2015-04-20

Essays in Political Economics and Public Policy

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ESSAYS IN POLITICAL ECONOMICS AND PUBLIC POLICY

By

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A DISSERTATION

Submitted to the Faculty
of the University of Miami
in partial fulfillment of the requirements for
the degree of Doctor of Philosophy

Coral Gables, Florida

May 2015

UNIVERSITY OF MIAMI

A dissertation submitted in partial fulfillment of
the requirements for the degree of
Doctor of Philosophy

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LI, CHENG (Ph.D., Economics)
Essays in Political Economics and Public Policy (May 2015)

Abstract of a dissertation at the University of Miami.

Dissertation supervised by Professor Christopher Cotton.
No. of pages in text. (143)

This dissertation consists of three essays in the filed of political economics and public policy. The first essay provides a novel theory as to why campaign finance regulation, in the form of campaign contribution limits, may improve constituent welfare. The argument is developed in a game theoretic model of policymaking and lobbying. The model involves a three stage game played between a politician and two special interest groups. First, a policymaker can collect information or acquire expertise, which enables her to better compare the merits of alternative policy choices. Second, interest groups observe the policymaker's level of expertise and can offer political contributions in exchange for their preferred policy. Third, the policymaker chooses one of the policies. In equilibrium, expected political contributions are strictly decreasing in the policymaker's information. The analysis shows that the more information the policymaker acquires, the lower the expected payments from interest groups. A fully uninformed policymaker is unable to distinguish between policies and therefore makes her decision based only on contributions, maximizing competition between and payments from interest groups. The monetary benefits of remaining uninformed can dominate the costs associated with worse policy, and the policymaker prefers to remain fully uninformed about a range of issues, even when acquiring information is costless. The analysis also highlights a novel benefit of contribution limits, showing

that they can improve policy by decreasing incentives for a policymaker to remain uninformed.

The second essay studies the optimal law enforcement policy at borders and airports. At borders and airports, law enforcement targets major, planned crime such as smuggling and terrorism. Such crime tends to be planned by a strategic criminal organization that can recruit agents to attempt crime on its behalf. In this essay, 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. The analysis shows that 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.

The third essay examines the deterrence effects of higher pleading standards in litigation. In a recent decision, the U.S. Supreme Court increases pre-discovery pleading standards, which increase the standard of plausibility that a lawsuit must meet before proceeding to discovery and trial. In this essay, we develop a game theoretic model of litigant behavior to study the impact of higher pleading standards on choices to engage in illegal or negligent activity. The analysis shows how increasing pleading standards tends to increase illegal activity, and can increase litigation costs. These results provide a counterpoint to the Supreme Court's argument that increased plausibility requirements will decrease the costs of litigation.

To my beautiful wife, Ye Su.

ACKNOWLEDGEMENTS

A lot of people have provided generous support crucial to the completion of this dissertation.

I would first like to thank my advisor Chris Cotton. Chris has been an excellent advisor, who provided invaluable guidance in my graduate studies. His encouragement and sense of humor always kept me motivated (and entertained). I am grateful to my other committee members, Ralph Boleslavsky, Ayca Kaya, Manuel Santos, for numerous helpful discussions, insightful comments on earlier drafts of my papers and generous support of my research.

I would like to thank other faculty members at University of Miami, Sebastian Calonico, Michael Connolly, Carlos Flores, Laura Giuliano, Alex Horenstain, Ilwoo Hwang, David Kelly, and Chris Parmeter, for their excellent comments on my papers and their generous help in my career at Miami. I am also grateful to my officemates, Xuan Chen, Luke Fitzpatrick, Huong Nguyen, Changlin Qiu, Zhuo Tan, Yongmin Zang, for their friendship and support.

Finally, I would like to thank my family. Thank you to my parents, Yuanhong Li and Xiaofei Chen, for their priceless emotional support. Thank you to my wife, Ye Su, for her love and encouragement. This dissertation is dedicated to her.

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Introduction

This dissertation consists of three essays in the filed of political economics and public policy.

Chapter 2 examines the welfare effects of campaign contribution limits. Campaign finance reform is a hotly debated topic in the United States. Advocates of reform believe that campaign finance regulations can prevent political contributions from buying policy favors and thus reduce the influence of special interests in policymaking. Opponents of campaign finance reform, however, argue that campaign finance limitations violate the First Amendment. The academic literature on campaign finance reform has not reached a consensus on the welfare effect of campaign finance regulations. Chapter 2 provides a novel theory as to why campaign finance regulation, in the form of campaign contribution limits, may improve constituent welfare. The argument is developed in a game theoretic model of policymaking and lobbying. The model involves a three stage game played between a politician and two special interest groups. First, a policymaker can collect information or acquire expertise, which enables her to better compare the merits of alternative policy choices. Second, interest groups observe the policymaker's level of expertise and can offer political contributions in exchange for their preferred policy. Third, the policymaker chooses one of the policies. In equilibrium, expected political contributions are strictly decreasing in the policymaker's information. The analysis shows that the more information the policymaker acquires, the lower the expected payments from interest groups. A fully uninformed policymaker is unable to distinguish between policies and therefore makes her decision based only on contributions, maximizing competition between and payments from interest groups. The monetary benefits of remaining uninformed can dominate the costs associated with worse policy, and the policymaker prefers to remain fully uninformed about a range of issues, even when acquiring information is costless. The analysis also highlights a novel benefit of contribution limits, showing that they can improve policy by decreasing incentives for a policymaker to remain uninformed.

Chapter 3 (joint work with Christopher Cotton) studies the optimal law enforcement policy at borders and airports. At borders and airports, law enforcement targets major, planned crime such as smuggling and terrorism. Such crime tends to be planned by a strategic criminal organization that can recruit agents to attempt crime on its behalf. Previous models of criminal activity focus on decentralized crime, such as the independent decisions of individuals to carry illegal weapons and drugs in their automobiles. These models are not ideal to study law enforcement at borders and airports because they fail to capture the strategic element in centrally planned criminal activities. In chapter 3, 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. The analysis shows that 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.

Chapter 4 (joint work with Sergio J. Campos and Christopher Cotton) examines the deterrence effects of higher pleading standards in litigation. In a recent decision, *Bell Atlantic Corp.* v. *Twombly* (550 U.S. 544, 570 [2007]), the U.S. Supreme Court increases pre-discovery pleading standards, which increase the standard of plausibility that a lawsuit must meet before proceeding to discovery and trial. Essentially, this ruling makes it more difficult for a lawsuit to proceed to discovery and trial. In a later case, *Ashcroft* v. *Iqbal* (556 U.S. 662, 684 [2009]), the Court made clear that this new pleading standard applies to all cases. In chapter 4, we develop a game theoretic model of litigant behavior to study the impact of higher pleading standards on choices to engage in illegal or negligent activity. A potential defendant's decision to engage in conduct which may harm another party depends on the likelihood that the defendant's action causes harm, and the probability an injured party sues, obtains discovery and proves the claim in court. *Twombly* and *Iqbal* change the pleading standard and therefore change the likelihood of obtaining discovery and proceeding to trial. In this way, the Supreme Court ruling affects the incentives potential defendants have for taking potentially harmful actions in the first place. The analysis shows how increasing pleading standards tends to increase illegal activity, and can increase litigation costs. These results provide a counterpoint to the Supreme Court's argument that increased plausibility requirements will decrease the costs of litigation.

CHAPTER 2
Strategically Uninformed Politicians and Lobbying

2.1 Background

There is a popular view held by the U.S. public that politicians are often "uninformed" or "ignorant," unable to to weigh the costs and benefits of alternative policies. Anecdotal evidence suggests that policymakers frequently do not fully understand the details of legislation on which they vote. As U.S. House Judiciary Chairman John Conyers (D-Mich.) explained this in 2009 when discussing health care reform: "I love these Members of Congress, they get up say 'Read the bill.' What good is reading the bill if it's a thousand pages and you don't have two days and two lawyers to find out what it means after you read the bill?"[1] Additionally, empirical evidence suggests that politicians often have an incorrect view of their constituents' preferences when voting on policies (Broockman and Skovronz, 2013). The lack of full expertise may simply be the result of a policymaking environment where officials face severe time and resource constraints and find it infeasible to fully understand each of the many complex issues on which they vote (e.g. Bauer, Dexter, and de Sola Pool, 1963; Hansen, 1991; Hall, 1996). We show how this may, however, not be the whole story. We present a game theoretic model of policymaking and lobbying in which expected political contributions are strictly increasing in politician ignorance. We show how politicians may have an incentive to strategically remain uninformed on a range of issues, unable to compare the merits of policy alternatives. This is because remaining

[1] Additionally, in 2013, after observing 14 senators take the step of recalling a bill a day after voting for it, Texas State Senator Kel Seliger said "I would be very reluctant to stand up and say that I was poorly informed and ill-prepared and clueless, which is exactly what we're talking about happened here." See report by *The Texas Tribune*, available at http://www.texastribune.org/2013/05/02/do-over-votes-raise-questions/.

uninformed or ignorant on an issue maximizes political contributions from special interest groups.

Our model involves a three stage game, played between interest groups and a single policymaker who cares about both the merits of implemented policy and collecting political contributions. In the first stage, the policymaker decides how informed to become about policy alternatives. Formally, she chooses the precision of the signal she observes about the merits of the alternative policies. In the second stage, special interest groups, each favoring an alternative policy outcome, engage in a standard monetary lobbying game. The interest groups simultaneously provide offers to the policymaker. An offer specifies how large of political contribution a group provides when the policymaker implements its favored policy. In the third stage, the policymaker chooses the policy that offers the greatest weighted combination of expected policy benefits and promised political contributions.

The choice of signal informativeness lends itself to a variety of reasonable interpretations. First, it may represent how much expertise a politician acquires about an issue, either individually or by hiring expert staff. A politician with greater expertise can better judge the merits of different policy proposals, and more accurately compare the quality of alternative proposals given available evidence. Second, the choice of signal informativeness may represent a politician's evidence collection efforts. For example, it may capture the size or methodology of a poll measuring constituent support for the alternative policies. The larger the poll, the more informative the results. It may also represent the amount of time spent discussing the policy alternatives with experts, or the number of resources devoted to studying the issue, for example, through one's own staff or the Congressional Research Service. We abstract from the costs associated with information acquisition in order to focus on the strategic incentives for remaining less informed. It is costless for the policymaker to become completely informed (in which case she perfectly observes the quality of the alternative policies), to remain completely uninformed (in which case she is unable to distinguish between the ex ante similar proposals), or to choose any intermediate level of signal informativeness. We will show that the policymaker often prefers to remain uninformed, even when acquiring information is costless.

Our analysis identifies a tradeoff between policy quality and political contributions that arises as the policymaker collect better information or acquires more expertise on an issue. We consider a setting in which no policy alternative stands out as more promising ex ante; such an assumption ensures a monotonic relationship between information and political contributions which in turn emphasizes the key mechanism behind our results and maximizes intuition. A policymaker who collects no information will be indifferent between the policy alternatives based on their expected merits and will implement the policy that results in the largest political contribution. In this case, the competition between the interest groups is most intense, driving up political contributions to the maximum feasible level. Alternatively, when the policymaker does collect information about the policy alternatives, she will almost certainly develop ex post policy preferences in favor of one of the alternatives. As the quality of her information increases (i.e. her signal becomes more informative), there are two direct effects. First, better information makes it more likely that she has correct beliefs about which policy alternative is highest quality. Second, better information tends to increase *how much* better one policy looks compared to the other. In this way, more information increases the ex post asymmetries between the expected qualities of the policy alternatives. As the difference between the policy alternatives increases, it effectively becomes less expensive for an interest group to ensure that the policymaker maker implements the ex post more promising policy. In this way, asymmetry decreases total political contributions.

Increasing the policymaker's ability to distinguish policies strictly increases her ability to identify and implement the better policy, but also strictly decreases political contributions. When the policymaker chooses how informed to become on the issue, she weighs the expected tradeoff between worse policy outcomes and higher political contributions. The more she cares about policy outcomes relative to contributions, the greater are her incentives to acquire information or expertise on the issue. For issues of high enough political importance, the policymaker prefers to become fully informed, able to accurately assess and compare the merits of the alternative policy proposals. These may be the issues that matter most for constituents and are most likely to influence future elections. The more interesting outcome involves less politically important issues, on which the policymaker may be willing to sacrifice the quality of policy outcomes in order to increase political contributions. On these issues, the policymaker prefers to remain fully ignorant, completely unable to distinguish between different policy proposals, as doing so maximizes political contributions.

After we exploring the incentives policymakers have to remain strategically uninformed, we then consider the role that campaign contribution limits may play in our framework. Our analysis identifies a novel benefit of campaign contribution limits: they decrease the incentives policymakers have to remain strategically uninformed. This is because a contribution limit constrains the financial gain associated with remaining uninformed, and encourages the policymaker to become informed about a larger range of issues. By encouraging politicians to become better informed, contribution limits can lead to better policy choices and higher constituent welfare.

Our qualitative results are robust to a number of extensions and alternative approaches to the model. We consider these in later sections of the paper. First, we show that our main results continue to hold regardless of whether interest groups observe policymaker signal realizations. That is, the general incentives and conclusions are the same in the case where the policymaker's information and therefore posterior beliefs are privately observed, as they are when the there is no private information and any information collection efforts are publicly observable. This suggests that the main insights of our analysis are likely to apply across a variety of issues and political environments. In other extensions we consider costly information acquisition, alternative monetary lobbying frameworks, and the possibility that the politician can hide her information collection efforts or the level of expertise she acquires.

The rest of the paper is organized as follows. Section 2.2 reviews the literature. Section 2.3 introduces the formal model. Section 2.4 solves the for equilibrium and presents the main results. Section 2.5 considers the impact of a contribution limit on equilibrium behavior and constituent welfare. Section 2.6 considers alternative assumptions involving private information. Section 2.7 considers a number of additional extensions. Section 2.8 concludes.

2.2 Literature Review

Economists and political scientists have highlighted two means by which political contributions influence the decisions of politicians. First, political contributions are provided by interest groups to influence elections (e.g. Prat 2002a,b; Coate 2004a,b; Ashworth 2006). In these literatures, candidates sell policy favors to interest groups for campaign contributions and use these contributions to finance campaign advertising, which provides information about the candidates (e.g. their quality, ideology) to voters.

The second strand of literature assumes that interest groups provide political contributions to influence the votes of sitting legislators. In monetary lobbying models, a politician sells policy favors through a rent-seeking contest (e.g. Tullock 1980), or an all-pay auction (e.g. Baye, Kovenock, and Vries 1993, Che and Gale 1998), or a menu auction (e.g. Bernheim and Whinston 1986, Grossman and Helpman 1994). In informational lobbying models, interest groups can influence a policymaker's decision not only by making political contributions but also by providing policy relevant information (e.g. Dahm and Porteiro 2008, Bennedsen and Feldmann 2006).

Our paper is closely related to the second strand of the literature in that we focus on an incumbent politician. Different from informational lobbying models that assume policy relevant information is produced and provided by interest groups, we take a unique approach to bringing information to a lobbying game. Specifically, we develop a lobbying model in which a politician strategically decides how informed she becomes about alternative policies and interest groups influence the politician's decision through the traditional monetary channel.

Our analysis of the model shows that the politician faces a trade off between acquiring policy relevant information and political contributions. When the politician becomes more informed about the policies, the intensity of contribution competition between the interest groups is reduced. This has a similar flavor to results found in other literatures. Moscarini and Ottaviani (2001) show that a more informative signal about the quality of a product reduces the intensity of price competition between firms. Boleslavsky and Cotton (2014) show that a more informative campaign undermines policy competition. Our analysis shows that without a contribution limit, the politician prefers to be completely ignorant about policies: the loss of contribution that arises from increasing signal informativeness dominates the benefit. This result provides a novel theory as to why politicians prefer to remain uninformed when making policy decisions.

The academic literature on campaign finance reform has not reached a consensus on the welfare effect of campaign finance reform. While some studies find that campaign contribution limits can result in better policy decisions (e.g. Austen-Smith

1998; Prat 2002a,b; Coate 2004a; Cotton 2009, 2012), other papers suggest that contribution limits may harm constituent welfare (e.g. Riezman and Wilson 1997; Coate 2004b; Drazen, Limao, and Stratmann 2007; Dahm and Porteiro 2008). Our analysis shows that the politician has greater incentive to acquire information about the merits of alternative policies with the presence of a contribution limit. Since a more informed politician is able to make better policy decisions, a contribution limit leads to better policy outcomes and higher constituent welfare. To our knowledge, this benefit of campaign contribution limits is first identified in our paper and represents contribution to the campaign finance literature.

2.3 Model

A politician (she) must choose between two alternative policies, which are respectively backed by two interest groups. We use $i \in \{1, 2\}$ to denote both a policy and its interest group.

The politician cares about both policy quality and political contributions. This is consistent with the idea that both a good policy and good financing can help a policymaker win reelection. When the policymaker implements policy i, she receives utility

$$U_P(q_i, c_i) = \lambda q_i + c_i,$$

where q_i is the quality or net benefits associated with policy i, c_i are the political contributions the policymaker receives from interest group i when she implements policy i, and λ captures the political importance of the issue on which the policymaker is selecting policy. The assumption that politician's utility is additively separable and linear is consistent with a variety of papers including Bennedsen and Feldmann (2006), Dahm and Porteiro (2008) and Cotton (2012). When discussing normative interpretations of the results, we assume that constituent welfare is strictly increasing in the quality of the implemented policy, q_i, and that it does not directly depend on contributions, c_i.

The quality of each policy is an independent realization of a Normally distributed random variable: $q_i \sim N(\mu, 1)$. Neither the policymaker nor the interest groups observe q_i ex ante, although the distribution is common knowledge. We assume that both policies have the same expected quality, and therefore neither policy stands out on its merits ex ante. This symmetry assumption allows us to focus on the setting in which the intuition behind our results in most pronounced, and where there is a strict negative relationship between information and political contributions.

Interest groups are advocates in favor of their own preferred policy; they receive benefit v when the policymaker implements their policy and do not benefit when the policymaker implements the other policy alternative. Their payoffs are unaffected by the quality of either proposal. When policy i is chosen, interest group $i \in \{1, 2\}$ receives payoff $u_i = v - c_i$, and when policy i is not chosen, interest group i receives payoff $u_i = 0$.

The game takes place in three stages. In the first stage of the game, the policymaker chooses how much information or expertise to acquire about the quality of the alternative policies. We model this information acquisition by assuming that the policymaker controls the variance of a signal she observes about the quality of each policy alternative. For each policy alternative i, the policymaker observes a realization s_i of random variable $S_i \sim N(q_i, \sigma^2)$. The realization of s_i is on average equal to the true quality of the policy. When $\sigma = 0$, the policymaker perfectly learns the true quality of each proposal. As σ increases, the policymaker's information about each policy becomes less informative in the sense of Blackwell. When $\sigma \to \infty$, the policymaker learns no additional information about the state of the world and must rely only on the priors when making future decisions.

For now, we assume that the policymaker's signal realization s_i represents a private assessment of the evidence. Therefore, interest groups do not observe s_i. At the same time, we assume that the interest groups can observe the policymaker's general level of expertise on the issue, and therefore observe σ. This may be directly observable, or it may be inferable from investments made by the policymaker in hiring an expert staff. In section 2.7, we show that the politician prefers to make her choice of σ observable to the interest groups, rather than hiding her choice of σ. We also show that all main results continue to hold when the policymaker has no private information.

In the second stage of the game, the two interest groups engage in monetary lobbying. Interest groups simultaneously make contribution offers to the policymaker. Specifically, each interest group makes an offer c_i to the policymaker, which it commits to pay if the policymaker implements policy i. Consistent with past models of political influence, we assume that interest groups make campaign contributions contingent on the decision of the politician, with interest group i delivering its promised contribution only if its policy is chosen by the politician.[2] In section 2.7, we show that the policymaker prefers to allocate favors in this way, rather than through an all pay auction in which both interest groups pay regardless of the eventual policy decision.

In the third stage, the policymaker observes the contribution offers c_1 and c_2, as well as the signal realizations from the first stage. She then implements whichever policy provides her the higher expected utility, accounting for the promised contributions and expected policy quality.

The game described above is a dynamic game of incomplete but symmetric information. Therefore, Perfect Bayesian Equilibria is the appropriate solution concept

[2]This is consistent with a simple form of menu auction, which has become the workhorse framework of lobbying. See Bernheim and Whinston (1986), Grossman and Helpman (1994), Besley and Coate (2001) and Bennedsen and Feldmann (2006).

for this game. Since no information asymmetry exists, no signalling takes place in this game. In the next section, we solve the Perfect Bayesian Equilibrium strategies of the game described above.

2.4 Analysis

In this section, we solve the Perfect Bayesian Equilibrium strategies of the game described in Section 2.3. In this game, there is no campaign contribution limit so interest groups can make any non-negative contribution offer to the politician. We first derive the probability that each policy is chosen by the politician, and then consider interest groups' decision in political contributions. After that, we consider the politician's decision on how much information or expertise to acquire. All the proofs are in the Appendix.

