the possibility this is an equilibrium. A similar argument may be made for the choice of $b < 1-r_B$. The simultaneous choice of $a < 1-r_A$ and $b < 1 - r_B$ may be ruled out because the budget constraint $\bar{s} \geq \bar{s}_{nc}$ means law enforcement has unused resources that it could devote to screening the group(s) from which the criminal organization chooses to recruit. Thus, no equilibrium exists when $\bar{s} \geq \bar{s}_{nc}$ in which there is criminal activity. Similarly, there cannot exist an no crime equilibrium when $\bar{s} < \bar{s}_{nc}$ because that would mean that either $a < 1 - r_A$, $b < 1 - r_B$ or both, and the criminal organization's best response will involve recruitment.

Proof to Proposition 4.2

Here, we consider the cases where resources are not sufficient to eliminate crime, i.e., $\bar{s} < \bar{s}_{nc}$. In this setting, law enforcement expects payoff $u_{LE} = (q_A a + q_B b)v$, which it maximizes subject to its resource constraint $\lambda a + (1 - \lambda)b \leq \bar{s}$. Conditional on $\bar{s} < \bar{s}_{nc}$ (which assures that $q_A > 0$ and/or $q_B > 0$), law enforcement always prefers to use all available resources.

Thus, in equilibrium, $\lambda a + (1-\lambda)b = \bar{s}$, or equivalently,

$$a = \frac{\bar{s} - (1-\lambda)b}{\lambda}. \tag{6}$$

The screening strategy of law enforcement may be fully represented by its choice of b conditional on $\bar{s}$. Screening rate a is implied form b according to (6). Similarly, in the case where criminal activity is not fully eradicated, the recruitment strategy of the criminal organization may be fully represented by its choice of the probability it recruits from the type B population, q_B, where $q_A = 1 - q_B$.

Plugging (6) and $q_A = 1 - q_B$ into our expression for u_{LE} gives

$$u_{LE} = ((1-q_B)\frac{\bar{s} - (1-\lambda)b}{\lambda} + q_B b)v.$$

For all $q_B < 1-\lambda$, this expression is strictly decreasing in b, and therefore law enforcement's best response involves screening the type A population as much as possible. For all $q_b > 1-\lambda$, this expression is strictly increasing in b, and law enforcement's best response involves screening the type B population as much as possible. When $q_B = 1-\lambda$, the expression is independent of b, and thus any b constitutes a best response for law enforcement.

The expected payoffs to the criminal organization are $u_C(A) = 1 - a - r_A = 1 - (\bar{s} - (1-\lambda)b)/\lambda - r_A$ from recruiting a type A operative, and $u_C(B) = 1 - b - r_B$ from recruiting a type B operative. For all $b > \bar{s} + \lambda(r_A - r_B)$, the best response of the criminal organization involves recruiting a type A operative. For all $b < \bar{s} + \lambda(r_A - r_B)$, its best response involves recruiting a type B operative. When $b = \bar{s} + \lambda(r_A - r_B)$, any recruitment strategy constitutes a best response.

When $\bar{s} < (1-\lambda)(r_A - r_B)$, the unique point of intersection between the best response functions of law enforcement and the criminal organization is when $b = \bar{s}/(1-\lambda)$ and $q_B = 1$. The equilibrium involves the criminal organization recruiting only from the type B population, and law enforcement focusing all of its resources on screening the type B population (i.e., $a = 0$). Despite all screening being directed at the recruited group, law enforcement resources are sufficiently low that the screening efforts do not impact criminal behavior.

When $\bar{s} = (1-\lambda)(r_A - r_B)$, the best response functions overlap over a range of q_B. There exists a continuum of equilibrium, one for any $q_B \in [1-\lambda, 1]$, in which the criminal organization plays q_B and law enforcement chooses $b = \bar{s}/(1-\lambda) = r_A - r_B$. Here, law enforcement devotes all of its resources to screening the type B population (i.e., $a = 0$), and this leads the criminal organization to be indifferent in its recruitment strategy. The equilibrium requires that the criminal population recruit from the type B population frequently enough (i.e., $q_B \geq 1-\lambda$) to assure law enforcement does not have an incentive to deviate in its recruitment strategy. (Whenever $\bar{s} \leq (1-\lambda)(r_A - r_B)$, it is a best response for the criminal organization to set $q_B = 1$ for any choice of screening strategy (a, b), verifying the justification for (A2) in the paper.)

When $\bar{s} > (1-\lambda)(r_A - r_B)$ (and $\bar{s} < \bar{s}_{nc}$), the best response functions overlap at a single crossing point where $q_B = 1-\lambda$ and $b = \bar{s} + (r_A - r_B)\lambda$. This is a mixed strategy equilibrium in which the criminal organization's recruitment strategy makes law enforcement indifferent in its screening strategy, and law enforcement's screening strategy makes the criminal organization indifferent in its recruitment strategy. Here $q_A = \lambda$ and $q_B = 1 - \lambda$, and $a = \bar{s} - (1-\lambda)(r_A - r_B)$ and $b = \bar{s} + \lambda(r_A - r_B)$.

This represents a complete characterization of the equilibria for each possible $\bar{s}$.