2.4.1 Monetary lobbying subgame

After observing signal realization $S_i = s_i$, the politician updates her belief about q_i. Given that $q_i \sim N(\mu, 1)$ and $S_i | q_i \sim N(q_i, \sigma^2)$, the politician's posterior belief regarding q_i given a particular signal realization s_i is

$$q_i | S_i = s_i \sim N(\frac{s_i + \mu\sigma^2}{1+\sigma^2}, \frac{\sigma^2}{1+\sigma^2}).$$

Therefore, the expected quality of policy i given signal realization s_i is the mean of this distribution

$$E(q_i | S_i = s_i) = \frac{s_i + \mu\sigma^2}{1+\sigma^2}.$$

Given signal realization s_i and contribution offer c_i, the politician chooses policy 1 when

$$\lambda E(q_1 | S_1 = s_1) + c_1 > \lambda E(q_2 | S_2 = s_2) + c_2.$$

This is equivalent to

$$\frac{s_1 + \mu\sigma^2}{1+\sigma^2} - \frac{s_2 + \mu\sigma^2}{1+\sigma^2} > \frac{c_2 - c_1}{\lambda}. \tag{2.1}$$

The left hand side of inequality (1) represents the difference in expected policy quality. A positive value means that the policy 1 is of higher expected quality. The right hand side represents the difference in political contributions, and a positive value means interest group 2 provides more political contributions to the politician than interest group 1. The politician chooses policy 1 only if the expected policy benefit dominates any contribution disadvantage. Given that the signal regarding q_i is stochastic, neither group can choose contribution offers to guarantee that inequality (1) holds or fails to hold. Therefore, the probability that policy 1 is selected equals the probability inequality (1) is satisfied.

Given that $q_i \sim N(\mu, 1)$ and $S_i|q_i \sim N(q_i, \sigma^2)$, we have $S_i \sim N(\mu, 1+\sigma^2)$. This implies that

$$\frac{s_i + \mu\sigma^2}{1+\sigma^2} \sim N(\mu, \frac{1}{1+\sigma^2}).$$

To simplify exposition, we define

$$\gamma \equiv \sqrt{\frac{2}{1+\sigma^2}}.$$

Because γ is strictly decreasing in $\sigma \geq 0$, and Blackwell informativeness is strictly decreasing in signal variance σ, it follows that informativeness is strictly increasing in γ. The higher is γ, the more informed the policymaker is about the quality of the policies. γ takes on its maximum value at $\gamma = \sqrt{2}$ when $\sigma = 0$ and policymaker signals are fully informative, and takes on its minimum value at $\gamma = 0$ when $\sigma \to \infty$ and policymaker signals are fully uninformative.

Therefore,

$$\frac{s_1 + \mu\sigma^2}{1+\sigma^2} - \frac{s_2 + \mu\sigma^2}{1+\sigma^2} \sim N(0, \gamma^2).$$

This implies that the politician chooses the policy proposed by interest group 1 with probability

$$\Phi(\frac{c_1 - c_2}{\lambda\gamma}),$$

where function $\Phi(\cdot)$ represents the cumulative distribution function of the standard normal random variable $N(0,1)$.

In the second stage of the game, interest groups engage in monetary lobbying, each simultaneously making political contribution offers to the politician, anticipating how their promised contributions affect the politician's policy decision. Interest group i receives payoff $u_i = v - c_i$ when its policy is chosen by the politician, and receives payoff $u_i = 0$ otherwise. The expected payoff of interest group 1 is therefore

$$E(u_1) = \Phi(\frac{c_1 - c_2}{\lambda\gamma})(v - c_1).$$

The derivative of this function with respect to c_1 is

$$\frac{\partial E(u_1)}{\partial c_1} = -\Phi(\frac{c_1 - c_2}{\lambda\gamma}) + \frac{1}{\lambda\gamma}\phi(\frac{c_1 - c_2}{\lambda\gamma})(v - c_1).$$

This expression illustrates the tradeoff that interest groups face when choosing which level of political contributions to offer the politician. If an interest group marginally increases its contribution, then it experiences a marignal cost whenever it wins the competition. This cost is reflected in the first term. However, increasing political contributions also increases the probability the interest group's policy is chosen by the politician. The second term reflects this benefit.

There are two possible subgame equilibria, depending on the politician's choice of signal informativeness in the first stage of the game. First, there is the case in which the equilibrium contribution offer c^* is positive for both interest groups. In this case, each interest group chooses a level of political contributions such that the marginal benefits of increasing political contributions equal the marginal cost of doing so, given the equilibrium contribution strategy of the other interest group. This is the case when the politician chooses a relatively uninformative signal at the beginning of the game. Second, there is the possibility that both groups contribute $c^* = 0$ in equilibrium. This is the case when the politician chooses a sufficiently informative signal in the first stage of the game. The following lemma summarizes the unique equilibrium contribution choice.

Lemma 2.4.1 (Equilibrium political contributions) *When $\lambda > v/\sqrt{\pi}$, there exists a threshold value of $\bar{\gamma} = \sqrt{2\pi}v/(\pi\lambda)$ such that equilibrium contributions are strictly decreasing in informativeness for up to threshold $\gamma = \bar{\gamma}$, and constant at zero for all higher values of γ. When $\lambda < v/\sqrt{\pi}$, there equilibrium contributions are strictly decreasing in informativeness for all feasible values of γ.*

Variable γ can take on a maximum value of $\sqrt{2}$. Therefore if $\sqrt{2\pi}v/(\pi\lambda) \leq \sqrt{2}$ or equivalently $\lambda \geq v/\sqrt{\pi}$, then both $c^* = 0$ and $c^* > 0$ are possible in equilibrium. If, alternatively, $\lambda < v/\sqrt{\pi}$, then for all feasible γ, the only equilibrium involves $c^* > 0$.

Figure 2.1 illustrates the relationship between equilibrium political contributions and signal informativeness for the case where $\lambda > v/\sqrt{\pi}$ and therefore $\sqrt{2\pi}v/(\pi\lambda) < \sqrt{2}$. In this case, for all $\gamma \in [0, \sqrt{2\pi}v/(\pi\lambda))$, equilibrium political contributions are decreasing in the quality of policymaker information, γ. For all $\gamma \in [\sqrt{2\pi}v/(\pi\lambda), \sqrt{2}]$, equilibrium political contributions always equal zero. Therefore, political contributions are always maximized when $\gamma = 0$.

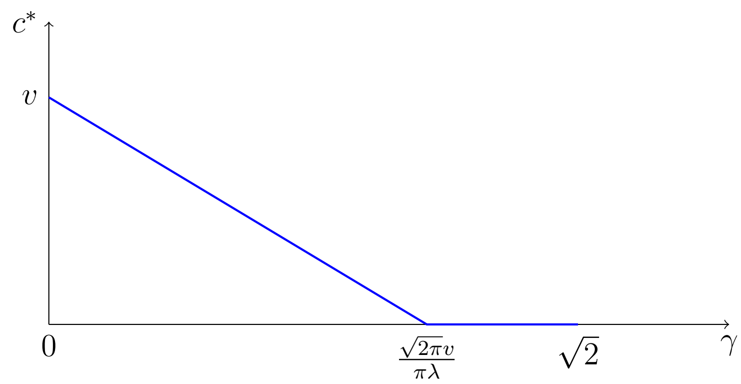

Figure 2.1 Equilibrium political contributions and signal informativeness with no contribution limit (an example given $\lambda > v/\sqrt{\pi}$)

When the politician chooses a completely uninformative signal, the policies remain indistinguishable on their merits. In this case, the politician's decision over policy will be based exclusively on political contributions. Specifically, she will choose the policy preferred by the interest group that offers the highest level of political contribution. In this case, the competition over political contributions is most fierce and both interest groups offer the highest level of political contribution to the politician. When the politician chooses an informative signal, however, she receives additional information on the merits of the policies. In this case, offering a smaller contribution than the other interest group does not necessarily lose the competition. This is because an informed politician is able to perceive the differences in policy quality, and the information she uncovers may reveal one interest group's policy to be of sufficiently high quality to overcome its contribution disadvantage. The interest groups react to the anticipated revelation of information about policy quality by contributing less. In equilibrium, an informative signal undermines the incentive for interest groups to contribute, resulting in fewer political contributions. When the politician receives sufficiently accurate information about policy quality, she receives no political contributions from the interest groups.

We use q_s to denote the quality of the selected policy. Lemma 2.4.1 shows that in equilibrium both interest groups offer the same level of political contribution to the politician. Therefore, in equilibrium the politician's policy decision will be based exclusively on expected policy quality. Specifically, she will choose the policy of higher expected quality. The expected quality of the selected policy given signal realizations s_1 and s_2 is

$$E(q_s|s_1, s_2) = max\{\frac{s_1 + \mu\sigma^2}{1+\sigma^2}, \frac{s_2 + \mu\sigma^2}{1+\sigma^2}\}.$$

We have shown that $\frac{s_i+\mu\sigma^2}{1+\sigma^2}$ is distributed according to $N(\mu, \frac{1}{1+\sigma^2})$. Therefore, the expected quality of the selected policy is

$$\begin{aligned} E(q_s) &= E[E(q_s|s_1, s_2)] \\ &= E[max\{Q_1, Q_2\}], \end{aligned}$$

where $Q_i \sim N(\mu, \frac{1}{1+\sigma^2})$.

Define $Z = \frac{Q_1-Q_2}{\gamma}$. We can show $Q_1 - Q_2 \sim N(0, \gamma^2)$ and $Z \sim N(0, 1)$. Then we have

$$\begin{aligned} E(q_s) &= E[max\{Q_1 - Q_2, 0\} + Q_2] \\ &= E[max\{Q_1 - Q_2, 0\}] + E[Q_2] \\ &= \gamma E[max\{Z, 0\}] + \mu \\ &= \gamma \int_0^\infty z\phi(z)d(z) + \mu \\ &= \frac{1}{\sqrt{2\pi}}\gamma + \mu. \end{aligned}$$

It follows directly from the above equation that the expected quality of the selected policy is increasing γ. When the politician chooses a more informative signal, she is able to better compare the merits of alternative policies. This allows the politician to make better policy decisions and improves the expected quality of the selected policy.

2.4.2 Policymaker information acquisition

In the first stage, the politician decides how much information or expertise to acquire about alternative policies. For now, we assume that $\lambda > v/\sqrt{\pi}$ or equivalently $\sqrt{2\pi}v/(\pi\lambda) < \sqrt{2}$. In this case, the politician anticipates to receive contribution offers $c_1 = c_2 = v - \frac{\sqrt{2\pi}}{2\alpha}\gamma$ when she chooses a signal with informativeness level $\gamma < \frac{\sqrt{2\pi}v}{\pi\lambda}$, and anticipates to receive contribution offers $c_1 = c_2 = 0$ when she chooses a signal with informativeness level $\gamma \geq \frac{\sqrt{2\pi}v}{\pi\lambda}$.

Suppose the politician chooses a signal such that $\gamma < \frac{\sqrt{2\pi}v}{\pi\lambda}$. In this case, the politician's expected payoff equals

$$\begin{aligned} E(U_P) &= \lambda(\mu + \frac{1}{\sqrt{2\pi}}\gamma) + v - \frac{\sqrt{2\pi}}{2}\lambda\gamma \\ &= \lambda\mu + v + \frac{\lambda}{\sqrt{2\pi}}\gamma - \frac{\pi\lambda}{\sqrt{2\pi}}\gamma. \end{aligned}$$

We can see from the above expression that a more informative signal has two opposite effects on the politician's expected payoff. First, it provides more information to the politician about the merits of alternative policies. This helps the politician make better policy decisions and increases the politician's expected payoff. On the other hand, however, a more informative signal reduces the level of political contributions offered by interest groups, which decreases the politician's expected payoff. In this case, the marginal return of increasing signal informativeness (i.e. $\lambda/\sqrt{2\pi}$) is lower than its marginal cost (i.e. $\pi\lambda/\sqrt{2\pi}$). Therefore, the politician prefers to choose a completely uninformative signal $\gamma = 0$ rather than any other $\gamma < \frac{\sqrt{2\pi}v}{\pi\lambda}$. This leads to a payoff of $\lambda\mu + v$.

When the politician chooses $\gamma \geq \frac{\sqrt{2\pi}v}{\pi\lambda}$ in the first stage of the game, she expects zero contribution from the interest groups and her expected payoff equals

$$\begin{aligned} E(U_p) &= \lambda(\mu + \frac{1}{\sqrt{2\pi}}\gamma) + 0 \\ &= \lambda\mu + \frac{\lambda}{\sqrt{2\pi}}\gamma. \end{aligned}$$

In this case, the politician's expected payoff is strictly increasing in γ. Therefore, the politician prefers to choose a fully informative signal $\gamma = \sqrt{2}$ rather than any other $\gamma \geq \frac{\sqrt{2\pi}v}{\pi\lambda}$. In this case she receives payoff $\lambda\mu + \frac{\lambda}{\sqrt{\pi}}$.

Figure 2.2 depicts the relationship between the politcian's expected payoff and her choice of information quality for the case when $\lambda > v/\sqrt{\pi}$. As the value of γ increases, the politician's expected payoff first decreases and then increases. So the politician chooses between $\gamma = 0$ and $\gamma = \sqrt{2}$. By choosing $\gamma = 0$, the politician makes the worst policy decision but attracts the highest level of political contributions from the interest groups. By choosing $\gamma = \sqrt{2}$, the politician makes the best policy decision but receives no political contribution from the interest groups.

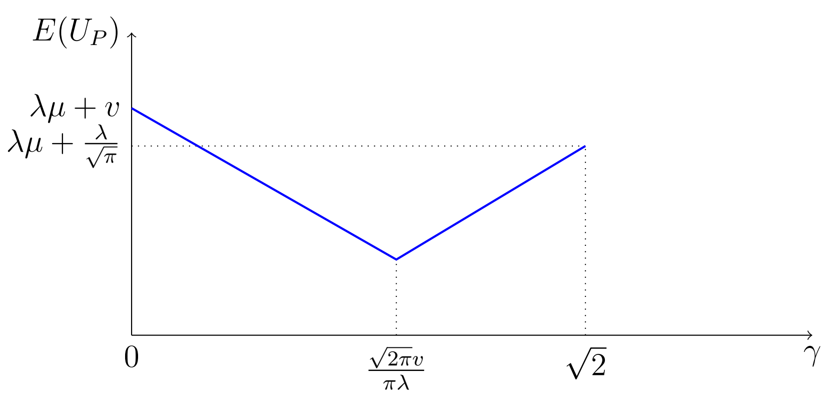

Figure 2.2 The politician's expected payoff and signal informativeness with no contribution limit (an example given $\lambda > v/\sqrt{\pi}$)

The more the politician cares about policy outcomes relative to political contributions, the greater are her incentives to acquire information or expertise. We assume that the politician chooses the more informative signal when indifferent between multiple values. Therefore, the politician chooses $\gamma = 0$ when

$$\lambda\mu + v > \lambda\mu + \frac{\lambda}{\sqrt{\pi}} \Leftrightarrow \frac{v}{\sqrt{\pi}} < \lambda < \sqrt{\pi}v,$$

and chooses $\gamma = \sqrt{2}$ when

$$\lambda\mu + v \leq \lambda\mu + \frac{\lambda}{\sqrt{\pi}} \Leftrightarrow \lambda \geq \sqrt{\pi}v.$$

Up until now, we have assumed that $\lambda > v/\sqrt{\pi}$. When $\lambda < v/\sqrt{\pi}$ or equivalently $\sqrt{2\pi}v/(\pi\lambda) > \sqrt{2}$, $\sqrt{2}$ is at the left hand side of $\sqrt{2\pi}v/(\pi\lambda)$ in Figure 2. This implies that the politician's expected payoff strictly decreases as the value of γ increases from 0 to $\sqrt{2}$. So for issues such that $\lambda < v/\sqrt{\pi}$, the politician prefers to choose $\gamma = 0$.

Therefore, for issues of sufficiently high political importance (i.e. $\lambda \geq \sqrt{\pi}v$), the politician chooses $\gamma = \sqrt{2}$ and becomes fully informed about policies. For less politically important issues (i.e. $\lambda < \sqrt{\pi}v$), however, the politician chooses $\gamma = 0$ and remains fully ignorant about policies. The following proposition summarizes this result.

Proposition 2.4.1 (Equilibrium Informativeness) *In equilibrium, the politician chooses to be fully informed for issues of high enough political importance (i.e. $\lambda \geq \sqrt{\pi}v$), and chooses to be completely ignorant for issues of less political importance (i.e. $\lambda < \sqrt{\pi}v$).*

A more informative signal allows the politician to make better policy decision and thus increases the politician's expected payoff. On the other hand, more accurate information reduces the level of political contributions attracted by the politician. When choosing how informed to become about one issue, the politician weighs the tradeoff between better policy decision and lower political contributions. For issues of high political importance, the benefits of acquiring a more accurate signal dominate the cost, and the politician chooses a fully informative signal. For issues of less political importance, the loss of contribution that arises from increasing signal informativeness dominates the benefit. In this case, the politician prefers to be completely ignorant about policies in equilibrium.

Given the equilibrium behaviors of the politician and the interest groups, we can derive the expected quality of the selected policy in equilibrium.

Corollary 2.4.1 (Expected Policy Quality) *In equilibrium, the expected quality of the selected policy equals μ for issues such that $\lambda < \sqrt{\pi}v$, and equals $\mu + \frac{1}{\sqrt{\pi}}$ for issues such that $\lambda \geq \sqrt{\pi}v$.*

2.5 Contribution Limit

In this section, we consider the impact of a contribution limit on equilibrium behavior and policy outcomes. We denote the contribution limit by $\bar{c}$. When the contribution limit is imposed, interest groups contributions cannot exceed this limit. Because interest groups would never contribute more than v, a limit greater than v has no impact on equilibrium behavior. Such a "non-binding" contribution limit is not interesting and therefore we focus on a limit that is strictly less than v in this section. Specifically, we assume $\bar{c} \in [0, v)$.

2.5.1 Game with contribution Limit

For now, we assume that $\lambda > v/\sqrt{\pi}$ or equivalently $\sqrt{2\pi}v/(\pi\lambda) < \sqrt{2}$. Lemma 2.4.1 shows that when the politician chooses $\gamma \geq \sqrt{2\pi}v/(\pi\lambda)$ in the first stage of the game, both interest groups offer zero contribution to the politician in the game without contribution limit. In this range of γ, imposing contribution limit $\bar{c}$ has no impact on interest group contribution behavior and the interest groups continue to offer zero contribution to the politician.

Lemma 2.4.1 also shows that when the politician chooses $\gamma < \frac{\sqrt{2\pi}v}{\pi\lambda}$ in the first stage of the game, interest groups offer $c_1 = c_2 = v - \frac{\sqrt{2\pi}}{2}\lambda\gamma$ to the politician in the game without contribution limit. In the Appendix, we show that when contribution limit $\bar{c}$ is imposed, interest groups offer $c_1^* = c_2^* = v - \frac{\sqrt{2\pi}}{2}\lambda\gamma$ to the politician when

$$v - \frac{\sqrt{2\pi}}{2}\lambda\gamma < \bar{c} \Leftrightarrow \frac{\sqrt{2\pi}(v-\bar{c})}{\pi\lambda} < \gamma < \frac{\sqrt{2\pi}v}{\pi\lambda},$$

and offer $c_1^* = c_2^* = \bar{c}$ to the politician when

$$v - \frac{\sqrt{2\pi}}{2}\lambda\gamma \geq \bar{c} \Leftrightarrow \gamma \leq \frac{\sqrt{2\pi}(v-\bar{c})}{\pi\lambda}.$$

Figure 2.3 illustrates the relationship between equilibrium political contributions and signal informativeness with contribution limit $\bar{c}$ given $\lambda > v/\sqrt{\pi}$. When the informativeness of the signal is no greater than $\sqrt{2\pi}(v-\bar{c})/(\pi\lambda)$, interest groups always offer $\bar{c}$, the highest level of political contributions allowed by the contribution limit, to the politician. When the informativeness of the signal γ is between $\sqrt{2\pi}(v-\bar{c})/(\pi\lambda)$ and $\sqrt{2\pi}v/(\pi\lambda)$, political contributions offered by the interest groups are decreasing in signal informativeness. When γ exceeds $\sqrt{2\pi}v/(\pi\lambda)$, interest groups never provide political contributions to the politician.