Proof to Corollary 4.3

Follows immediately from plugging in the equilibrium values of q_A, q_B, a and b into our equations for $\mathcal{C}$, u_{LE} and u_C.

Proof to Lemma 5.1

Consider the possibility that the criminal organization does not engage in criminal activity in equilibrium. If either $a < 1 - r_A$ or $b < 1 - r_B$, then the criminal organization prefers to recruit an operative (and engage in criminal activity). Therefore, law enforcement must choose both $a \geq 1 - r_A$ and $b \geq 1 - r_B$, for which it is a best response for the criminal organization to not engage in criminal activity. Given that $r_B < r_A$, the least costly $\bar{s}$ which invokes no crime involves $b = 1 - r_B$ and $a = b - \bar{\delta} = 1 - r_B - \bar{\delta}$. The minimum screening capacity under which crime may be eliminated is given by $\bar{s}'_{nc}$ as defined by (5). For any capacity $\bar{s} \geq \bar{s}'_{nc}$, law enforcement has the budget to fully eliminate crime while satisfying the profiling rule. If it chooses $a \geq 1 - r_A$ and $b \geq 1 - r_B$, it is a best response for the criminal organization to forgo criminal activity. If the criminal organization forgoes criminal activity, any screening strategy is a best response for law enforcement. Therefore, there exists an equilibria for each screening strategy (a, b) such that $a \geq 1 - r_A$, $b \geq 1 - r_B$, $|b - a| \leq \bar{\delta}$, and $\lambda a + (1-\lambda)b \leq \bar{s}$, in which law enforcement plays (a, b) and the criminal organization refrains from crime. We rule out equilibria with criminal activity when $\bar{s} \geq \bar{s}'_{nc}$, and equilibria without criminal activity when $\bar{s} < \bar{s}'_{nc}$ in the same way we ruled out such equilibria in the Proof to Lemma 4.1.

Proof to Proposition 5.2

Here we derive the equilibria of the game for the case where $\bar{s} < \bar{s}'_{nc}$, the range of budgets for which criminal activity exists in equilibrium.

First, we rule out the possibility that an equilibrium exists in which the criminal organization mixes in its recruitment strategy. Suppose instead that the criminal organization mixes between recruiting type A and type B agents. It must get the same expected payoffs from recruiting a type A and a type B operative: $u_C(A) = u_C(B) \iff 1 - a - r_A = 1 - b - r_B$. Rearranging this equation gives $b - a = r_A - r_B$, which contradicts $\bar{\delta} < r_A - r_B$ given that $\delta \equiv |b - a|$ and $\delta < \bar{\delta}$. Therefore, no equilibrium with a mixed recruiting strategy exists.

Similarly, we can show that the criminal organization always prefers to recruit a lower-cost type B operative rather than a type A operative. The criminal organization always prefers to recruit a type B operative when

$$1 - a - r_A < 1 - b - r_B \iff b - a < r_A - r_B,$$

which is guaranteed by $\bar{\delta} < r_A - r_B$. Lemma 5.1 establishes that criminal recruitment takes place in equilibrium when $\bar{s} < \bar{s}'_{nc}$. Therefore, in equilibrium $q_A = 0$ and $q_B = 1$.

To determine law enforcement's screening strategy, recognize that since the criminal organization recruits a type B operative, the law enforcement's best response is to maximize b subject to the budget constraint $\lambda a+(1-\lambda)b \leq \bar{s}$ and the profiling rule requiring $b-a \leq \bar{\delta}$. When both inequalities bind,

$$a = \bar{s} - (1-\lambda)\bar{\delta} \quad \text{and} \quad b = \bar{s} + \lambda\bar{\delta}. \tag{7}$$

Both a and b must be on $(0,1)$. Variable b satisfies the constraint when $\bar{s} < 1 - \lambda\bar{\delta}$, a constraint that is always satisfied when $\bar{s} < \bar{s}'_{nc}$. Variable a satisfies the constraint when $(1-\lambda)\bar{\delta} < \bar{s}$. Therefore, the derived values of a and b apply when

$$(1-\lambda)\bar{\delta} < \bar{s} < \bar{s}'_{nc}. \tag{8}$$

Notice that $\bar{\delta} < r_A - r_B$ implies that $\bar{s}'_{nc} > \bar{s}_{nc}$. The minimum screening capacity that eliminates crime is higher under limited profiling than unconstrained profiling, meaning that (A1) will also restrict attention to the case with criminal activity where $\bar{s} < \bar{s}'_{nc}$. Also, $(1-\lambda)\bar{\delta} < (1-\lambda)(r_A - r_B)$, meaning that (A2) also restricts attention to the case where $(1-\lambda)\bar{\delta} < \bar{s}$. Therefore (A1) and (A2) guarantee that $\bar{s}$ satisfied (8).

For lower values of $\bar{s}$, the profiling rule does not bind. That is, when $\bar{s} \leq (1-\lambda)\bar{\delta}$, the officer chooses screening strategies

$$a = 0 \quad \text{and} \quad b = \bar{s}\frac{1}{1-\lambda}.$$

This case is ruled out by (A2).