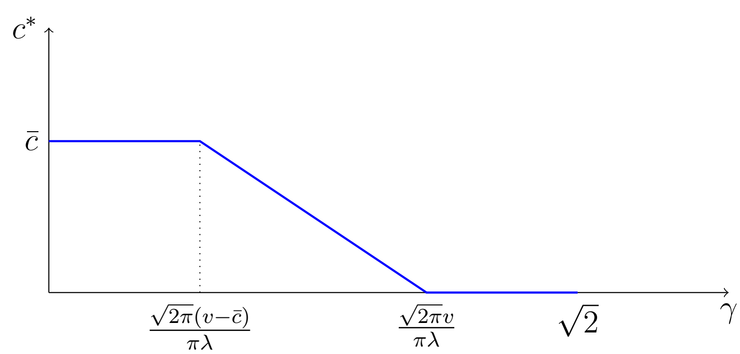

Figure 2.3 Equilibrium political contributions and signal informativeness with contribution limit $\bar{c}$ (an example given $\lambda > v/\sqrt{\pi}$)

When the signal informativeness does not exceed $\sqrt{2\pi}(v-\bar{c})/(\pi\lambda)$, interest groups always offer the highest level of political contributions $\bar{c}$ to the politician. In this case, acquiring more information strictly increases the politician's expected payoff: a more informative signal increases the expected quality of the selected policy without impacting the level of political contributions offered by interest groups. When the signal informativeness is between $\sqrt{2\pi}(v-\bar{c})/(\pi\lambda)$ and $\sqrt{2\pi}v/(\pi\lambda)$, the politician's expected payoff is decreasing in signal informativeness. For this range of γ, increasing signal informativeness increases the expected policy quality at the cost of attracting lower level of political contributions. Since the cost of lower political contribution dominates the benefit of better policymaking, the politician's expected payoff decreases when she acquired more information or expertise. When the politician chooses $\gamma \geq \sqrt{2\pi}v/(\pi\lambda)$, she expects zero contribution from the interest groups. In this case, acquiring more information or expertise increases the expected policy quality without impacting the level of political contributions offered by interest groups. Therefore, the politician's expected payoff is strictly increasing in γ. Figure 4 shows the relationship between the politician's expected payoff and her choice of signal informativeness when there is contribution limit $\bar{c}$.

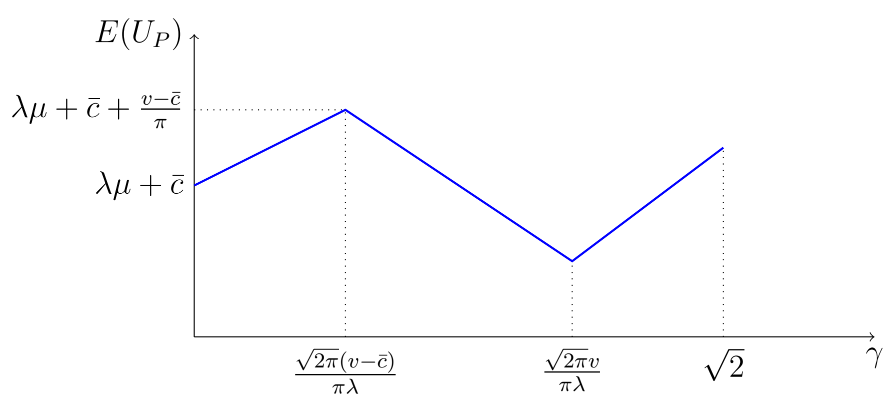

Figure 2.4 The politician's expected payoff and signal informativeness with contribution limit $\bar{c}$ (an example given $\lambda > v/\sqrt{\pi}$)

As we can see from Figure 2.4, when the signal informativeness is no greater than

$\sqrt{2\pi}v/(\pi\lambda)$, the politician's expected payoff peaks at $\gamma = \sqrt{2\pi}(v - \bar{c})/(\pi\lambda)$. At this level of signal informativeness, the politician receives expected payoff $\lambda\mu + \bar{c} + \frac{v-\bar{c}}{\pi}$. When the signal informativeness is higher than $\sqrt{2\pi}v/(\pi\lambda)$, the politician's expected payoff is increasing in γ. Therefore, the politician prefers to become fully informed and expect payoff $\lambda\mu + \frac{\lambda}{\sqrt{\pi}}$. The politician prefers to choose $\gamma = \sqrt{2\pi}(v - \bar{c})/(\pi\lambda)$ when

$$\lambda\mu + \bar{c} + \frac{v - \bar{c}}{\pi} > \lambda\mu + \frac{\lambda}{\sqrt{\pi}} \Leftrightarrow \frac{v}{\sqrt{\pi}} < \lambda < \frac{v + (\pi - 1)\bar{c}}{\sqrt{\pi}},$$

and prefers to choose $\gamma = \sqrt{2}$ when

$$\lambda\mu + \bar{c} + \frac{v - \bar{c}}{\pi} < \lambda\mu + \frac{\lambda}{\sqrt{\pi}} \Leftrightarrow \lambda > \frac{v + (\pi - 1)\bar{c}}{\sqrt{\pi}}.$$

With a contribution limit, the politician's decision to collect information and acquire expertise also depends on the political importance of an issue. For issues of sufficient political importance (i.e. $\lambda > \frac{v+(\pi-1)\bar{c}}{\sqrt{\pi}}$), the politician prefers to become fully informed. For less important issues (i.e. $\lambda < \frac{v+(\pi-1)\bar{c}}{\sqrt{\pi}}$), however, the politician prefers to be moderately informed.

Up until now, we have assumed that $\lambda > v/\sqrt{\pi}$. When $\lambda < v/\sqrt{\pi}$ or equivalently $\sqrt{2\pi}v/(\pi\lambda) > \sqrt{2}$, $\sqrt{2}$ is at the left hand side of $\sqrt{2\pi}v/(\pi\lambda)$ in Figure 4. This implies that for $\gamma \in [0, \sqrt{2}]$, the politician's expected payoff is maximized at $\gamma = \sqrt{2\pi}(v - \bar{c})/(\pi\lambda)$. Therefore, for issues such that $\lambda < v/\sqrt{\pi}$ the politician prefers to choose $\gamma = \sqrt{2\pi}(v - \bar{c})/(\pi\lambda)$.

Proposition 2.5.1 (Equilibrium Informativeness with Contribution Limit) *In the game with contribution limit $\bar{c}$, the politician chooses a signal with informativeness level $\gamma = \frac{\sqrt{2\pi}(v-\bar{c})}{\pi\lambda}$ for issues such that $\lambda < \frac{v+(\pi-1)\bar{c}}{\sqrt{\pi}}$, and chooses a fully informative signal for issues such that $\lambda \geq \frac{v+(\pi-1)\bar{c}}{\sqrt{\pi}}$.*

With the presence of a contribution limit, the politician never remains ignorant about the relative merits of different policies. For issues of sufficient political importance, the politician chooses to be fully informed. For issues of less political importance, the politician becomes moderately informed. Given the equilibrium strategy of the politician, we can calculate the expected quality of the selected policy in the game with contribution limit.

Corollary 2.5.1 (Expected Policy Quality with Contribution Limit) *In the game with contribution limit $\bar{c}$, the expected quality of the selected policy equals $\mu + \frac{v-\bar{c}}{\pi\lambda}$ for issues such that $\lambda < \frac{v+(\pi-1)\bar{c}}{\sqrt{\pi}}$, and equals $\mu + \frac{1}{\sqrt{\pi}}$ for issues such that $\lambda \geq \frac{v+(\pi-1)\bar{c}}{\sqrt{\pi}}$.*

2.5.2 Effect of contribution limit

In this subsection, we consider the impact of contribution limits on the politician's decision to collect information and policy outcomes. From Proposition 2.4.1, we know that in the game without contribution limit, the politician chooses to be fully informed for issues such that $\lambda > \sqrt{\pi}v$, and chooses to be completely ignorant for issues such that $\lambda < \sqrt{\pi}v$. Proposition 2.5.1 shows that in the game with contribution limit $\bar{c}$, the politician chooses a signal with informativeness level $\gamma = \frac{\sqrt{2\pi}(v-\bar{c})}{\pi\lambda}$ for issues such that $\lambda < \frac{v+(\pi-1)\bar{c}}{\sqrt{\pi}}$, and chooses a fully informative signal for issues such that $\lambda > \frac{v+(\pi-1)\bar{c}}{\sqrt{\pi}}$.

By inspection, $\frac{v+(\pi-1)\bar{c}}{\sqrt{\pi}} < \sqrt{\pi}v$. This implies that a contribution limit incentivizes the politician to become fully informed for a larger range of issues. For issues such that $\lambda < \frac{v+(\pi-1)\bar{c}}{\sqrt{\pi}}$), the politician remains fully ignorant about policy alternatives when there is no contribution limit. But with a contribution limit, the politician chooses to be moderately informed. This implies that a contribution limit incentivizes the politician to become more informed for less important issues .

Proposition 2.5.2 (Contribution Limit and Informativeness) *A contribution limit incentivizes the politician to become fully informed for a larger range of issues. It also incentivizes the politician to become more informed for less important issues .*

The expected policy quality in the case with and without contribution limit are given in Corollary 2.4.1 and Corollary 2.4.1 respectively. This allows us to analyze how a contribution limit affects the expected policy quality.

Proposition 2.5.3 (Contribution Limit and Expected Policy Quality) *A contribution limit increases the expected policy quality for issues such that $\lambda < \sqrt{\pi}v$, and has no impact on the expected policy quality for issues such that $\lambda \geq \sqrt{\pi}v$.*

Since the constituent welfare is increasing in policy quality, a contribution limit improves constituent welfare by increasing the quality of the selected policy.

2.6 No private policymaker information

Up until now, we have assumed that the policymaker observes a private signal about the quality of each alternative policy. This is consistent with the idea that the policymaker's private signal realization is equivalent to a subjective impression of publicly observable evidence. It is also consistent with the idea that the policymaker's efforts to collect information are observable, but the realization of these efforts are private (e.g. Congressional Research Services reports are not typically shared with interest groups or the general public). However, such assumptions may not always be reasonable. In this section, we consider the alternative assumption that both the policymaker's information collection efforts and the realizations of these efforts are publicly observable (at least by the interest groups involved on the relevant issue).

In this section, we can make either of two alternative assumptions about interest group private information. Like we have assumed up until now, we can continue to assume that interest groups are uninformed about the relative value of the alternative policy proposals to the politician. This is the case of no private information, where at all stages of the game, both the politician and the two interest groups have the same information. Alternatively, we can assume that the interest groups have private information about the quality of their proposal at the onset of the game. The results are the same under both assumptions, because in both cases the interest groups' contribution offers are based only on the public signal realizations of the politician. That is, interest groups do not base their contribution on what they *know* about the policies; they instead base their contributions on what the policymaker *believes* about the relative quality of the policies.

The primary difference between the analysis in this section and the analysis in the previous sections is that interest groups know which policy the policymaker favors at the onset of the monetary lobbying game. In equilibrium, the interest group that supports the favored policy is able to ensure that its policy is implemented by offering the policymaker just large enough of a political contribution to eliminate the alternative policy from consideration. As was previously the case, the policy that the politician believes has the strongest merits, ex post, is always implemented in equilibrium.

Following similar logic as previous sections, interest groups offer the largest political contributions when their policies are ex post indistinguishable based on their merits. The larger the quality of one policy compared to the other, the less the interest group associated with the favored policy must pay to ensure it is selected, and the lower are overall political contributions. As the policymaker collects more information, the expected ex post asymmetries between the policies increase, and therefore the expected contributions made by the interest groups decrease. In expectation, equilibrium political contributions are maximized when the policymaker remains fully uninformed. In the Appendix, we formally walk through this analysis. We show how again the politician faces a tradeoff between signal informativeness and political contributions. By becoming more informed about policies, the politician becomes better at selecting policies, but attracts fewer political contributions. In equilibrium, the politician's choice of how much information to acquire depends λ, the political importance of an issue. We show that there exists a threshold $\bar{\lambda}$ such that

- when $\lambda > \bar{\lambda}$, the politician prefers fully informative signals, and
- when $\lambda < \bar{\lambda}$, the politician prefers fully uninformative signals.

When the issue is of enough political importance, the politician prefers to become fully informed. Although in this case the politician receives no political contribution from the interest groups, she makes the best policy decision. For issues of sufficient political importance, the benefit of better policymaking dominates the monetary cost. For issues of less political importance, the loss of political contributions associated with a more informative signal dominates the benefit. Therefore, the politician prefers to remain fully ignorant. A contribution limit in this case constrains the politician's ability to attract political contributions and reduces the financial gain associated with becoming uninformed. This incentivizes the politician to become fully informed for a larger range of issues and therefore improves constituent welfare.

2.7 Alternative Assumptions

In this section, we consider extensions of the initial analysis. We first consider costly information acquisition and alternative monetary lobbying frameworks. After that, we consider an alternative model with an initial stage in which the politician decides whether to hide her information collection efforts or her level of expertise from the interest groups.

2.7.1 Costly Signals

In the initial analysis, we assume that it is costless for the politician to collect information or acquire expertise. But this assumption is not necessary for our results. In this section, we consider the case when it is costly for the politician to acquire an informative signal about policies. Specifically, we assume that the politician must pay $k\gamma$, where $k > 0$, to receive a signal with informativeness level γ. This cost is increasing in γ because the politician incurs a higher cost when she puts in more efforts to collect information or acquires higher level of expertise.

In the Appendix, we formally derive the equilibrium strategies for the costly signal case. We show that the main results in the paper continue to hold in this setting. When acquiring an informative signal is costly, the marginal cost of increasing signal informativeness becomes greater: it not only reduces political contributions but also imposes a direct cost on the politician. This makes increasing signal informativeness less attractive. Compared with the case when it is costless to collect information or acquire expertise, the politician prefers to be uninformed for a larger range of issues. Specifically, the politician chooses $\gamma = 0$ for issues such that $\lambda < k + \sqrt{\pi}v$ and chooses $\gamma = \sqrt{2}$ for issues such that $\lambda > k + \sqrt{\pi}v$. As the marginal cost of increasing signal informativeness (i.e. k) increases, the politician remains fully uninformed about policies for a larger range of issues.

In the Appendix, we show that in the case with a contribution limit, the politician chooses $\gamma = \frac{\sqrt{2\pi}(v-\bar{c})}{\pi\lambda}$ for issues such that $\lambda < \bar{\lambda}$ and chooses $\gamma = \sqrt{2}$ for issues such that $\lambda > \bar{\lambda}$, where $\bar{\lambda} < k + \sqrt{\pi}v$. This implies that a contribution limit incentivizes the politician to become fully informed for a larger range of issues. When a contribution limit is enforced, the politician's ability to attract political contributions is constrained. In this case, the monetary benefit of remaining uninformed becomes lower, and the politician chooses to become fully informed for a larger range of issues.

For issues of less political importance $\lambda < k + \sqrt{\pi}v$, a contribution limit eliminates political ignorance among politicians and incentivizes the politician to become more informed about the policies.

2.7.2 Alternative Monetary Lobbying Framework

In the body of the paper, we assume that the politician sells policy favors using a menu auction. Specifically, interest group i delivers its promised contributions to the politician only if its prefered policy is chosen by the politician. In this section, we consider an alternative model with an initial stage in which the politician decides whether to sell policy favor using a menu auction or an all-pay auction. If the politician decides to sell policy favor using an all-pay auction, both interest groups must pay their promised contributions regardless of the politician's policy choice. After the politician chooses how to sell policy favor, the politician decides how much information to collect and how much expertise to acquire, and then interest groups engage in monetary lobbying. In the last stage, the politician decides which policy to implement, accounting for both the merits of each policy alternative and political contributions offered by the interest groups.

Let's consider the subgame after the politician chooses to sell policy favors with an all-pay auction. In this case, the politician receives political contributions offered by both interest groups regardless of her policy decision. Since the politician cares about both policy quality and political contributions, she chooses interest group 1's policy when

$$\lambda E(q_1|S_1 = s_1) + (c_1 + c_2) > \lambda E(q_2|S_2 = s_2) + (c_1 + c_2).$$

This is equivalent to

$$\frac{s_1 + \mu\sigma^2}{1 + \sigma^2} - \frac{s_2 + \mu\sigma^2}{1 + \sigma^2} > 0.$$

As we can see from above, when the politician chooses to sell policy favor with an all-pay auction, she will choose the policy of higher expected quality. Political contributions in this case have no impact on the politician's policy decision. The interest groups anticipate this and they choose not to offer political contributions to the politician. Therefore, the politician no longer faces a trade off between policy information and political contributions. In equilibrium, the politician prefers to become fully informed about the policies and her expected payoff equals $E(U_P) = \lambda\mu + \frac{\lambda}{\sqrt{\pi}}$.

If the politician decides to sell policy favor using a menu auction, the equilibrium strategies of the politician and the interest groups are all identical to what we have described in the body of the paper. In this case, the politician's expected payoff equals $E(U_P) = \lambda\mu + v$ for issues such that $\lambda < \sqrt{\pi}v$, and equals $E(U_P) = \lambda\mu + \frac{\lambda}{\sqrt{\pi}}$ for issues such that $\lambda > \sqrt{\pi}v$. So for issues of sufficient political importance (i.e. $\lambda > \sqrt{\pi}v$), the politician receives the same expected pyaoff from using a menu auction and an all-pay auction. For issues that are less politically important (i.e. $\lambda < \sqrt{\pi}v$), however, the politician receives higher expected payoff by using a menu auction. Therefore, when there is no contribution limit, the politician weakly prefers to sell policy favor using a menu auction.

In the Appendix, we show that when there is a contribution limit, the politician also weakly prefers to use a menu auction to sell policy favor. This implies that in the alternative model, the equilibrium strategies of the politician and interest groups are all identical to those described in Section 2.4 and Section 2.5. Therefore, our main results continue to hold in this alternative model.

2.7.3 Unobservable Signal Informativeness

In the previous analysis, we assume interest groups can perfectly observe the policymaker's efforts to collect information, her level of expertise, and therefore the informativeness of the signal chosen by the politician. In this section, we consider an augmented game with an initial stage, in which the politician decides whether to hide or publicize her choice of signal informativeness. The rest of the game is identical to the game described in Section 2.3. In the second stage of the game, the politician chooses γ, the informativeness of the signal. The politician's choice of γ is unobservable to interest groups if she decides to hide her choice of signal informativeness in the first stage, and is perfectly observable to interest groups otherwise. If interest groups do not observe the politician's choice of γ, they act on their conjectures of the politician's strategy. In equilibrium, these conjectures are correct. In the third stage of the game, interest groups simultaneously decide how much political contributions to offer to the politician. In the last stage of the game, the politician decides which policy to implement.

In the Appendix, we fully characterize the equilibrium strategies of the politician and the interest groups in this augmented game. We show that the politician (weakly) prefers to make her choice of signal informativeness perfectly observable to interest groups in the case with and without a contribution limit. Therefore, in this augmented game, the equilibrium strategies of the politician and the interest groups are all identical to those described in Section 2.4 and Section 2.5. This implies that our main results continue to hold when we allow the politician to hide her efforts in information collection or her level of expertise.

2.8 Conclusion

This paper has two primary contributions. First, it develops a novel theory as to why politicians prefer to remain uninformed when making policy decisions. The theory is developed in a lobbying model in which an incumbent politician strategically decides how informed to become about the merits of alternative policies. The analysis of the model shows that the politician faces a trade off between policy quality and political contributions when deciding how much information to acquire. By becoming more informed about the policy alternatives, the politician makes better policy decisions but attracts fewer political contributions from interest groups. The latter is because a more informed politician can better differentiate between policies, which undermines the competition between interest groups. In equilibrium, the politician prefers to remain completely uninformed about a range of issues as the costs associatd with becoming more informed dominate the benefits.

Second, this paper identifies a new channel through which contribution limits improve constituent welfare: they incentivize politicians to become informed on a larger range of issues. A contribution limit reduces the financial gain associated with remaining uninformed and gives the politician an incentive to acquire more information about the merits of alternative policies. Since a more informed politician is able to make better policy decisions, a contribution limit leads to better policy outcomes and higher constituent welfare.

The US Supreme Court's 2010 decision in *Citizens United v. Federal Election Commission* eliminates the previous ban on corporations and unions using their own money to support political campaigns. Although the ruling does not affect campaign contribution limits, it allows the formation of super PACs which can accept unlimited contributions from individuals, corporations and unions. Interest groups can now make unlimited contributions to a politician's super PAC rather than the politician herself. In this sense, the Citizens United ruling is equivalent to a removel of campaign contribution limits. Our analysis suggests that this ruling may harm constituent welfare by incentivizing politicians to become less informed about policies.

It is important to note that there are other benefits and disadvantages of contribution limits that we do not address in our paper. For example, contribution limits may reduce the funds available for campaign advertising and result in less-informed voters, more extreme candiates and less welfare (Coate, 2004b). In this paper, we focus on an incumbent politician and abstract away from elections. Future work may incorporate our model to an election game or empirically test the implications of our results.

CHAPTER 3
Profiling, Screening and Criminal Recruitment

3.1 Background

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.[3]

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

[3] 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."

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.[4] By strategically choosing whom to recruit, criminal organizations select the observable characteristics of those committing crime on their behalf.[5] 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 eff-

[4]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 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; Frantz, Jr., Johnston, and Bernstein, 2002). Similarly, drug cartels often recruit mules to transport drugs on their behalf. Bjerk and Mason (2011) provide an overview of this process.

[5]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.

ective 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.[6]

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 to screen the two population groups only marginally more fairly than it does without a restriction. This leads to more-

[6]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, 2012), while recruiting an unemployed teen methamphetamine user from a poor neighborhood may take only a day (see The Associate Press, 2012).

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).[7]

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.

Section 3.2 reviews the literature. Section 3.3 describes the model of criminal recruitment and law enforcement. Section 3.4 solves for the equilibrium when law enforcement is unrestricted in its ability to screen two population groups at different rates. Section 3.5 solves for the equilibrium when law enforcement is restricted in its ability to profile. Section 3.6 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 3.7 considers

[7] 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.

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 3.8 concludes.

3.2 Literature Review

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).[8] 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

[8] 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.

screen one population group at a higher rate.[9] Therefore, simply showing that officers screen one population group at 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.[10] A number of papers extend Knowles, Persico, and Todd (2001) in a variety of directions.[11] 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

[9] 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 (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.

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

[11] 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.

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).

3.3 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 expensive, time-consuming, or otherwise difficult to recruit.[12]

[12]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 3.7, we explicitly model operative behavior in the criminal recruitment process, and we show

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 3.7, 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 simul-

how our results hold up under reasonable alternative assumptions about the recruitment process.

taneous move game in which both law enforcement and the criminal organization choose their strategies at the same time.[13]

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

$$\mathcal{C} = q_A(1-a) + q_B(1-b), \tag{3.1}$$

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.

$$u_{LE} = (q_A\ a + q_B\ b)v, \tag{3.2}$$

$$u_C = \mathcal{C} - q_A r_A - q_B r_B. \tag{3.3}$$

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.

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

Definition 3.3.1 *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 $\delta = 0$.

[13] 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.

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 3.3.2 *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 $\bar{\delta}$.*

3.3.2 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 3.7, 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.

3.4 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 (3.2) and the criminal organization's expected payoff is given by (3.3). 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

$$\bar{s}_{nc} = \lambda(1 - r_A) + (1 - \lambda)(1 - r_B) = 1 - \lambda r_A - (1 - \lambda)r_B. \tag{3.4}$$

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 3.4.1 *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 assume the law enforcement budget is not sufficient to deter all crime in equilibrium:

Assumption 3.4.1

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

We also assume the law enforcement budget is sufficient to impact criminal behavior:

Assumption 3.4.2

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

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 3.4.1 *In the unique equilibrium under unconstrained profiling and Assumption 3.4.1 and Assumption 3.4.2, 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 Assumption 3.4.1 and Assumption 3.4.2, which restrict attention to the most interesting range of parameter values. If Assumption 3.4.1 is violated, then the law enforcement budget is sufficiently large that the only equilibrium involves no crime. If Assumption 3.4.2 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.[14]

We calculate the amount of criminal activity and player payoffs for any $\bar{s}$ satisfying Assumption 3.4.1 and Assumption 3.4.2.

Corollary 3.4.1 *Under unconstrained profiling and Assumption 3.4.1 and Assumption 3.4.2, in the unique equilibrium*

$$\mathcal{C} = 1 - \bar{s},$$

$$u_{LE} = \bar{s}\ v,$$

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

3.5 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

[14] 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.

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

$$\bar{s}'_{nc} = \lambda(1 - r_B - \bar{\delta}) + (1-\lambda)(1-r_B) = 1 - r_B - \lambda\bar{\delta}. \tag{3.5}$$

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 3.5.1 *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 Assumption 3.4.2 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 3.5.1 *In the unique equilibrium under profiling rule* $\bar{\delta} \in [0, r_A - r_B)$*, and Assumption 3.4.1 and Assumption 3.4.2, 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 Assumption 3.4.1 and Assumption 3.4.2. We use superscript $\bar{\delta}$ to denote the outcome under a binding profiling rule.

Corollary 3.5.1 *Under profiling rule* $\bar{\delta} \in [0, r_A - r_B)$*, and Assumption 3.4.1 and Assumption 3.4.2, 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.

3.6 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.[15] $\bar{\delta} = 0$ is restrictive enough that any potential benefits from restricting profiling are completely offset by the loss of officer flexibility when choosing a screening strategy.

Theorem 3.6.1 *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

[15] 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 3.4.1, 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.

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.[16]

Corollary 3.6.1 *Requiring equal treatment never increases the effectiveness of law enforcement compared to unconstrained profiling. Any other profiling rule is more effective than* $\bar{\delta} = 0$.

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 3.6.2 *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.

[16] Of course, this conclusion ignores the wellbeing of innocent people subject to additional search. We discuss this further in Section 3.7.

3.7 Extensions

In the 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.

3.8 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.

CHAPTER 4
Deterrence and Pleading Standards in Litigation

4.1 Background

Federal courts in the United States have recently expressed concern about the high costs of litigation for defendants, particularly the costs of discovery.[17] Because of the "American rule," which makes the parties responsible for their own litigation costs (Rowe, 1982), defendants may incur great costs in litigation even when they are not liable.

In a recent antitrust case, *Bell Atlantic Corp.* v. *Twombly* (550 U.S. 544, 570 [2007]), the U.S. Supreme Court addressed this concern by increasing the pleading standard, permitting a defendant to seek dismissal of a lawsuit before discovery if the plaintiff fails to allege a "plausible" claim. The Court rejected prior case law which permitted suits to proceed to discovery and trial if the facts alleged were "merely consistent with" an entitlement to recovery. The Court emphasized that a "plausibility" standard is necessary because the implausibility of a claim should "be exposed at the point of minimum expenditure to time and money by the parties and the court."[18] In a later case, *Ashcroft* v. *Iqbal* (556 U.S. 662, 684 [2009]), the Court made clear that this new pleading standard applies to all cases.

The Court's concerns in *Twombly* and *Iqbal* have spurred voluminous legal schol-

[17] Discovery is a phase of litigation that allows the parties to compel the disclosure of evidence from each other and from third parties. It is costly because the parties incur the costs of providing requested information to the other side. For example, a party is permitted to request documents or other tangible things from another party (Fed. R. Civ. P. 34). Typically a request for documents requires a party to incur extensive search costs (e.g., looking through file cabinets and warehouses, searching through electronic databases), production costs (e.g., making paper copies of the documents, subjecting the copies to review by attorneys for redaction of privileged matters), and distribution costs (e.g., shipping the documents to the requesting party). Similar costs arise for depositions (Fed. R. P. 30), which allow the parties to compel the oral testimony of witnesses under oath.

[18] *Twombly* at 557 and 558.

arship (see Reinert, 2012). However, the literature has focused almost exclusively on their effects on lawsuits already filed in federal court (Engstrom, 2013; Kaplow, 2013). In contrast, we examine the effects of the stronger pleading standards implemented by *Twombly* and *Iqbal* on the defendant's incentives to engage in unlawful conduct in the first place. Ours is one of only a few papers that focus on the effect of the Supreme Court's decision on deterrence.

A potential defendant's decision to engage in conduct which may harm another party depends on the likelihood that the defendant's action causes harm, and the probability an injured party sues, obtains discovery and proves the claim in court. *Twombly* and *Iqbal* change the pleading standard and therefore change the likelihood of obtaining discovery and proceeding to trial. In this way, the Supreme Court ruling affects the incentives potential defendants have for taking potentially harmful actions in the first place.

The impact of pleading standards on deterrence has largely been overlooked by the literature. We develop a game theoretic model of litigant behavior to study the effects of stronger pleading standards on the primary behavior of potential defendants. Using intuitive assumptions, our analysis considers how an increase in pleading standards affects deterrence, and how its effect on deterrence may influence litigation accuracy and total litigation costs. Our paper is not intended as a thorough welfare analysis or to determine the optimal pleading standard, which would require a broader consideration of all potential costs and benefits of the procedure change.[19] Rather, our focus is on deterrence. Our model is intentionally simple, intended to maximize intuition about how pleading standards influence incentives to engage in illegal activity, a cost of raising the pleading standard which has largely been overlooked in the literature.

The analysis determines how a potential defendant's incentives to engage in an

[19]Kaplow (2012) provides such an analysis, which we discuss in the literature review.

illegal activity depends on the pleading standard. The equilibrium probability with which the defendant takes the illegal action influences the likelihood the plaintiff wins a suit that makes it to trial. In equilibrium, the defendant takes the unlawful action neither so infrequently that it would never be rational for the plaintiff to sue, nor so frequently that the plaintiff and judge always expect that he is liable. Rather, he plays a mixed strategy. The defendant takes the unlawful action just often enough to leave the judge indifferent between trying or dismissing a case. The probability that the judge dismisses a case is increasing in pleading standards. The defendant recognizes this, and in response to the higher pleading standards, he chooses the unlawful action more often. A similar effect would be caused by anything that increased the standard a case is held to before proceeding to discovery and trial.

When deterrence decreases, potential defendants engage in illegal activities more often, and the total amount of litigation increases. In this way, increasing pleading standards can increase total litigation costs. This result works against to the standard argument in favor of higher pleading standards, as put forth by the Supreme Court and throughout the literature. The majority in *Iqbal*, for example, emphasized that "[l]itigation, though necessary to ensure that officials comply with the law, exacts heavy costs in terms of efficiency and expenditure of valuable time and resources that might otherwise be directed to the proper execution of the work of the Government" (*Iqbal*, 556 U.S. at 685). We show that this is not necessarily the case. Through its effect on deterrence, increasing pleading standards increase total costs of litigation, the exact thing that increasing the standard is intended to decrease. To understand this, note that total litigation costs depend on both the number of injuries and the probability an injury claim proceeds to litigation. We show that with stronger pleading standards, a potential defendant engages in the unlawful activity more often, which results in the plaintiff experiencing harm more often, which can lead to an increase in litigation. For similar reasons, judicial screening increases the equilibrium probability that the potential defendant is liable, but does not change the probability that a liable defendant compensates the plaintiff for her injury. This increases the ex ante probability that a defendant harms and does not compensate a plaintiff, decreasing outcome accuracy.

Our results stand in contrast with those from models that do not account for the impact of pleading standards on deterrence, and demonstrate the importance of considering deterrence in an analysis of higher pleading standards. If we took the probability of defendant liability as fixed, then increasing higher pleading standards unambiguously decreases litigation costs. Allowing potential defendants to rationally change their behavior in response to changes in pleading standards reverses the results. When accounting for (negative) deterrence effects, increasing pleading standards tends to increase unlawful activity, resulting in a net increase in litigation costs and a net decrease in litigation accuracy.

One of the primary arguments in favor of increasing pleading standards is that doing so will decrease the prevalence of nuisance suits, which filed by plaintiffs with the intention of enticing settlement from defendants who are likely not liable. Such suits are not present in our initial analysis, as our model assumes that the defendant always has an opportunity to harm the plaintiff, and abstracts from settlements. To address these concerns, Section 4.6 introduces a new model which incorporates these features, and determines under which conditions plaintiffs file nuisance suits. We show how increasing the pleading standard in this environment continues to decrease deterrence. Thus, our main result from the earlier sections is shown to hold even in the presence of nuisance suits. Increasing pleading standards increases incentives of potential defendants to engage in illegal activity, even when it may decrease incentives for plaintiffs to file nuisance suits. In this way, our analysis highlights a cost of increased pleading standards which has been overlooked in the literature, but which should not be ignored when considering the costs and benefits of the change in judicial procedure.

We formulate our argument using a stylized model, designed to most effectively convey the intuition behind our results, and illustrate how higher pleading standards decreases deterrence and can push up total litigation costs. Our intention is to isolate the deterrence effect, rather than to derive social welfare or the optimal pleading standard, and therefore it is appropriate to consider the simplest environment for which our results exist. For example, we treat the process of discovery and trial following a judge's decision to permit a case as a black box, assuming only that it imposes costs on litigants and determines a trial outcome. We also abstract from chilling effects, the possibility that defendants become overly precautious when facing the possibility of litigation. Formally modeling such aspects of litigation would improve the realism of the model, but would also greatly increase the complexity of the analysis without adding to the basic intuition behind our argument. It is worth noting, however, that some of these extensions could lead to increased pleading standards providing benefits that are not captured by our initial analysis. We discuss these possibilities, including chilling effects, in Section 4.7.

The paper is presented as follows. Section 4.2 present literature review. Section 4.3 develops the game theoretic model. Section 4.4 solves for the equilibrium of the game. Section 4.5 considers the impact of imposing strictly pleading standards. Section 4.6 considers an extension of our framework, in which nuisance suits arise in equilibrium. Section 4.7 discusses alternative assumptions and Section 4.8 concludes. The appendix provides formal proofs of our results.

4.2 Literature Review

Twombly and *Iqbal* have generated a significant amount of scholarship, with at least one scholar finding that, as of 2012, the decision has "been cited by more than 26,000 courts, more than 500 law review articles, and innumerable briefs and motions" (Reinert, 2012). Some scholars have expressed support for the new pleading standard (e.g. Anderson and Huffman, 2010). Others, however, have argued that the new pleading standards place a significant burden on plaintiffs asserting claims, particularly civil rights claims, and that the standards effectively reduce access to justice (e.g. Spencer, 2013; Dodson, 2012; Gelbach, 2011; Steinman, 2010; Miller, 2010). Still others argue that the new pleading standards are not new at all, since courts have consistently required "plausibility" by only crediting "reasonable inferences" (e.g Hartnett, 2009; Huston, 2010). And still others argue that the new pleadings standards should be coupled with revised discovery procedures to avoid access to justice problems (e.g. Fitzpatrick, 2012; Dodson, 2010).

The economic literature on the deterrence effect of law enforcement is also vast. In his seminal work, Becker (1968) argues that since rational criminals respond to conditions of risks, the probability and the severity of punishment deter crime. Since then, scholars have focused on characterizing the optimal law enforcement system and have extended Becker's model to a variety of aspects of law enforcement.[20] Previous research also examines the effect of tort reforms on incentives to obey the law and incentives for care. Png (1987) studies the effects of changes in court award, negligence standard and the allocation of litigation costs on potential injurer's incentive for care. Hylton (1990, 1993) and Wijck and Velthoven (2000) analyze the influence of litigation cost allocation rules on deterrence. Polinsky and Che (1991) examines the effect of

[20]Garoupa (1997) and Polinsky and Shavell (2000) provide excellent surveys of the theory of optimal law enforcement.

reforms in the liability system on incentives for care. Daughety and Reinganum (2013, 2014) studies how different liability regimes affect the choice of care by firms when harm is cumulative. Jost (1995) examines the effect of discovery rules on the incentives for accident prevention by potential injurers. Landeo, Nikitin, and Baker (2007) studies the effect of punitive damages reforms, such as damage caps and split awards, on deterrence.

Despite the significant scholarship, only a few scholars have acknowledged the effect of *Twombly* and *Iqbal* on the defendant's ex ante behavior. The most closely related paper to ours is the concurrent work of Kaplow (2012), which presents a general game theory model and considers termination of lawsuits at different points during multistage adjudication. Kaplow, like us, allows dismissal standards to influence incentives to take harmful actions in the first place. His impressive analysis focuses on determining the characteristics of *optimal* dismissal procedures in a general model; but given the generality of the framework, one cannot solve for closed form solutions of equilibrium strategies, or say much about how changes to dismissal standards influence equilibrium behavior away from the social optimum. Our paper, on the other hand, presents a simple, highly-stylized model which focuses primarily on deterrence effects. We are able to derive closed-form solutions for equilibrium strategies, and develop an understanding of how pleading standards influence deterrence, even away from the socially optimal level. Being able to do this is important for considering the impact of the recent Supreme Court rulings, as there is no reason to believe that pleading standards are or were set at the optimal level. Finally, by considering the simplest possible model in which pleading standards influence deterrence, we focus on developing intuition about the deterrence effects, which have generally been overlooked in the literature.

In a law review article, Kaplow (2013) also discusses deterrence effects associated with pleading standards. Others who have pointed out the potential effect of *Twombly* and *Iqbal* on deterrence have done so only briefly (Engstrom, 2013; Hoffman, 2011). Our analysis and Kaplow (2012) are the only articles that we are aware of to analyze these effects within a formal model.

Many scholars, including the Federal Judiciary Center, have empirically studied the effect of *Twombly* and *Iqbal* (Engstrom, 2013; Gelbach, 2011, 2012). However, they have only focused on the effect of the decisions on dismissal rates. Of these scholars, Jonah Gelbach has acknowledged the effect of *Twombly* and *Iqbal* on "primary behavior" (Gelbach, 2012). But Gelbach only provides some examples of the possible effects of judicial screening on deterrence.[21]

4.3 Model

We develop a stylized model simplified to highlight only the aspects of the litigation process which are important for our argument. There are three players: a plaintiff P who may experience harm, a defendant D who may be liable for the harm, and a judge J.

The game takes place in four stages:

1. D decides whether to take an unlawful action that benefits himself, but increases the probability that P suffers a loss. If he takes the unlawful action, he is "liable." Whether P suffers a loss is publicly observable, but whether D is liable is not. If P suffers a loss, regardless of whether D is liable, the game moves on to stage 2. Let $\ell \in \{0, 1\}$ indicate that D takes the unlawful action.

2. Observing the harm he experienced, P decides whether to sue D . Let $s \in \{0, 1\}$ indicate that P sues D .

[21] The paper notes that a full-scale model of deterrence "is a daunting [task], and it is certainly beyond the scope of [his] work" (p44).

3. J observes whether P suffered a loss, as well as the model parameters, and updates his beliefs about the probability that D is liable. J then decides whether to dismiss the case or proceed to trial. Let $d \in \{0, 1\}$ indicate that J dismisses the case. When $d = 1$, the game ends. When $d = 0$, the game proceeds to stage 4.

4. This is a non-strategic stage representing trial, including discovery and courtroom proceedings. We abstract from the details of the trial stage and for now assume simply that trial perfectly reveals whether D is liable. A liable D must compensate P for her full loss. A not liable D makes no payment to P . In addition to any compensation, trial imposes costs on D and P , which we denote by $c_{\mathsf{D}} > 0$ and $c_{\mathsf{P}} > 0$.

We use ρ with an action-specific subscript to denote a mixed strategy. That is, ρ_ℓ denotes the probability D chooses the unlawful action, ρ_s denotes the probability P sues D , and ρ_d denotes the probability J dismisses a suit.

We model D's choice of whether to take the liable action in stage 1 as a choice between two alternative actions, x_1 and x_0. Action x_1 provides a higher direct benefit to D, but also imposes a negative externality on P, for which D is "liable." Without loss of generality, we assume action x_1 and x_0 provides P benefit $v_1 = v > 0$ and $v_0 = 0$ respectively. So v represents the reletive benefit from the unlawful action. One may imagine that x_1 is an act of negligence (e.g., not taking reasonable safety precautions), an act that is so inherently dangerous (e.g., using dynamite) that the law makes the defendant strictly liable for all losses caused by the act, or an intentional illegal act (e.g., entering into an agreement to restrain trade). When D takes action x_1, P experiences a loss of value $h > 0$ with probability 1 due to D's action. When D takes action x_0, he is "not liable," although P may still experience loss h (e.g., one may still slip in a driveway even if the owner takes all reasonable steps to minimize ice build up on the driveway; a mine may still collapse even if the mining company used an explosive that is not inherently dangerous under the law; or there may be restraints of trade that do not violate antitrust law). Let $\eta \in (0,1)$ denote the probability that P experiences loss h when D chooses x_0; with probability $1-\eta$ no loss occurs.[22] Any loss suffered by P is publicly observed, although neither P nor J observe whether D is liable.

Let t generally denote the value of the transfer payment made from D to P. Given the formulation of the game, t will take on one of two values, $t \in \{0, h\}$, where $t = 0$ if P is not harmed, if P does not sue, if a suit is dismissed, or if trial finds D not liable; and $t = h$ if trial finds D liable.

If P brings suit against D, and the suit is not dismissed by J, the case moves to a trial stage in which it is publicly revealed whether D is liable. The trial stage encompasses more than just the courtroom proceedings. It also captures the discovery process that takes place following a judge's decision not to dismiss a case, in which the parties have an opportunity to compel the disclosure of evidence from each other. We abstract from the details of the trial stage and for now assume simply that when J does not dismiss a suit, ℓ is perfectly revealed because J has all of the relevant evidence before her.[23] A suit that reaches the trial stage imposes legal costs c_{P} on P and c_{D} on D, which encompass total costs of preparing for and going to trial.

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[22] Assuming that loss occurs with probability 1 when x_1 simplifies the analysis, but does not drive any of the results. Similar qualitative results would hold if we alternatively assumed harm probabilities η_1 and η_0 corresponding to actions x_1 and x_0, where $0 < \eta_0 < \eta_1 < 1$, meaning that loss is more likely when D takes the unlawful action.