This represents a complete characterization of the equilibria for each possible $\bar{s}$. Given (A1) and (A2), the unique equilibrium involves $q_B = 1$ and (a,b) as given by (7).

Proof to Corollary 5.3

Follows immediately from plugging in the equilibrium values of q_A, q_B, a and b into our equations for $\mathcal{C}$, u_{LE} and u_C.

Proof to Theorem 6.1

Follows immediately from comparing $\mathcal{C}$, u_{LE} and u_C from Corollaries 4.3 and 5.3.

Proof to Corollary 6.2

Follows immediately from comparing $\mathcal{C}$ from Corollaries 4.3 and 5.3, and from establishing that successful crime $\mathcal{C}$ is strictly decreasing in $\bar{\delta} \in [0, r_A - r_B)$.

Proof to Theorem 6.3

Follows immediately from comparing $\mathcal{C}$ from Corollaries 4.3 and 5.3, and from establishing that successful crime $\mathcal{C}$ is strictly decreasing in $\bar{\delta} \in [0, r_A - r_B)$.

References

ACLU. 2004. "Sactioned Bias: Racial Profiling Since 9/11." Report by the American Civil Liberties Union.

Antonovics, Kate, and Brian Knight. 2009. "A New Look at Racial Profiling: Evidence from the Boston Police Department." *Review of Economics and Statistics*, 91(1): 163–177.

Anwar, Shamena, and Hanming Fang. 2006. "An Alternative Test of Racial Prejudice in Motor Vehicle Searches: Theory and Evidence." *American Economic Review*, 91(1): 127–151.

Ayres, Ian. 2002. "Outcome Tests of Racial Disparities in Police Practices." *Justice Research and Policy*, 4: 131–142.

Becker, Gary S. 1968. "Crime and Punishement: An Economic Aproach." *Journal of Political Economy*, 76(2): 169–217.

Bergen, Peter L. 2001. *Holy War, Inc.: Inside the Secret World of Osama bin Laden.* New York, NY: Simon and Schuster.

Bergen, Peter L. 2006. *The Osama Bin Laden I Know: An Oral History of Al Qaeda's Leader.* New York, NY: Simon and Schuster.

Bernhardt, Dan, and Mattias K. Polborn. 2010. "Non-convexities and the Gains from Concealing Defenses from Committed Terrorists." *Economics Letters*, 107: 52–54.

Bier, Vicki. 2007. "Choosing What to Protect." *Risk Analysis*, 27: 607–620.

Bier, Vicki, Santiago Oliveros, and Larry Samuelson. 2007. "Choosing What to Protect: Strategic Defensive Allocation Against An Unknown Attacker." *Journal of Public Economic Theory*, 9: 563–587.

Bjerk, David, and Caleb Mason. 2011. "The Market for Mules: Risk and Compensation of Cross-Border Drug Couriers." working paper.

Ehrlich, Issac. 1973. "Participation in Illegitimate Activities: A Theoretical and Empirical Investigation." *Journal of Political Economy*, 81(3): 521–565.

Gelman, Andrew, Jeffrey Fagan, and Alex Kiss. 2007. "An Analysis of the New York City Police Department's 'Stop-and-Frisk' Policy in the Context of Claims of Racial Bias." *Journal of the American Statistical Association*, 102(479): 813–823.

Hernández-Murillo, Rubén, and John Knowles. 2004. "Racial Profiling or Racist Policing? Bounds Tests in Aggregate Data." *International Economic Review*, 45(3): 959–989.

Knowles, John, Nicola Persico, and Petra Todd. 2001. "Racial Bias in Motor-Vehicle Searches: Theory and Evidence." *Journal of Political Economy*, 109(1): 203–209.

Lakdawalla, Darius, and George Zanjani. 2005. "Insurance, Self-protection and the Economics of Terrorism." *Journal of Public Economics*, 89: 1891–1905.

Persico, Nicola. 2002. "Racial Profiling, Fairness and Effectiveness of Policing." *American Economic Review*, 92(5): 1472–1497.

Persico, Nicola, and Petra E. Todd. 2005. "Profiling, Imperfect Screening and Airport Security." *American Economic Review, Papers and Proceedings*, 95(2): 127–131.

Persico, Nicola, and Petra E. Todd. 2006. "Generalising the Hit Rates Test for Racial Bias in Law Enforcement, with an Application to Vehicle Searches in Wichita." *The Economic Journal*, 116(515): F351–F367.

Swann, Maxine. 2013. "The Professor, the Bikini Model and the Suitcase Full of Trouble." Published online March 8, 2013, http://tinyurl.com/ae9x7cj.

The Associated Press. 2012. "Mexico drug gangs using more children as mules." Published online at CBS News, March 14, 2012, http://tinyurl.com/8xqghsj.

The New York Times. 2002. "Threats and Responses: Pieces of a Puzzle; On Plotters' Path to U.S., A Stop at bin Laden Camp." Published online September 10, 2002, http://tinyurl.com/nunvutu.

Wright, Lawrence. 2006. *The Looming Tower, The Looming Tower: Al-Qaeda and the Road to 9/11.* New York, NY: Knopf.