[23] We note that the trial stage may not, and usually cannot, perfectly reveal the liability of D because the judge is limited to the relevant evidence provided by the parties. Nevertheless, we assume that liability is "perfectly" revealed because the judge cannot consider anything more than this evidence to determine liability. Indeed, it probably does not make sense to compare the evidence at trial to perfect information because in most cases there is no way for either the parties or the judge to know what "really" happened. In Section 4.7, we discuss in more detail how legal error affects our results.

Both P and D are concerned about payments made from D to P and about the cost of trial. The plaintiff and defendant earn respective payoffs

$$u_{\mathsf{P}} = -h + t - s(1-d)c_{\mathsf{P}}, \quad \text{and} \quad u_{\mathsf{D}} = v_\ell - t - s(1-d)c_{\mathsf{D}},$$

when P suffers loss h, and $u_{\mathsf{P}} = 0$ and $u_{\mathsf{D}} = v_0$ when P does not suffer loss h. Remember, $t = 0$ when the judge dismisses the case or a trial reveals that D is not liable, and $t = h$ when a trial reveals D is liable. The value $s(1-d)$ equals 0 when P does not sue D or the suit is dismissed, and 1 when the case reaches trial.

Given that P suffered loss h, P and J form their beliefs about D's first period action. Denote these beliefs by μ, where μ is the probability P and J believe $\ell = 1$ given that P suffered a loss. P forms these beliefs after harm occurs, while J form these beliefs during the pleading procedure, when he is likely to be made aware of the parameter values (for $c_{\mathsf{D}}, c_{\mathsf{P}}, \nu, h, \eta$) which apply for the given lawsuit.

J dismisses a case when she believes D is sufficiently unlikely to be liable. Formally, there exists a threshold value $\bar{\mu} \in (0,1)$ such that J dismisses a case when $\mu < \bar{\mu}$, allows the case to proceed to trial when $\bar{\mu} < \mu$, and can choose either action or to to randomize when $\mu = \bar{\mu}$.[24] One interpretation of $\bar{\mu}$ is that the threshold at which the social benefits of trial equal the costs. When μ is higher than this threshold, D is sufficiently likely to be liable that a trial is warranted, and when μ is lower than this threshold, the probability of trial leading to D being found liable is sufficiently low that a trial is not worth the costs. We take a general approach to interpreting

[24] It is concevable that a pleading standard set by high court specifies that J take a specific action when $\mu = \bar{\mu}$. However, this does not appear to be the case when examining the language of the *Twombly* and *Iqbal* rulings, which strongly suggest that the courts engage in a cost benefit analysis when deciding whether to dismiss a lawsuit, necessarily giving J some discretion to dismiss (or not dismiss) in very close cases. We therefore focus on pleading standards that do not specify a tie breaking action; although considering such rules would be necessary if considering the optimal design of pleading standards, which is not a focus of our paper.

these pleading standards, solving the game for any $\bar{\mu} \in (0,1)$, and thus allowing for any underlying objective function by J .

Because both *Twombly* and *Iqbal* increase the standard of plausibility that a lawsuit must meet before proceeding to discovery and trial, the new pleading standard can be reasonably interpreted as an increase in $\bar{\mu}$.

We solve for the Perfect Bayesian Equilibrium (PBE) of the game. A description of equilibrium must define: (1) D's choice of ρ_ℓ; (2) P's choice of ρ_s; and (4) J's choice of ρ_d. Additionally, a formal description of equilibrium should include P and J's beliefs about ℓ, given by μ. In equilibrium, each player's strategy must be a best response given the strategies of the other players and the player's beliefs. Beliefs must be consistent with Bayes' Rule given the equilibrium strategies.

It is a requirement of Perfect Bayesian Equilibrium that equilibrium beliefs are consistent with player strategies in earlier stages of the game. In equilibrium, the posterior beliefs that P and J form about D's first period action must be consistent with D's strategy ρ_ℓ. The equilibrium posterior belief represented by the probability D is liable is therefore

$$\mu = Pr(\ell = 1|h) = \frac{\rho_\ell}{\rho_\ell + \eta(1-\rho_\ell)}.$$

In order to focus the analysis on the most relevant parameter cases, we introduce two assumptions regarding D's benefit from unlawful action relative to lawful action, v, and P's loss from unlawful action, h.

First, we assume that D's benefit from unlawful action relative to lawful action is not too large:

Assumption 4.3.1

$$v < h + (1-\eta)c_D$$

When this assumption is violated, taking the unlawful action is sufficiently attractive so that D always takes the unlawful action. We make this assumption to focus on litigation in which judicial screening may impact D's decision to take the unlawful action.

Second, we assume that the benefit to P of going to trial against a liable defendant $(h - c_{\mathsf{P}})$ is positive:

Assumption 4.3.2

$$h > c_{\mathsf{P}}$$

When this assumption is violated, P would never sue D . We make this assumption to focus on litigation in which J may play an active role.

4.4 Equilibrium

We divide the possible equilibria into three categories. First, we consider the "full deterrence" possibility in which D always chooses action x_0. Second, we consider the "no deterrence" possibility in which D always chooses the unlawful action x_1. Third, we consider the "partial deterrence" possibility in which D mixes between action x_1 and x_0.

4.4.1 Full Deterrence Equilibrium

We can rule out the existence of a full deterrence equilibrium in which D always takes the lawful action, x_0.

In a full deterrence equilibrium, D always takes the lawful action, x_0. J's equilibrium belief about D's liability must be consistent with D's action. In a full deterrence equilibrium, J's posterior belief is $\mu = Pr(\ell = 1|h) = 0$. This is lower than $\bar{\mu}$, so J always dismisses a lawsuit. Given J's equilibrium strategy, D anticipates payoff $v_0 = 0$

from the lawful action. When D deviates to take the unlawful action, he expects payoff $v_1 = v > 0$. Therefore, D has an incentive to deviate to take the unlawful action and a full deterrence equilibrium does not exist.

4.4.2 No Deterrence Equilibrium

We can also rule out the existence of a no deterrence equilibrium in which D always takes the unlawful action, x_1.

In a no deterrence equilibrium, D always takes the unlawful action, x_1. P and J's equilibrium beliefs about D's liability must be consistent with D's action, so their beliefs are $\mu = Pr(\ell = 1|h) = 1$ in a no deterrence equilibrium. This is higher than $\bar{\mu}$, so J always allows a lawsuit to proceed.

Given J's equilibrium strategy, P anticipates benefits $h - c_{\mathsf{P}}$ from bringing suit against D. Assumption 4.3.2 ensures $h - c_{\mathsf{P}} > 0$, so P prefers to sue D in a no deterrence equilibrium.

Given P and J's equilibrium strategy, D anticipates payoff $v_1 - h - c_{\mathsf{D}}$ from the unlawful action. When D deviates to take the lawful action, he expects payoff $v_0 - \eta c_{\mathsf{D}}$. In a no deterrence equilibrium, D must prefer to take the unlawful action rather than the lawful action. This is the case when $v_1 - h - c_{\mathsf{D}} > v_0 - \eta c_{\mathsf{D}}$, or equivalently $v > h + (1 - \eta)c_{\mathsf{D}}$. Since this contradicts Assumption 4.3.2, a no deterrence equilibrium does not exist.

4.4.3 Partial Deterrence Equilibrium

Next, we consider the possibility of a partial deterrence equilibrium, where D chooses the unlawful action only some of the time. There are two possible partial deterrence equilibria, depending on the value of $\bar{\mu}$.

The first possibility happens when pleading standards are sufficiently low. This is the case when

$$\bar{\mu} < \frac{c_{\mathsf{P}}}{h}. \tag{4.1}$$

When pleading standards are sufficiently low, J always allows lawsuits to proceed to trial. In equilibrium, D mixes in his choice of the unlawful action, taking the unlawful action just often enough to leave to leave P indifferent between pursuing trial and not suing. Lemma 4.4.1 provides a formal summary of this partial deterrence equilibrium.

Lemma 4.4.1 *When (4.1) is satisfied, there exists a partial deterrence equilibrium in which*

- *D's strategy: choose the unlawful action with probability*

$$\rho_\ell = \frac{\eta c_P}{h - (1-\eta)c_P}.$$

- *P's strategy: bring suit against D with probability*

$$\rho_s = \frac{v}{h + (1-\eta)c_D}$$

- *J's strategy: never dismiss the suit*

$$\rho_d = 0.$$

- *Posterior beliefs:*

$$\mu = \frac{c_P}{h}.$$

A different partial deterrence equilibrium exists when the pleading standards are relatively high. This is the case when

$$\bar{\mu} \geq \frac{c_{\mathsf{P}}}{h}. \tag{4.2}$$

In this case, J dismisses a lawsuit only some of the time. The equilibrium involves D mixing in his choice to take the unlawful action, taking the unlawful action often enough to leave P always suing D, and J indifferent between dismissing a case and allowing a case to proceed to trial. J then dismisses a case just often enough to make D indifferent in his choice of whether to take the unlawful action. Lemma 4.4.2 provides a formal summary of this partial deterrence equilibrium.

Lemma 4.4.2 *When (4.2) is satisfied, there exists a partial deterrence equilibrium in which*

- *D's strategy: choose the unlawful action with probability*

$$\rho_\ell = \frac{\eta\bar{\mu}}{1-(1-\eta)\bar{\mu}}.$$

- *P's strategy: always sues*

$$\rho_s = 1.$$

- *J's strategy: dismiss a case with probability*

$$\rho_d = 1 - \frac{v}{h+(1-\eta)c_{\mathsf{D}}}.$$

- *Posterior beliefs:*

$$\mu = \bar{\mu}.$$

When $\bar{\mu} = c_\mathsf{P}/h$, there is a continuum of partial deterrence equilibria, which differ in terms of P's strategy to sue and J's strategy to dismiss a case, but not in D's strategy to take the unlawful action which is the same in each of the equilibria. One of these equilibria is identical to the partial deterrence equilibrium that is described in Lemma 4.4.2. When discussing the impact of stronger pleading standards, we focus on this equilibrium. Assuming that a different equilibrium arrises in the case where a continuum of equilibria exists does not change our results.

4.5 Impact of Stronger Pleading Standards

The main contribution of our analysis is to study the impact of stronger pleading standards on litigation outcomes and behavior, while accounting for the fact that changes in litigation procedure will alter the incentives for potential defendants to engage in unlawful behavior in the first place. Since stronger pleading standards can be interpreted as an increase in $\bar{\mu}$ in our model, we consider the impact of an increase in $\bar{\mu}$ on deterrence, litigation costs and litigation accuracy in this section.

4.5.1 Deterrence

In this section, we consider the impact of increased pleading standards on D's ex ante decision between the unlawful action x_1 and the lawful action x_0.

From Lemma 4.4.1, when $\bar{\mu} < c_\mathsf{P}/h$, there exists a partial deterrence equilibrium in which D chooses the unlawful action with probability

$$\rho_\ell = \frac{\eta c_P}{h - (1-\eta)c_P}.$$

This probability does not depend on $\bar{\mu}$. So an increase in $\bar{\mu}$ has no impact on deterrence.

From Lemma 4.4.2, when $\bar{\mu} \geq c_{\mathsf{P}}/h$, there exists a partial deterrence equilibrium in which D chooses the unlawful action with probability

$$\rho_\ell = \frac{\eta\bar{\mu}}{1-(1-\eta)\bar{\mu}}.$$

By inspection, this probability is increasing in $\bar{\mu}$. So a marginal increase in $\bar{\mu}$ increases the probability that D takes the unlawful action, decreasing deterrence.

Notice that when $\bar{\mu} = c_{\mathsf{P}}/h$, the two equilibrium values of ρ_ℓ are equal. This implies that the level of deterrence is a continuous function of $\bar{\mu}$, at first constant and then decreasing in the pleading standard.

When pleading standards are sufficiently low (when $\bar{\mu} < c_{\mathsf{P}}/h$), J always brings suit to trial. In this case, a marginal increase in pleading standards has no impact on behavior or deterrence. When pleading standards are relatively high (when $\bar{\mu} \geq c_{\mathsf{P}}/h$), J dismisses a lawsuit with positive probability, and this probability depends on the strength of the pleading standards. In this case, a marginal increase in pleading standards results in higher probability that a lawsuit is dismissed by J. D anticipates higher dismissal rates associated with higher pleading standards, and chooses the unlawful action more often.

Therefore, when pleading standards are sufficiently low (when $\bar{\mu} < c_{\mathsf{P}}/h$), a marginal increase in pleading standards has no impact on deterrence. When pleading standards are relatively high (when $\bar{\mu} \geq c_{\mathsf{P}}/h$), a marginal increase in pleading standards decreases deterrence. Together, these results imply the following.

Proposition 4.5.1 *Suppose the pleading standard increases from $\bar{\mu}$ to $\bar{\mu}' \in (\bar{\mu}, 1)$. If $\bar{\mu}' \leq c_{\mathsf{P}}/h$, then the increase in pleading standard has no impact on deterrence. If $\bar{\mu}' > c_{\mathsf{P}}/h$, then the increase in pleading standard decreases deterrence.*

4.5.2 Litigation Costs

Now we consider how stronger pleading standards affect total litigation costs. A suit that reaches the trial stage imposes legal costs on both P and D. The expected total litigation costs depend on the probability that P experiences harm and the probability that a suit reaches the trial stage. Denote total litigation costs by c.

$$Ec = [\rho_\ell \rho_s(1-\rho_d) + (1-\rho_\ell)\eta\rho_s(1-\rho_d)](c_{\mathsf{P}} + c_{\mathsf{D}}).$$

Given equilibrium strategies described in Lemma 4.4.1 and Lemma 4.4.2, we have

$$Ec = \begin{cases} \frac{\eta v h (c_{\mathsf{P}}+c_{\mathsf{D}})}{(h+(1-\eta)c_{\mathsf{D}})(h-(1-\eta)c_{\mathsf{P}})} & \text{if } \bar{\mu} < c_{\mathsf{P}}/h \\ \frac{\eta v (c_{\mathsf{P}}+c_{\mathsf{D}})}{(h+(1-\eta)c_{\mathsf{D}})(1-(1-\eta)\bar{\mu})} & \text{if } \bar{\mu} \geq c_{\mathsf{P}}/h \end{cases}$$

As shown in Lemma 4.4.1, when pleading standards are sufficiently low (when $\bar{\mu} < c_{\mathsf{P}}/h$), J always allows a lawsuit to proceed to discovery and trial. In this case, D's decision to take the unlawful action and P's decision to sue do not depend on $\bar{\mu}$. A marginal increase in $\bar{\mu}$ has no impact on the probability that P experiences harm or the probability that a suit reaches the trial stage, and therefore does not affect the expected litigation costs.

When pleading standards are relatively high (when $\bar{\mu} \geq c_{\mathsf{P}}/h$), D's decision to take the unlawful action depends on the strength of the pleading standards. A marginal increase in $\bar{\mu}$ incentivizes D to take the unlawful action more often, and therefore increases the probability that P experiences harm. But the probability that a claim reaches trial is independent of the pleading standard. Therefore, stronger pleading standards increase the probability that P experiences harm *and* a suit reaches the trial stage, resulting in higher expected litigation costs.

Therefore, when pleading standards are sufficiently low (when $\bar{\mu} < c_{\mathsf{P}}/h$), a marginal increase in pleading standards has no impact on total litigation costs. When pleading standards are relatively high (when $\bar{\mu} \geq c_{\mathsf{P}}/h$), a marginal increase in pleading standards increases total litigation costs. Together, these results imply the following.

Proposition 4.5.2 *Suppose the pleading standard increases from $\bar{\mu}$ to $\bar{\mu}' \in (\bar{\mu}, 1)$. If $\bar{\mu}' \leq c_{\mathsf{P}}/h$, then the increase in pleading standard has no impact on expected litigation costs. If $\bar{\mu}' > c_{\mathsf{P}}/h$, then the increase in pleading standard increases total expected litigation costs.*

In contrast to the Supreme Court's statement that higher pleading standards decrease the costs of litigation, we find that the society may spend more on litigation with higher pleading standards. This is because judicial screening causes the number of injury claims to increase, and does not alter the probability a given injury claim reaches trial.

4.5.3 Outcome Accuracy

Now we consider how increased pleading standards affect the expected value of $\delta \equiv |\ell h - t|$, which represents the compensation error that occurs when a liable D does not fully compensate P for her loss.

Given equilibrium strategies described in Lemma 4.4.1 and Lemma 4.4.2, we have

$$E\delta = \begin{cases} \frac{\eta c_{\mathsf{P}} h(h+(1-\eta)c_{\mathsf{D}}-v)}{(h+(1-\eta)c_{\mathsf{D}})(h-(1-\eta)c_{\mathsf{P}})} & \text{if } \bar{\mu} < c_{\mathsf{P}}/h \\ \\ \frac{\eta\bar{\mu}h((h+(1-\eta)c_{\mathsf{D}})-v)}{(h+(1-\eta)c_{\mathsf{D}})(1-(1-\eta)\bar{\mu})} & \text{if } \bar{\mu} \geq c_{\mathsf{P}}/h \end{cases}$$

As shown in Lemma 4.4.1, when pleading standards are sufficiently low (when $\bar{\mu} < c_{\mathsf{P}}/h$), J always allows a lawsuit to proceed to discovery and trial. In this case, D's decision to take the unlawful action and P's decision to sue do not depend on $\bar{\mu}$. A marginal increase in $\bar{\mu}$ has no impact on the probability that P experiences harm or the probability that a liable D compensates P's loss, and therefore does not affect the expected compensation error.

When pleading standards are relatively high (when $\bar{\mu} \geq c_{\mathsf{P}}/h$), a marginal increase in $\bar{\mu}$ incentivizes D to take the unlawful action more often, but has no impact on the probability that a liable D compensates P's loss. Therefore, stronger pleading standards increase the probability that D is liable *and* does not compensate P's loss. This increases the expected compensation error and reduces outcome accuracy.

Therefore, when pleading standards are sufficiently low (when $\bar{\mu} < c_{\mathsf{P}}/h$), a marginal increase in pleading standards has no impact on outcome accuracy. When pleading standards are relatively high (when $\bar{\mu} \geq c_{\mathsf{P}}/h$), a marginal increase in pleading standards decreases outcome accuracy. Together, these results imply the following.

Proposition 4.5.3 *Suppose the pleading standard increases from $\bar{\mu}$ to $\bar{\mu}' \in (\bar{\mu}, 1)$. If $\bar{\mu}' \leq c_{\mathsf{P}}/h$, then the increase in pleading standard has no impact on expected outcome* *accuracy. If $\bar{\mu}' > c_P/h$, then the increase in pleading standard decreases expected outcome accuracy.*

4.5.4 Eliminating Pleading

The analysis is primarily concerned with studying the impact that an increase in the pleading standards has on outcomes. Given we find that increasing pleading standards has detrimental effects, simultaneously increasing both illegal activity and litigation costs, it is worth discussing the possibility of eliminating pleading and the judge's ability to dismiss cases prior to discovery.

The elimination of pleading is equivalent to setting $\bar{\mu} = 0$ in our framework. Just as an increase in pleading standards is never beneficial in our framework, the elimination of pleading is never harmful. It will either improve outcomes or have no impact on behavior.

In a world without pleading, a case is certain to go to trial if the plaintiff sues. This increases the incentives that a potential defendant has to avoid harming the plaintiff. In this case, illegal activity and the costs of litigation are lower than when judges hold cases to high standards of plausibility before allowing them to proceed to discovery and trial.

4.6 Extension with Nuisance Suits

One of the primary arguments in favor of increased pleading standards is that they will decrease the prevalence of "in terrorem" or nuisance lawsuits. These are frivolous lawsuits intended to entice settlement from a likely innocent defendant who wants to avoid litigation costs.

Nuisance suits do not arise in equilibrium of our initial model. One might imagine that such suits do not arise because we abstract from settlements, ignoring the possibility that litigants might choose to settle a case prior to trial. Even if we allowed pre-trial settlements in our model, however, nuisance suits would not arise. This is because a defendant who expects a nuisance suit has an incentive to at least sometimes engage in the illegal activity, and when the defendant sometimes engages in the illegal activity, any lawsuit against him can no longer be considered frivolous. Rather, nuisance suits do not arise in our framework due to the underlying assumption that the defendant in our model can always take an action that harms the plaintiff. This leads a defendant who anticipates a nuisance suit to choose the harmful action. To get nuisance suits as part of an equilibrium, the model needs to allow the plaintiff to sue a defendant who may have had no opportunity to cause harm, while also allowing the litigants to settle before incurring the costs of trial.

In this section, we consider an alternative model which incorporates these elements. We keep the initial model from Section 4.3 unchanged except for the following alternations. First, we assume that the harmful action, x_1, is only available to D with probability ϕ. With probability $1-\phi$, D does not have an opportunity to take action x_1 and by default must choose the non-liable action, x_0. (For example, D may not always have the need to remove ice from his drive, may not always have access to dynamite, and may not always have opportunity to engage in illegal non-competitive behavior.) Second, after J decides whether to dismiss the lawsuit but before trial costs are incurred, P can propose a settlement to D . Denote the take it or leave it settlement offer by s. If D accepts, then $t = s$. If D rejects, then the suit proceeds to trial, just as in the previous sections.

In this section, we assume that D's benefit from unlawful action relative to lawful action is not too large:

Assumption 4.6.1

$$v \leq (1-\eta)c_{\mathsf{D}}$$

This assumption has similar function as Assumption 4.3.1 in the initial model. When Assumption 4.6.1 is violated, taking the unlawful action is so attractive that D always takes the unlawful action even when J never dismisses a lawsuit. We make this assumption to focus on litigation in which judicial screening may impact D's decision to take the unlawful action.

We define a nuisance suit as any lawsuit where P's settlement strategy is intended to get settlement payments from non-liable defendants. P rationally anticipates that D will accept a higher settlement offer when liable than when not liable, but even a non-liable D will accept a settlement offer of up to $s = c_{\mathsf{D}}$ as doing so is no more costly than paying trial costs. Therefore, a nuisance suit involves P offering settlement $s = c_{\mathsf{D}}$, and the offer being accepted by D even when not liable. In the appendix, we show that the equilibrium takes one of three possible forms, depending on relative parameter values.

First, there exists an equilibrium with nuisance suits exists if and only if

$$\bar{\mu} < \min\{\frac{\phi}{\phi + (1-\phi)\eta}, \frac{c_{\mathsf{D}} + c_{\mathsf{P}}}{h + c_{\mathsf{D}} + c_{\mathsf{P}}}\}. \tag{4.3}$$

In this equilibrium, D takes the unlawful action with probability

$$\rho_\ell = \frac{\eta\bar{\mu}}{\phi(1-(1-\eta)\bar{\mu})}$$

when he is able to, and always takes the lawful action when the unlawful action is unavailable. When P experiences harm, he always sues D, and J dismisses a case with probability

$$\rho_d = 1 - \frac{v}{(1-\eta)c_{\mathsf{D}}}.$$

When J allows a case to proceed to litigation, P offers $s = c_{\mathsf{D}}$ to D.

Second, there exists an equilibrium in which P targets settlements towards liable defendants (thus not engaging in nuisance suits) when

$$\frac{c_{\mathsf{D}}+c_{\mathsf{P}}}{h+c_{\mathsf{D}}+c_{\mathsf{P}}} \leq \bar{\mu} < \frac{\phi}{\phi+(1-\phi)\eta} \tag{4.4}$$

In this equilibrium, D takes the unlawful action with the same probability in the previous equilibrium when he is able to, J dismisses suits with probability $\rho_d = 1-\nu/\left((1-\eta)c_{\mathsf{D}}\right)$, and if the suit is not dismissed, P offers settlement $s = h + c_{\mathsf{D}}$, which is only accepted by a liable defendant.

Third, there exists a no-deterrence equilibrium in which the probability that D has the opportunity to commit harm is sufficiently low that J always dismisses the case, and D responds, when the opportunity arises, by taking the illegal action. This is the case when

$$\frac{\phi}{\phi+(1-\phi)\eta} \leq \bar{\mu} \tag{4.5}$$

In discussing these results, it is helpful to imaging a world in which there are many issues spanning the universe of values $h > 0$, $c_{\mathsf{D}} + c_{\mathsf{P}} > 0$, $\phi \in [0,1]$ and $\eta \in [0,1]$. Hence, any combination of values h, $c_{\mathsf{D}} + c_{\mathsf{P}}$, ϕ and η may sometimes occur. This means that there always exists a range of situations in which (4.3) is satisfied and nuisance suits arise in equilibrium. The lower bound equals the pleading standard, and thus increasing the pleading standard $\bar{\mu}$ decreases the range of settings in which plaintiffs successfully file nuisance suits. This captures the intuition for the Supreme Court's argument that high litigation costs are leading to nuisance suits, and that increasing pleading standards can decreases the prevalence of such suits.

However, our results show that deterring nuisance suits is not the only effect of an increase in pleading standards. As μ increases, equilibrium ρ_ℓ in the first and second equilibrium cases also increases, as D engages in the illegal activity more often.

Therefore, even in the parameter cases for which nuisance suits exists, increasing the pleading standard decreases deterrence.

Proposition 4.6.1 *In the model with nuisance suits, increasing pleading standards*

- *decreases the range of parameter values for which* P *files nuisance suits*
- *increases illegal activity when* $\bar{\mu} < \phi/(\phi + (1 - \phi)\eta)$*, and otherwise does not change the prevalence of illegal activity.*

The relationship between pleading standards and total litigation costs is less straightforward than in previous sections due to the fact that when a case is dismissed or settled, neither litigant pays costs of discovery and trial. When $\bar{\mu}$ is sufficiently low that nuisance suits exist, there are no litigation costs as all suits settle. If $\bar{\mu}$ increases to the to the point where (4.4) is satisfied, total litigation costs increase as non-liable defendants refuse settlement and prove their case in court. Once $\bar{\mu}$ increases further such that (4.5) is satisfied, however, the judge begins to dismiss all cases and total litigation costs fall to zero. In a game with settlements, litigation expenses provide little indication of social welfare, as they are lowest in the situations where either nuisance suits or illegal activity are most extreme.

Given the deterrence effects of increasing pleading standards, our results suggest that alternative procedural mechanisms that decrease nuisance suits without decreasing deterrence may dominate an increase in the pleading standard. Alternative possibilities include committing the parties to liability determinations by the judge, such as barring settlement between the parties prior to trial, or mandating motions for summary judgment (Rosenberg and Shavell, 2006; Kozel and Rosenberg, 2004).

The analysis in this section illustrates how increasing pleading standards can simultaneously decrease the prevalence of nuisance suits and increase illegal activity.

Considering the tradeoff between these positive and negative effects is beyond the scope of the current paper. Doing so requires a more detailed consideration of the real world distribution of the parameters at the heart of the model, which may allow one to further compare the trade off between the benefits and costs. At a minimum, the current analysis highlight how increasing pleading standards cannot be done at zero costs, and that there are deterrence effects which should be taken into account to assessing judicial procedure.

4.7 Alternative assumptions

In the previous section, we extend the model to allow for settlement, and nuisance suits. In this section, we discuss other simplifying assumptions that we made in the model, and whether relaxing them is likely to affect our results.

4.7.1 Imperfect trial outcomes

In the above analysis, we consider an environment in which trials perfectly reveal defendant liability. This means that a defendant, aware of his own liability, can perfectly predict trial outcomes. This assumption greatly simplifies the analysis and exposition of the paper. Relaxing this assumption does not change the qualitative results.

In unreported analysis, we solve the game assuming that trials result in the wrong outcome with positive probability. The effect of increased pleading standards on deterrence, litigation costs and litigation accuracy does not change as long as wrong outcomes do not happen too often.

4.7.2 Abstracting from "chilling" effects

The model focuses on a setting in which deterring defendants from a potentially harmful activity is optimal. Absent from the analysis is any notion of a "chilling" effect, where the threat of lawsuits leads a potential defendant to take an overly safe action from the perspective of social welfare (e.g. a company does not enter a market for fear of being sued). In such an alternative setting, judicial screening may be beneficial if it encourages more risky (but socially optimal) behavior. In such situations, the pleading standard effectively becomes the new liability rule (see Easterbrook, 1989). This is another potential benefit of judicial screening that is absent from our analysis, which could help offset the negative effects of increased pleading standards.

The interaction between pleading standards and deterrence effects which we identify in our model will continue to exist even if we incorporate chilling effects. Because we are concerned with exploring the deterrence effect, rather than conducting a general welfare analysis or determining the optimal level of pleading standard, it is appropriate to abstract from chilling effects in our analysis. For further discussion of the chilling effect in the context of judicial screening, see Kaplow (2013, 2012).

4.8 Conclusion

In *Bell Atlantic Corp.* v. *Twombly* (550 U.S. 544 [2007]) and *Ashcroft* v. *Iqbal* (556 U.S. 662, 684 [2009]), the U.S. Supreme Court increased the standard of plausibility that lawsuits must meet before being allowed by a judge to proceed to discovery and trial. The Court has concluded that stronger pleading standards are necessary to reduce the number of unnecessary lawsuits, decrease total costs of litigation, and improve outcome accuracy. Although these claims are true in a setting in which the unlawful behavior of defendants is taken as given, our analysis shows how the conclusions may be reversed when potential defendants can adjust their unlawful behavior in response to changes in the litigation environment. When we account for deterrence effects, stronger pleading standards lead to the dismissal of weaker cases which would otherwise proceed to trial, which in turn incentivizes potential defendants to take unlawful actions more often. In this way, stronger pleading standards decrease deterrence, increasing the amount of unlawful activity. This can lead to the simultaneous increase in total litigation costs and decrease in outcome accuracy. With deterrence effects, our model finds that increased pleading standards tend to have the opposite effects as argued by the Supreme Court.

Our results do not rule out the possibility that stronger pleading standards provides benefits in some situations. In Section 4.6, we show that stronger pleading standards may decrease the prevalence of pure nuisance suits where plaintiffs sue with the intention of inducing a settlement from a defendant who is most-likely not liable. In that setting, we show how stronger pleading standards simultaneously decrease the prevalence of nuisance suits, and increases illegal activity. Because of this, our contribution should be seen as highlighting a previously unrecognized cost of increasing pleading standards, which exists along side the previously recognized benefits. Our results emphasize the importance of accounting for deterrence effects when considering changes to judicial procedure.

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APPENDIX A
Appendix for Chapter 2

A.1 Proofs

Proof of Lemma 2.4.1. In the body of the paper, we have established that the derivative of interest group 1's expected payoff with respect to c_1 is

$$\frac{\partial E(u_1)}{\partial c_1} = -\Phi(\frac{c_1 - c_2}{\lambda\gamma}) + \frac{1}{\lambda\gamma}\phi(\frac{c_1 - c_2}{\lambda\gamma})(v - c_1). \tag{A.1}$$

This implies that

$$\frac{\phi(\frac{c_1-c_2}{\lambda\gamma})}{\Phi(\frac{c_1-c_2}{\lambda\gamma})} \gtreqqless \frac{\lambda\gamma}{v - c_1} \Leftrightarrow \frac{\partial E(u_1|c_1, c_2)}{\partial c_1} \gtreqqless 0. \tag{A.2}$$

Because the CDF of a normal distribution is log-concave (Bagnoli and Bergstrom, 2005), function $\phi(\cdot)/\Phi(\cdot)$ is decreasing. Since the argument of this function $\frac{c_1-c_2}{\lambda\gamma}$ is increasing in c_1, the left hand side of inequality (A.2) is decreasing in c_1. The right hand side of inequality (A.2) is strictly increasing in c_1. Therefore, for any value of c_2, (A.2) can hold as an equality for at most one value of c_1: at most one critical point of the interest group payoff function exists. Also note that when c_1 is less than the value of the critical point, the left hand side of inequality (A.2) is higher than the right hand side, implying that $\frac{\partial E(u_1|c_1,c_2)}{\partial c_1} > 0$. Therefore, the critical point defines a local maximum of interest group 1's expected payoff. Because this local maximum is the unique critical point of the interest group payoff function, it must be a global maximum. When (A.2) holds with equality, we have

$$\frac{\phi(\frac{c_1-c_2}{\lambda\gamma})}{\Phi(\frac{c_1-c_2}{\lambda\gamma})} = \frac{\lambda\gamma}{v - c_1}. \tag{A.3}$$

This function defines interest group 1's best response to c_2.

Similarly, the following equation defines interest group 2's best response to c_1

$$\frac{\phi(\frac{c_2-c_1}{\lambda\gamma})}{\Phi(\frac{c_2-c_1}{\lambda\gamma})} = \frac{\lambda\gamma}{v-c_2}. \tag{A.4}$$

Combining the above two equations, we have

$$(v-c_1)\Phi(\frac{c_2-c_1}{\lambda\gamma}) = (v-c_2)\Phi(\frac{c_1-c_2}{\lambda\gamma}). \tag{A.5}$$

This equation defines an interior equilibrium. Note that interest group i would never choose $c_i > v$. Suppose $c_1 < c_2 \leq v$ satisfies equation (A.5). Then we have $\Phi(\frac{c_2-c_1}{\lambda\gamma}) > \frac{1}{2} > \Phi(\frac{c_1-c_2}{\lambda\gamma}) > 0$ and $v - c_1 > v - c_2 \geq 0$. This implies that $(v - c_1)\Phi(\frac{c_2-c_1}{\lambda\gamma}) > (v-c_2)\Phi(\frac{c_1-c_2}{\lambda\gamma})$. A contradiction. Similarly, we can show $c_2 < c_1 \leq v$ does not satisfy equation (A.5). Therefore, the only possible solution to this equation is $c_1 = c_2$. When $c_1 = c_2$, the left hand side of equation (A.5) becomes $\frac{1}{2}(v-c_1)$, and the right hand side becomes $\frac{1}{2}(v-c_2)$. They are equal when $c_1 = c_2$. Therefore, $c_1 = c_2$ is the only solution to equation (A.5).

When $c_1 = c_2$, equation (A.3) becomes

$$\frac{\phi(0)}{\Phi(0)} = \frac{\lambda\gamma}{v-c_1}. \tag{A.6}$$

Solving the above equation, we have interest group 1's equilibrium choice of contribution

$$c_1 = v - \frac{\sqrt{2\pi}}{2}\lambda\gamma. \tag{A.7}$$

Similarly, we can show interest group 2's equilibrium choice of contribution

$$c_2 = v - \frac{\sqrt{2\pi}}{2}\lambda\gamma. \tag{A.8}$$

In an interior equilibrium, $0 < c_1 < v$ and $0 < c_2 < v$. Therefore, an interior equilibrium exists only when

$$v - \frac{\sqrt{2\pi}}{2}\lambda\gamma > 0 \Leftrightarrow \gamma < \frac{\sqrt{2\pi}v}{\pi\lambda}. \tag{A.9}$$

Now let's consider equilibria involving corner solutions. It is easy to exclude equilibria in which either interest group offers v to the politician. Given $c_2 \in [0, v]$, we have

$$\frac{\partial E(u_1)}{\partial c_1} \mid_{c_1=v} = -\Phi(\frac{v - c_2}{\lambda\gamma}) < 0. \tag{A.10}$$

This implies that for values of c_1 near v, the interest group's expected payoff is decreasing in c_1. Therefore, $c_1 = v$ is never a response. Similarly, we can show that interest group 2 would never choose $c_2 = v$.

We can also rule out equilibria in which one interest group offers zero contribution to the politician but the other group offers a positive level of contribution. Consider the case $c_1 = 0$ and $0 < c_2 < v$. In order for $c_1 = 0$ to be interest group 1's best response, the following condition must hold:

$$\frac{\phi(-\frac{c_2}{\lambda\gamma})}{\Phi(-\frac{c_2}{\lambda\gamma})} \leq \frac{\lambda\gamma}{v}. \tag{A.11}$$

Meanwhile, if interest group 2's response to $c_1 = 0$ is internal, it must be the case that

$$\frac{\phi(\frac{c_2}{\lambda\gamma})}{\Phi(\frac{c_2}{\lambda\gamma})} = \frac{\lambda\gamma}{v - c_2}. \tag{A.12}$$

Combining these inequalities gives

$$\frac{\phi(-\frac{c_2}{\lambda\gamma})}{\Phi(-\frac{c_2}{\lambda\gamma})} < \frac{\phi(\frac{c_2}{\lambda\gamma})}{\Phi(\frac{c_2}{\lambda\gamma})}. \tag{A.13}$$

Since the CDF of a normal distribution is log-concave, function $\phi(\cdot)/\Phi(\cdot)$ is decreasing. This implies that $-\frac{c_2}{\lambda\gamma} > \frac{c_2}{\lambda\gamma}$. A contradiction.

What remains is an equilibrium in which both interest groups offer zero contribution to the politician. Consider the case $c_1 = c_2 = 0$. In order for $c_1 = 0$ to be interest group 1's best response, the following condition must hold

$$\frac{\phi(0)}{\Phi(0)} \leq \frac{\lambda\gamma}{v} \Leftrightarrow \gamma \geq \frac{\sqrt{2\pi}v}{\pi\lambda}. \tag{A.14}$$

This condition also ensures that $c_2 = 0$ is interest group 2's best response. Therefore, when $\gamma \geq \frac{\sqrt{2\pi}v}{\pi\lambda}$, we have an equilibrium in which both interest groups offer zero contributions to the politician.

Now we have established that in the monetary lobbying subgame, we have a unique equilibrium. In this equilibrium, interest groups offer the same level of campaign contribution to the politician: $c_1^* = c_2^* = c^*$, where

$$c^* = \begin{cases} v - \frac{\sqrt{2\pi}}{2}\lambda\gamma & \text{if } \gamma < \frac{\sqrt{2\pi}v}{\pi\lambda} \\ 0 & \text{if } \gamma \geq \frac{\sqrt{2\pi}v}{\pi\lambda} \end{cases}$$

A1 ensures that $\frac{\sqrt{2\pi}v}{\pi\lambda}$ is less than $\sqrt{2}$. ■

Proof of Proposition 2.4.1. Follows from the analysis in Section 2.4. ■

Proof of Corollary 2.4.1. We have established that the expected policy quality equals $E(q_s) = \mu + \frac{1}{\sqrt{2\pi}}\gamma$.

Proposition 2.4.1 shows that the politician chooses to be fully informed for issues of high enough political importance (i.e. $\lambda > \sqrt{\pi v}$), and chooses to be completely ignorant for issues of less political importance (i.e. $\lambda < \sqrt{\pi v}$). As a result, the expected policy quality equals $\mu + \frac{1}{\sqrt{\pi}}$ for issues such that $\lambda > \sqrt{\pi}v$, and equals μ for issues such that $\lambda < \sqrt{\pi}v$. ■

Equilibrium Political Contributions with Contribution Limit. Lemma 2.4.1 shows that when the politician chooses $\gamma < \frac{\sqrt{2\pi}v}{\pi\lambda}$, interest groups offer $c_1 = c_2 = v - \frac{\sqrt{2\pi}}{2}\lambda\gamma$ to the politician in the game without contribution limit. Contribution limit $\bar{c}$ has no impact on equilibrium behavior when

$$v - \frac{\sqrt{2\pi}}{2}\lambda\gamma \leq \bar{c} \Leftrightarrow \gamma \geq \frac{\sqrt{2\pi}(v-\bar{c})}{\pi\lambda}. \tag{A.15}$$

In this case, interest groups offer $c_1 = c_2 = v - \frac{\sqrt{2\pi}}{2\alpha}\gamma$ to the politician in the game with contribution limit.

Contribution limit $\bar{c}$ changes equilibrium behavior when

$$v - \frac{\sqrt{2\pi}}{2}\lambda\gamma > \bar{c} \Leftrightarrow \gamma < \frac{\sqrt{2\pi}(v-\bar{c})}{\pi\lambda}. \tag{A.16}$$

In this case, the monetary lobbying subgame has a unique equilibrium. In this equilibtium, both interest groups offer $c_1 = c_2 = \bar{c}$ to the politician. In the following analysis, we first establish that $c_1 = c_2 = \bar{c}$ is an equilibrium, and then we prove this is the unique equilibrium.

We have established that when there is no contribution limit, interest group 1's equilibrium political contributions satisfy

$$\frac{\phi(0)}{\Phi(0)} = \frac{\lambda\gamma}{v - c_1^*}, \tag{A.17}$$

where $c_1^* = v - \frac{\sqrt{2\pi}}{2}\lambda\gamma$.

The right hand side of equation (A.17) is increasing in c_1^*, so when $c_1^* > \bar{c}$ we have

$$\frac{\lambda\gamma}{v - c_1^*} > \frac{\lambda\gamma}{v - \bar{c}}. \tag{A.18}$$

This implies that the left hand side of equation (A.17) is also greater than $\frac{\lambda\gamma}{v-\bar{c}}$. Since the left hand side of equation (A.17) can be expressed as $\frac{\phi(\frac{\bar{c}-\bar{c}}{\lambda\gamma})}{\Phi(\frac{\bar{c}-\bar{c}}{\lambda\gamma})}$, we have

$$\frac{\phi(\frac{\bar{c}-\bar{c}}{\lambda\gamma})}{\Phi(\frac{\bar{c}-\bar{c}}{\lambda\gamma})} > \frac{\lambda\gamma}{v - \bar{c}}. \tag{A.19}$$

From inequality (A.2), we know the above inequality implies that when $c_2 = \bar{c}$, interest group 1's expected payoff is increasing at $c_1 = \bar{c}$. Therefore, interest group 1's best response to $c_2 = \bar{c}$ is $c_1 = \bar{c}$. Similarly, we can show that interest group 2's best response to $c_1 = \bar{c}$ is $c_2 = \bar{c}$. Therefore, when $c^* > \bar{c}$, we have an equilibrium in which $c_1 = c_2 = \bar{c}$.

Next, we establish the uniqueness of the equilibrium. Suppose that in equilibrium interest group 2 contributes $c_2 = \hat{c} \in [0, \bar{c})$. Since the right hand side of equation (A.17) is increasing in c_1^*, when $c_1^* > \bar{c} > \hat{c}$ we have

$$\frac{\lambda\gamma}{v - c_1^*} > \frac{\lambda\gamma}{v - \hat{c}}. \tag{A.20}$$

This implies that the left hand side of equation (A.17) is also greater than $\frac{\lambda\gamma}{v-\hat{c}}$. The left hand side of equation (A.17) can be expressed as $\frac{\phi(\frac{\hat{c}-\hat{c}}{\lambda\gamma})}{\Phi(\frac{\hat{c}-\hat{c}}{\lambda\gamma})}$, so we have

$$\frac{\phi(\frac{\hat{c}-\hat{c}}{\lambda\gamma})}{\Phi(\frac{\hat{c}-\hat{c}}{\lambda\gamma})} > \frac{\lambda\gamma}{v - \hat{c}}. \tag{A.21}$$

From inequality (A.2), we know the above inequality implies that when $c_2 = \hat{c}$, interest group 1's expected payoff is increasing at $c_1 = \hat{c}$. Therefore, interest group 1 has an incentive to offer more than what interest group 2 has offered. Similarly, we can show that interest group 2 has an incentive to offer more than what interest group 1 has offered. This implies that we cannot have an equilibrium in which an interest group offers less than $\bar{c}$. So $c_1 = c_2 = \bar{c}$ is the unique equilibrium when $\gamma < \frac{\sqrt{2\pi}(v-\bar{c})}{\pi\lambda}$. ■

Proof of Proposition 2.5.1. Follows from the analysis in Section 2.5. ■

Proof of Corollary 2.5.1. We have established that the expected quality of the selected policy equals $E(q_s) = \mu + \frac{1}{\sqrt{2\pi}}\gamma$.

Proposition 2.5.1 shows that in the game with contribution limit $\bar{c}$, the politician chooses a signal with informativeness level $\gamma = \frac{\sqrt{2\pi}(v-\bar{c})}{\pi\lambda}$ for issues such that $\lambda < \frac{v+(\pi-1)\bar{c}}{\sqrt{\pi}}$, and chooses a fully informative signal for issues such that $\lambda > \frac{v+(\pi-1)\bar{c}}{\sqrt{\pi}}$. Therefore, in the game with contribution limit $\bar{c}$, the expected policy quality equals $\mu + \frac{1}{\sqrt{\pi}}$ for issues such that $\lambda > \frac{v+(\pi-1)\bar{c}}{\sqrt{\pi}}$, and equals $\mu + \frac{v-\bar{c}}{\pi\lambda}$ for issues such that $\lambda < \frac{v+(\pi-1)\bar{c}}{\sqrt{\pi}}$. ■

Proof of Proposition 2.5.2. Follows from the analysis in Section 2.5. ■

Proof of Proposition 2.5.3. Follows from the analysis in Section 2.5. ■

A.2 No private policymaker information

Suppose that both the politician and the interest groups observe $s_1 > s_2$. The politician chooses policy 1 when

$$\lambda E(q_1|S_1 = s_1) + c_1 \geq \lambda E(q_2|S_2 = s_2) + c_2. \tag{A.22}$$

This is equivalent to

$$c_1 \geq c_2 - \lambda(\frac{s_1 + \mu\sigma^2}{1+\sigma^2} - \frac{s_2 + \mu\sigma^2}{1+\sigma^2}). \tag{A.23}$$

Given s_1, s_2 and c_2, interest group 1 can always have its policy selected by contributing $\max\{v - \lambda(\frac{s_1+\mu\sigma^2}{1+\sigma^2} - \frac{s_2+\mu\sigma^2}{1+\sigma^2}), 0\}$. We can show that in equilibrium, interest group 1 contributes $\max\{v - \lambda(\frac{s_1+\mu\sigma^2}{1+\sigma^2} - \frac{s_2+\mu\sigma^2}{1+\sigma^2}), 0\}$ and the politician chooses policy 1. In this case, the politician expects political contributions

$$E[\max\{v - \lambda(\frac{s_1 + \mu\sigma^2}{1+\sigma^2} - \frac{s_2 + \mu\sigma^2}{1+\sigma^2}), 0\} | s_1 > s_2] \tag{A.24}$$

We have established in the body of the paper that

$$\frac{s_1 + \mu\sigma^2}{1+\sigma^2} - \frac{s_2 + \mu\sigma^2}{1+\sigma^2} \sim N(0, \gamma^2), \tag{A.25}$$

where $\gamma = \sqrt{\frac{2}{1+\sigma^2}}$ and it represents the informativeness of the signal chosen by the politician. This implies that

$$Z \equiv \frac{1}{\gamma}(\frac{s_1 + \mu\sigma^2}{1+\sigma^2} - \frac{s_2 + \mu\sigma^2}{1+\sigma^2}) \sim N(0, 1). \tag{A.26}$$

Therefore, the expected political contributions equals

$$\begin{aligned} E[\max\{v - \lambda\gamma Z, 0\} | z > 0] &= \int_0^{\frac{v}{\lambda\gamma}} (v - \lambda\gamma z) f(z | z > 0) dz \\ &= 2\int_0^{\frac{v}{\lambda\gamma}} (v - \lambda\gamma z)\phi(z) dz \\ &= 2\left[v\int_0^{\frac{v}{\lambda\gamma}} \phi(z)dz - \lambda\gamma\int_0^{\frac{v}{\lambda\gamma}} z\phi(z)dz\right] \\ &= 2\left[v(\Phi(\frac{v}{\lambda\gamma}) - \frac{1}{2}) - \lambda\gamma(\phi(0) - \phi(\frac{v}{\lambda\gamma}))\right] \end{aligned} \tag{A.27}$$

Similarly, we can show that when $s_1 < s_2$, interest group 2 contributes $\max\{v - \lambda(\frac{s_2+\mu\sigma^2}{1+\sigma^2} - \frac{s_1+\mu\sigma^2}{1+\sigma^2}), 0\}$ in equilibrium and the politician chooses policy 2 in equilibrium. In this case, the politician's expected political contributions also equals

$$2\left[v(\Phi(\frac{v}{\lambda\gamma}) - \frac{1}{2}) - \lambda\gamma(\phi(0) - \phi(\frac{v}{\lambda\gamma}))\right]. \tag{A.28}$$

Therefore, in equilibrium the politician expects total political contributions of

$$C^* = 2\left[v(\Phi(\frac{v}{\lambda\gamma}) - \frac{1}{2}) - \lambda\gamma(\phi(0) - \phi(\frac{v}{\lambda\gamma}))\right]. \tag{A.29}$$

We can show $C^* > 0$. Taking derivative of C^* with respect to γ, we have

$$\frac{\partial C^*}{\partial \gamma} = 2\left[v\phi(\frac{v}{\lambda\gamma})(-\frac{v}{\lambda\gamma^2}) - \lambda\phi(0) + \lambda\phi(\frac{v}{\lambda\gamma}) + \lambda\gamma\phi'(\frac{v}{\lambda\gamma})(-\frac{v}{\lambda\gamma^2})\right]. \tag{A.30}$$

Since $\phi'(\frac{v}{\lambda\gamma}) = (-\frac{v}{\lambda\gamma})\phi(\frac{v}{\lambda\gamma})$, we have

$$\begin{aligned}
\frac{\partial C^*}{\partial \gamma} &= 2\left[\phi(\frac{v}{\lambda\gamma})(-\frac{v^2}{\lambda\gamma^2}) - \lambda\phi(0) + \lambda\phi(\frac{v}{\lambda\gamma}) + \phi(\frac{v}{\lambda\gamma})(\frac{v^2}{\lambda\gamma^2})\right] \\
&= 2\left[-\lambda\phi(0) + \lambda\phi(\frac{v}{\lambda\gamma})\right] \\
&= 2\lambda\left[(\phi(\frac{v}{\lambda\gamma}) - \phi(0)\right] \\
&< 0.
\end{aligned} \tag{A.31}$$

Expected total political contributions are decreasing in the signal informativeness γ. This implies that the politician faces a trade off between policy information and political contributions. By becoming more informed about policies, the politician attracts fewer political contributions.

From the above analysis, we find that the politician always chooses the policy that generates the better signal. Therefore, the expected constituent welfare is

$$E(q_s) = E[max\{Q_1, Q_2\}], \tag{A.32}$$

where $Q_i = \frac{s_i+\mu\sigma^2}{1+\sigma^2}$ and $Q_i \sim N(\mu, \frac{1}{1+\sigma^2})$.

Since $Q_1 - Q_2 \sim N(0, \gamma^2)$, we have $Z \equiv \frac{Q_1-Q_2}{\gamma} \sim N(0,1)$. Then we have

$$\begin{aligned}
E(q_s) &= E[max\{Q_1 - Q_2, 0\} + Q_2] \\
&= E[max\{Q_1 - Q_2, 0\}] + E[Q_2] \\
&= \gamma E[max\{Z, 0\}] + \mu \\
&= \gamma \int_0^\infty z\phi(z)d(z) + \mu \\
&= \frac{1}{\sqrt{2\pi}}\gamma + \mu. \qquad \text{(A.33)}
\end{aligned}$$

This implies that the politician's expected payoff is

$$\begin{aligned}
E(U_P) &= \lambda(\mu + \frac{1}{\sqrt{2\pi}}\gamma) + C^* \\
&= \lambda(\mu + \frac{1}{\sqrt{2\pi}}\gamma) + 2\left[v(\Phi(\frac{v}{\lambda\gamma}) - \frac{1}{2}) - \lambda\gamma(\phi(0) - \phi(\frac{v}{\lambda\gamma}))\right] \\
&= \lambda\mu + \frac{1}{\sqrt{2\pi}}\lambda\gamma + 2v\Phi(\frac{v}{\lambda\gamma}) - v - 2\lambda\gamma\phi(0) + 2\lambda\gamma\phi(\frac{v}{\lambda\gamma}). \qquad \text{(A.34)}
\end{aligned}$$

Since $\phi(0) = \frac{1}{\sqrt{2\pi}}$, we have

$$E(U_P) = \lambda\mu - v - \frac{1}{\sqrt{2\pi}}\lambda\gamma + 2v\Phi(\frac{v}{\lambda\gamma}) + 2\lambda\gamma\phi(\frac{v}{\lambda\gamma}). \tag{A.35}$$

Taking derivative with respect to γ, we have

$$\begin{aligned}
\frac{\partial E(U_P)}{\partial \gamma} &= -\frac{1}{\sqrt{2\pi}}\lambda + 2v\phi(\frac{v}{\lambda\gamma})(-\frac{v}{\lambda\gamma^2}) + 2\lambda\phi(\frac{v}{\lambda\gamma}) + 2\lambda\gamma\phi'(\frac{v}{\lambda\gamma})(-\frac{v}{\lambda\gamma^2}) \\
&= -\frac{1}{\sqrt{2\pi}}\lambda - \frac{2v^2}{\lambda\gamma^2}\phi(\frac{v}{\lambda\gamma}) + 2\lambda\phi(\frac{v}{\lambda\gamma}) + 2\lambda\gamma(-\frac{v}{\lambda\gamma})\phi(\frac{v}{\lambda\gamma})(-\frac{v}{\lambda\gamma^2}) \\
&= -\frac{1}{\sqrt{2\pi}}\lambda - \frac{2v^2}{\lambda\gamma^2}\phi(\frac{v}{\lambda\gamma}) + 2\lambda\phi(\frac{v}{\lambda\gamma}) + \frac{2v^2}{\lambda\gamma^2}\phi(\frac{v}{\lambda\gamma}) \\
&= -\frac{1}{\sqrt{2\pi}} + 2\phi(\frac{v}{\lambda\gamma}) \qquad \text{(A.36)}
\end{aligned}$$

This expression is strictly increasing in λ. It ranges from a minimum value of $-1/\sqrt{2\pi}$ when $\lambda = 0$, to a maximum value of $1/\sqrt{2\pi}$ when $\lambda \to \infty$. Thus, there exists a cut value $\bar{\lambda} > 0$ such that:

- If $\lambda < \bar{\lambda}$, then $\partial E(U_P)/\partial\gamma < 0$ and the politician prefers fully uninformative signals.
- If $\lambda > \bar{\lambda}$, then $\partial E(U_P)/\partial\gamma > 0$ and the politician prefers fully informative signals.

A.3 Costly Signals

Game with no contribution limit When it is costly for the politician to choose a more informative signal, the analysis for the monetary lobbying subgame is the same as the analysis in Section 2.4. In the body of the paper, we have shown that interest groups offer the same level of political contributions to the politician: $c_1^* = c_2^* = c^*$, where

$$c^* = \begin{cases} v - \frac{\sqrt{2\pi}}{2}\lambda\gamma & \text{if } \gamma < \frac{\sqrt{2\pi}v}{\pi\lambda} \\ 0 & \text{if } \gamma \geq \frac{\sqrt{2\pi}v}{\pi\lambda} \end{cases}$$

First, suppose the politician chooses $\gamma < \frac{\sqrt{2\pi}v}{\pi\lambda}$. In this case, the politician has to pay $k\gamma$ and anticipates to receive $c_1 = c_2 = v - \frac{\sqrt{2\pi}}{2}\lambda\gamma$ from the interest groups.

Therefore, her expected payoff equals

$$\begin{aligned} E(U_P) &= \lambda(\mu + \frac{1}{\sqrt{2\pi}}\gamma) + (v - \frac{\sqrt{2\pi}}{2}\lambda\gamma) - k\gamma \\ &= \lambda\mu + v + \frac{(1-\pi)\lambda - k}{\sqrt{2\pi}}\gamma. \end{aligned} \tag{A.37}$$

By inspection, $E(U_P)$ is decreasing in γ. So the politician prefers to choose a completely uninformative signal $\gamma = 0$. In this case, the politician's expected payoff equals $\lambda\mu + v$.

Now suppose the politician chooses $\gamma \geq \frac{\sqrt{2\pi}v}{\pi\lambda}$. In this case, the politician has to pay $k\gamma$ and anticipates to receive $c_1 = c_2 = 0$ from the interest groups. The politician's expected payoff in this case equals

$$\begin{aligned} E(U_P) &= \lambda(\mu + \frac{1}{\sqrt{2\pi}}\gamma) - k\gamma \\ &= \lambda\mu + \frac{\lambda - k}{\sqrt{2\pi}}\gamma. \end{aligned} \tag{A.38}$$

By inspection, $E(U_P)$ is increasing in γ when $k < \lambda$ and decreasing in γ when $k > \lambda$. So the politician prefers to choose $\gamma = \sqrt{2}$ when $k < \lambda$. In this case, her expected payoff equals $\lambda\mu + \frac{\lambda - k}{\sqrt{\pi}}$. The politician prefers to choose $\gamma = \frac{\sqrt{2\pi}v}{\pi\lambda}$ when $k > \lambda$. In this case, her expected payoff equals $\lambda\mu + \frac{(\lambda-k)v}{\pi\lambda}$.

Let's first consider the case when $\lambda < k$. In this case, the politician compares her expected payoff from choosing $\gamma = 0$ and $\gamma = \frac{\sqrt{2\pi}v}{\pi\lambda}$ when deciding how much information to collect or how much expertise to acquire. Since $\lambda\mu + \frac{(\lambda-k)v}{\pi\lambda} < \lambda\mu + v$, the politician prefers to choose $\gamma = 0$ in equilibrium.

Now let's consider the case when $\lambda > k$. In this case, the politician compares her expected payoff from choosing $\gamma = 0$ and $\gamma = \sqrt{2}$ when deciding how much information to collect or how much expertise to acquire. Specifically, the politician chooses $\gamma = 0$ when

$$\lambda\mu + v > \lambda\mu + \frac{\lambda - k}{\sqrt{\pi}} \Leftrightarrow k < \lambda < k + \sqrt{\pi}v, \tag{A.39}$$

and chooses $\gamma = \sqrt{2}$ when

$$\lambda\mu + v < \lambda\mu + \frac{\lambda - k}{\sqrt{\pi}} \Leftrightarrow \lambda > k + \sqrt{\pi}v. \tag{A.40}$$

Therefore, the politician chooses $\gamma = 0$ for issues such that $\lambda < k + \sqrt{\pi}v$ and chooses $\gamma = \sqrt{2}$ for issues such that $\lambda > k + \sqrt{\pi}v$.

Game with contribution limit $\bar{c}$ Now we solve the game when there is a contribution limit $\bar{c}$. The analysis of the monetary lobbying subgame is the same as the analysis in Section 2.5. In the body of the paper, we have shown that interest groups offer the same level of political contributions to the politician: $c_1^* = c_2^* = c^*$, where

$$c^* = \begin{cases} \bar{c} & \text{if } \gamma \leq \frac{\sqrt{2\pi}(v-\bar{c})}{\pi\lambda} \\ v - \frac{\sqrt{2\pi}}{2}\lambda\gamma & \text{if } \frac{\sqrt{2\pi}(v-\bar{c})}{\pi\lambda} < \gamma < \frac{\sqrt{2\pi}v}{\pi\lambda} \\ 0 & \text{if } \gamma \geq \frac{\sqrt{2\pi}v}{\pi\lambda} \end{cases}$$

The following analysis is divided into two cases, depending on the value of k. Let's first consider the case when the marginal cost of increasing signal informativeness is low. This is the case when $\lambda > k$.

Suppose first that the politician chooses $\gamma \leq \frac{\sqrt{2\pi}(v-\bar{c})}{\pi\lambda}$. In this case, she has to pay $k\gamma$ and anticipates to receive $c_1 = c_2 = \bar{c}$ from the interest groups. The politician's expected payoff in this case equals

$$\begin{aligned} E(U_P) &= \lambda(\mu + \frac{1}{\sqrt{2\pi}}\gamma) + \bar{c} - k\gamma \\ &= \lambda\mu + \bar{c} + \frac{\lambda - k}{\sqrt{2\pi}}\gamma. \end{aligned} \tag{A.41}$$

Since $k < \lambda$, we have $E(U_P)$ is increasing in γ. So the politician prefers to choose $\gamma = \frac{\sqrt{2\pi}(v-\bar{c})}{\pi\lambda}$ and her expected payoff equals $\lambda\mu + \bar{c} + \frac{(\lambda-k)(v-\bar{c})}{\pi\lambda}$.

When the politician chooses $\gamma \in (\frac{\sqrt{2\pi}(v-\bar{c})}{\pi\lambda}, \frac{\sqrt{2\pi}v}{\pi\lambda})$, she has to pay $k\gamma$ and anticipates to receive $c_1 = c_2 = v - \frac{\sqrt{2\pi}}{2}\lambda\gamma$ from the interest groups. In this case, the politician's expected payoff equals

$$\begin{aligned} E(U_P) &= \lambda(\mu + \frac{1}{\sqrt{2\pi}}\gamma) + (v - \frac{\sqrt{2\pi}}{2}\lambda\gamma) - k\gamma \\ &= \lambda\mu + v + \frac{(1-\pi)\lambda - k}{\sqrt{2\pi}}\gamma. \end{aligned} \tag{A.42}$$

By inspection, $E(U_P)$ is decreasing in γ. Therefore, the politician prefers to choose the lowest γ in this range. In this case, the politician chooses $\gamma = \frac{\sqrt{2\pi}(v-\bar{c})}{\pi\lambda}$ and her expected payoff equals $\lambda\mu + \bar{c} + \frac{(\lambda-k)(v-\bar{c})}{\pi\lambda}$.

When the politician chooses $\gamma \geq \frac{\sqrt{2\pi}v}{\pi\lambda}$, she has to pay $k\gamma$ and anticipates to receive $c_1 = c_2 = 0$ from the interest groups. In this case, the politician's expected payoff becomes

$$\begin{aligned} E(U_P) &= \lambda(\mu + \frac{1}{\sqrt{2\pi}}\gamma) - k\gamma \\ &= \lambda\mu + \frac{\lambda - k}{\sqrt{2\pi}}\gamma. \end{aligned} \tag{A.43}$$

By inspection, $E(U_P)$ is increasing in γ. Therefore the politician prefers to choose $\gamma = \sqrt{2}$. In this case, the politician's expected payoff equals $\lambda\mu + \frac{\lambda-k}{\sqrt{\pi}}$.

When deciding how much information to collect or how much expertise to acquire, the politician compares her expected payoff from choosing $\gamma = \frac{\sqrt{2\pi}(v-\bar{c})}{\pi\lambda}$ and $\gamma = \sqrt{2}$. Specifically, the politician chooses $\gamma = \frac{\sqrt{2\pi}(v-\bar{c})}{\pi\lambda}$ when

$$\lambda\mu + \bar{c} + \frac{(\lambda - k)(v - \bar{c})}{\pi\lambda} > \lambda\mu + \frac{\lambda - k}{\sqrt{\pi}} \Leftrightarrow k < \lambda < \bar{\lambda}, \tag{A.44}$$

and chooses $\gamma = \sqrt{2}$ when

$$\lambda\mu + \bar{c} + \frac{v - \bar{c}}{\pi} - \frac{2k(v - \bar{c})^2}{\pi\lambda^2} < \lambda\mu + \frac{\lambda - k}{\sqrt{\pi}} \Leftrightarrow \lambda > \bar{\lambda}, \tag{A.45}$$

where $\bar{\lambda} < k + \sqrt{\pi}v$.

Next, we consider the case when $\lambda < k$. Suppose first that the politician chooses $\gamma \leq \frac{\sqrt{2\pi}(v-\bar{c})}{\pi\lambda}$. In this case, she has to pay $k\gamma$ and anticipates to receive $c_1 = c_2 = \bar{c}$ from the interest groups. The politician's expected payoff in this case equals

$$\begin{aligned} E(U_P) &= \lambda(\mu + \frac{1}{\sqrt{2\pi}}\gamma) + \bar{c} - k\gamma \\ &= \lambda\mu + \bar{c} + \frac{\lambda - k}{\sqrt{2\pi}}\gamma. \end{aligned} \tag{A.46}$$

Since $k > \lambda$, we have $E(U_P)$ is decreasing in γ. So the politician prefers to choose $\gamma = 0$ and her expected payoff equals $\lambda\mu + \bar{c}$.

When the politician chooses $\gamma \in (\frac{\sqrt{2\pi}(v-\bar{c})}{\pi\lambda}, \frac{\sqrt{2\pi}v}{\pi\lambda})$, she has to pay $k\gamma$ and anticipates to receive $c_1 = c_2 = v - \frac{\sqrt{2\pi}}{2}\lambda\gamma$ from the interest groups. In this case, the politician's expected payoff equals

$$\begin{aligned} E(U_P) &= \lambda(\mu + \frac{1}{\sqrt{2\pi}}\gamma) + (v - \frac{\sqrt{2\pi}}{2}\lambda\gamma) - k\gamma \\ &= \lambda\mu + v + \frac{(1-\pi)\lambda - k}{\sqrt{2\pi}}\gamma. \end{aligned} \tag{A.47}$$

By inspection, $E(U_P)$ is decreasing in γ. Therefore, the politician prefers to choose the lowest γ in this range. In this case, the politician chooses $\gamma = \frac{\sqrt{2\pi}(v-\bar{c})}{\pi\lambda}$ and her expected payoff equals $\lambda\mu + \bar{c} + \frac{(\lambda-k)(v-\bar{c})}{\pi\lambda}$. This is lower than $\lambda\mu + \bar{c}$, the politician's expexted payoff from choosing $\gamma = 0$.

When the politician chooses $\gamma \geq \frac{\sqrt{2\pi}v}{\pi\lambda}$, she has to pay $k\gamma$ and anticipates to receive $c_1 = c_2 = 0$ from the interest groups. In this case, the politician's expected payoff becomes

$$\begin{aligned} E(U_P) &= \lambda(\mu + \frac{1}{\sqrt{2\pi}}\gamma) - k\gamma \\ &= \lambda\mu + \frac{\lambda - k}{\sqrt{2\pi}}\gamma. \end{aligned} \tag{A.48}$$

By inspection, $E(U_P)$ decreasing in γ. Therefore the politician prefers to choose $\gamma = \frac{\sqrt{2\pi}v}{\pi\lambda}$. In this case, the politician's expected payoff equals $\lambda\mu + \frac{(\lambda-k)v}{\pi\lambda}$. This is lower than $\lambda\mu + \bar{c}$, the politician's expexted payoff from choosing $\gamma = 0$.

So from the above analysis, we know that when $\lambda < k$, the politician prefers to choose $\gamma = 0$ in the game with contribution limit. Combing this result with the results in the case when $\lambda > k$, we find the politician's equilibrium strategies.

For issues such that $\lambda < \bar{\lambda}$ the politician chooses $\gamma = \frac{\sqrt{2\pi}(v-\bar{c})}{\pi\lambda}$, and for issues such that $\lambda < \bar{\lambda}$ the politician chooses $\gamma = \sqrt{2}$. Here $\bar{\lambda} < k + \sqrt{\pi}v$.

A.4 An Alternative Monetary Lobbying Framework

Game with no contribution limit Now we solve the alternative model when there is no contribution limit. Let's consider the subgame after the politician decides to sell policy favor with an all-pay auction. Since the politician cares about both policy quality and political contributions, she chooses interest group 1's policy when

$$\lambda E(q_1|S_1 = s_1) + (c_1 + c_2) > \lambda E(q_2|S_2 = s_2) + (c_1 + c_2). \tag{A.49}$$

This is equivalent to

$$\frac{s_1 + \mu\sigma^2}{1 + \sigma^2} - \frac{s_2 + \mu\sigma^2}{1 + \sigma^2} > 0. \tag{A.50}$$

We have shown that

$$\frac{s_1 + \mu\sigma^2}{1 + \sigma^2} - \frac{s_2 + \mu\sigma^2}{1 + \sigma^2} \sim N(0, \gamma^2), \tag{A.51}$$

where $\gamma = \sqrt{\frac{2}{1+\sigma^2}}$ and it represents the informativeness of the signal the politician chooses. This implies that interest group 1's policy is chosen with probability

$$\Phi(0) = \frac{1}{2}. \tag{A.52}$$

Interest group 1 chooses c_1 to maximize its expected payoff

$$E(u_1|c_1, c_2) = \frac{1}{2}v - c_1. \tag{A.53}$$

Apparently, interest group 1 prefers to offer $c_1 = 0$ in equilibrium. Similarly, interest group 2 prefers to offer $c_2 = 0$ in equilibrium. Anticipating the interest groups' strategies, the politician chooses γ to maximize its expected payoff

$$E(U_p) = \lambda(\mu + \frac{1}{\sqrt{2\pi}}\gamma). \tag{A.54}$$

The politician's expected payoff is increasing in γ, so in equilibrium she chooses $\gamma = \sqrt{2}$ and expects payoff $E(U_P) = \lambda\mu + \frac{\lambda}{\sqrt{\pi}}$.

If the politician decides to sell policy favor using a menu auction, the equilibrium strategies of the politician and the interest groups are all identical to what we have described in the body of the paper. In this case, the politician's expected payoff equals $E(U_P) = \lambda\mu + v$ for issues such that $\lambda < \sqrt{\pi}v$, and equals $E(U_P) = \lambda\mu + \frac{\lambda}{\sqrt{\pi}}$ for issues such that $\lambda > \sqrt{\pi}v$.

For issues of sufficient political importance (i.e. $\lambda > \sqrt{\pi}v$), the politician receives the same expected pyaoff from using a menu auction and an all-pay auction. For issues that are less politically important (i.e. $\lambda < \sqrt{\pi}v$), however, the politician receives higher expected payoff by using a menu auction. Therefore, when there is no contribution limit, the politician prefers to sell policy favor using a menu auction.

Game with contribution limit $\bar{c}$ Now we solve the alternative model when there is a contribution limit $\bar{c}$. We have shown that when the politician sells policy favor using an all-pay auction, interest groups provide zero contribution to the politician. In this case, a contribution limit has no impact on the equilibrium behaviors of the interest groups or the politician. Therefore, when the politician sells policy favor using an all-pay auction, she also expects payoff $E(U_p) = \lambda\mu + \frac{\lambda}{\sqrt{\pi}}$ when there is a contribution limit.

The subgame after the politician decides to sell policy favor with a menu auction is identical to the game we solve in Section 2.5. From the previous analysis, we know that in this case the politician expects payoff $E(U_P) = \lambda\mu + \bar{c} + \frac{v-\bar{c}}{\pi}$ for issues such that $\lambda < \frac{v+(\pi-1)\bar{c}}{\sqrt{\pi}}$, and expects payoff $E(U_p) = \lambda\mu + \frac{\lambda}{\sqrt{\pi}}$ for issues such that $\lambda > \frac{v+(\pi-1)\bar{c}}{\sqrt{\pi}}$.

For issues of sufficient political importance (i.e. $\lambda > \frac{v+(\pi-1)\bar{c}}{\sqrt{\pi}}$), the politician receives the same expected pyaoff from using a menu auction and an all-pay auction. For issues that are less politically important (i.e. $\lambda < \frac{v+(\pi-1)\bar{c}}{\sqrt{\pi}}$), however, the politician receives higher expected payoff by using a menu auction. Therefore, the politician prefers to sell policy favor with a menu auction when there is a contribution limit.

A.5 Unobservable Signal Informativeness

Game with no contribution limit In this section, we solve the alternative model with an initial stage in which the politician decides whether to hide her choice of signal informativeness. The analysis of the monetary lobbying subgame is the same as the analysis in Section 2.4. Specifically, we can show that interest groups offer the same level of political contributions to the politician: $c_1^* = c_2^* = c^*$, where

$$c^* = \begin{cases} v - \frac{\sqrt{2\pi}}{2}\lambda\gamma & \text{if } \gamma < \frac{\sqrt{2\pi}v}{\pi\lambda} \\ 0 & \text{if } \gamma \geq \frac{\sqrt{2\pi}v}{\pi\lambda} \end{cases}$$

We first consider the subgame after the politician chooses to hide her choice of signal informativeness. Consider an equilibrium in which the politician chooses $\gamma = \hat{\gamma} < \frac{\sqrt{2\pi}v}{\pi\lambda}$. In equilibrium, interest group i conjectures that the politician chooses a signal with informativeness level $\hat{\gamma}$ and contributes

$$v - \frac{\sqrt{2\pi}}{2}\lambda\hat{\gamma}. \tag{A.55}$$

By choosing a signal with informativeness level γ, the politician expects payoff

$$\begin{aligned} E(U_p) &= \lambda(\mu + \frac{1}{\sqrt{2\pi}}\gamma) + v - \frac{\sqrt{2\pi}}{2}\lambda\hat{\gamma} \\ &= \lambda\mu + v - \frac{\sqrt{2\pi}}{2}\lambda\hat{\gamma} + \frac{1}{\sqrt{2\pi}}\lambda\gamma, \end{aligned} \tag{A.56}$$

which is increasing in γ. If the politician secretly deviates to choose $\gamma = \sqrt{2}$, she could receive strictly higher expected payoff. Therefore, there is no such an equilibrium in which the politician chooses signal informativeness $\gamma < \frac{\sqrt{2\pi}v}{\pi\lambda}$.

Consider an equilibrium in which the politician chooses $\gamma = \hat{\gamma} \in [\frac{\sqrt{2\pi}v}{\pi\lambda}, \sqrt{2})$. In equilibrium, interest group i conjectures that the politician chooses a signal with informativeness level $\hat{\gamma}$ and offers zero contribution to the politician. By choosing a signal with informativeness level γ, the politician expects payoff

$$\begin{aligned} E(U_p) &= \lambda(\mu + \frac{1}{\sqrt{2\pi}}\gamma) \\ &= \lambda\mu + \frac{1}{\sqrt{2\pi}}\lambda\gamma, \end{aligned} \tag{A.57}$$

which is increasing in γ. If the politician secretly deviates to choose $\gamma = \sqrt{2}$, she could receive strictly higher expected payoff. Therefore, there is no such an equilibrium in which the politician chooses signal informativeness $\gamma \in [\frac{\sqrt{2\pi}v}{\pi\lambda}, \sqrt{2})$.

Consider an equilibrium in which the politician is expected to choose $\gamma = \sqrt{2}$. In equilibrium, interest group i conjectures that the politician chooses a signal with informativeness level $\gamma = \sqrt{2}$, and offers zero contribution to the politician. So by choosing a signal with informativeness level γ, the politician expects payoff

$$E(U_p) = \lambda(\mu + \frac{1}{\sqrt{2\pi}}\gamma), \tag{A.58}$$

which is increasing in γ. The politician's payoff is maximized at $\gamma = \sqrt{2}$ and the politician has no incentive to choose any γ less than $\sqrt{2}$. Therefore, there is an equilibrium in which the politician chooses $\gamma = \sqrt{2}$.

Therefore, we have established that when the politician chooses to hide her choice of signal informativeness, there is a unique equilibrium in the subgame. In this equilibrium, the politician chooses $\gamma = \sqrt{2}$. Interest groups anticipate that the politician chooses $\gamma = \sqrt{2}$ and offer zero contribution to the politician. In this case, the politician expects to receive payoff

$$E(U_P) = \lambda\mu + \frac{\lambda}{\sqrt{\pi}}. \tag{A.59}$$

The subgame after the politician chooses to make her choice of signal informativeness observable to interest groups is identical to the game we solve in Section 2.4. From the previous analysis, we know that in this case the politician's expected payoff equals

$$E(U_P) = \lambda\mu + v \tag{A.60}$$

for issues such that $\lambda < \sqrt{\pi}v$, and equals

$$E(U_P) = \lambda\mu + \frac{\lambda}{\sqrt{\pi}} \tag{A.61}$$

for issues such that $\lambda > \sqrt{\pi}v$.

For issues of sufficient political importance (i.e. $\lambda > \sqrt{\pi}v$), the politician receives the same level of expected payoff from hiding and publicizing her choice of signal informativeness. For issues of less political importance (i.e. $\lambda < \sqrt{\pi}v$), the politician strictly prefers to make her choice of signal informativeness observable to interest groups. Therefore, in the case without contribution limit, we have a unique equilibrium in which the politician does not hide her choice of signal informativeness.

Game with contribution limit $\bar{c}$ In this section, we solve the alternative model when there is a contribution limit $\bar{c}$. The analysis of the monetary lobbying subgame is the same as the analysis in Section 2.5. Specifically, we can show that interest groups offer the same level of political contributions to the politician: $c_1^* = c_2^* = c^*$, where

$$c^* = \begin{cases} \bar{c} & \text{if } \gamma \leq \frac{\sqrt{2\pi}(v-\bar{c})}{\pi\lambda} \\ v - \frac{\sqrt{2\pi}}{2}\lambda\gamma & \text{if } \frac{\sqrt{2\pi}(v-\bar{c})}{\pi\lambda} < \gamma < \frac{\sqrt{2\pi}v}{\pi\lambda} \\ 0 & \text{if } \gamma \geq \frac{\sqrt{2\pi}v}{\pi\lambda} \end{cases}$$

We first solve the subgame after the politician chooses to hide her choice of signal informativeness. Consider an equilibrium in which the politician is expected to choose $\gamma = \hat{\gamma} \in [0, \frac{\sqrt{2\pi}(v-\bar{c})}{\pi\lambda}]$. In equilibrium, interest groups conjecture that the politician chooses a signal with informativeness level $\hat{\gamma}$, and they offer

$$c_1 = c_2 = \bar{c}. \tag{A.62}$$

By choosing a signal with informativeness level γ, the politician expects payoff

$$E(U_p) = \lambda(\mu + \frac{1}{\sqrt{2\pi}}\gamma) + \bar{c}, \tag{A.63}$$

which is increasing in γ. If the politician secretly deviates to choose $\gamma = \sqrt{2}$, she receives strictly higher expected payoff. Hence, there is no such an equilibrium in which the politician chooses signal informativeness $\gamma \in [0, \frac{\sqrt{2\pi}(v-\bar{c})}{\pi\lambda}]$.

Consider an equilibrium in which the politician is expected to choose $\gamma = \hat{\gamma} \in (\frac{\sqrt{2\pi}(v-\bar{c})}{\pi\lambda}, \frac{\sqrt{2\pi}v}{\pi\lambda})$. In equilibrium, interest group i conjectures that the politician chooses a signal with informativeness level $\hat{\gamma}$ and contributes

$$c_i = v - \frac{\sqrt{2\pi}}{2}\lambda\hat{\gamma}. \tag{A.64}$$

By choosing a signal with informativeness level γ, the politician expects payoff

$$\begin{aligned} E(U_P) &= \lambda(\mu + \frac{1}{\sqrt{2\pi}}\gamma) + v - \frac{\sqrt{2\pi}}{2}\lambda\hat{\gamma} \\ &= \lambda\mu + v - \frac{\sqrt{2\pi}}{2}\lambda\hat{\gamma} + \frac{1}{\sqrt{2\pi}}\lambda\gamma, \end{aligned} \tag{A.65}$$

which is increasing in γ. If the politician secretly deviates to choose $\gamma = \sqrt{2}$, she receives strictly higher expected payoff. Hence, there is no such an equilibrium in which the politician chooses signal informativeness $\gamma \in (\frac{\sqrt{2\pi}(v-\bar{c})}{\pi\lambda}, \frac{\sqrt{2\pi}v}{\pi\lambda})$.

Consider an equilibrium in which the politician chooses $\gamma = \hat{\gamma} \in [\frac{\sqrt{2\pi}v}{\pi\lambda}, \sqrt{2})$. In equilibrium, interest group i conjectures that the politician chooses a signal with informativeness level $\hat{\gamma}$ and offers zero contribution to the politician. By choosing a signal with informativeness level γ, the politician expects payoff

$$\begin{aligned} E(U_p) &= \lambda(\mu + \frac{1}{\sqrt{2\pi}}\gamma) \\ &= \lambda\mu + \frac{1}{\sqrt{2\pi}}\lambda\gamma, \end{aligned} \tag{A.66}$$

which is increasing in γ. If the politician secretly deviates to choose $\gamma = \sqrt{2}$, she could receive strictly higher expected payoff. Therefore, there is no such an equilibrium in which the politician chooses signal informativeness $\gamma \in [\frac{\sqrt{2\pi}v}{\pi\lambda}, \sqrt{2})$.

Consider an equilibrium in which the politician is expected to choose $\gamma = \sqrt{2}$. In equilibrium, interest group i conjectures that the politician chooses a signal with informativeness level $\gamma = \sqrt{2}$, and offers zero contribution to the politician. So by choosing a signal with informativeness level γ, the politician expects payoff

$$E(U_p) = \lambda(\mu + \frac{1}{\sqrt{2\pi}}\gamma), \tag{A.67}$$

which is increasing in γ. The politician's payoff is maximized at $\gamma = \sqrt{2}$ and the politician has no incentive to choose any γ less than $\sqrt{2}$. Therefore, there is an equilibrium in which the politician chooses $\gamma = \sqrt{2}$.

Therefore, we have established that when the politician chooses to hide her choice of signal informativeness, there is a unique equilibrium in the subgame. In this equilibrium, the politician chooses $\gamma = \sqrt{2}$. Interest groups anticipate that the politician chooses $\gamma = \sqrt{2}$ and offer zero contribution to the politician. In this case, the politician expects to receive payoff

$$E(U_P) = \lambda\mu + \frac{\lambda}{\sqrt{\pi}}. \tag{A.68}$$

The subgame after the politician chooses to make her choice of signal informativeness observable to interest groups is identical to the game we solve in Section 2.5. From the previous analysis, we know that in this case the politician's expected payoff equals

$$E(U_P) = \lambda\mu + \bar{c} + \frac{v - \bar{c}}{\pi} \tag{A.69}$$

for issues such that $\lambda < \frac{v+(\pi-1)\bar{c}}{\sqrt{\pi}}$, and equals

$$E(U_P) = \lambda\mu + \frac{\lambda}{\sqrt{\pi}} \tag{A.70}$$

for issues such that $\lambda > \frac{v+(\pi-1)\bar{c}}{\sqrt{\pi}}$.

For issues of sufficient political importance (i.e. $\lambda > \frac{v+(\pi-1)\bar{c}}{\sqrt{\pi}}$), the politician receives the same level of expected payoff from hiding and publicizing her choice of signal informativeness. For issues of less political importance (i.e. $\lambda < \frac{v+(\pi-1)\bar{c}}{\sqrt{\pi}}$), the politician strictly prefers to make her choice of signal informativeness observable to interest groups. Therefore, in the case with contribution limit $\bar{c}$, we have a unique equilibrium in which the politician does not hide her choice of signal informativeness.

APPENDIX B
Appendix for Chapter 3

B.1 Proofs

Proof to Lemma 3.4.1. 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 (3.4). 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 3.4.1. 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,

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

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 (B.1). 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 (B.1) 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 Assumption 3.4.2 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 3.4.1. 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 3.5.1. 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 (3.5). 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 3.4.1. ■

Proof to Proposition 3.5.1. 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 3.5.1 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,

$$a = \bar{s} - (1 - \lambda)\bar{\delta} \quad \text{and} \quad b = \bar{s} + \lambda\bar{\delta}. \tag{B.2}$$

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

$$(1 - \lambda)\bar{\delta} < \bar{s} < \bar{s}'_{nc}. \tag{B.3}$$

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 Assumption 3.4.2 also restricts attention to the case where $(1 - \lambda)\bar{\delta} < \bar{s}$. Therefore Assumption 3.4.1 and Assumption 3.4.2 guarantee that $\bar{s}$ satisfied (B.3).

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 Assumption 3.4.2.

This represents a complete characterization of the equilibria for each possible $\bar{s}$. Given Assumption 3.4.1 and Assumption 3.4.2, the unique equilibrium involves $q_B = 1$ and (a, b) as given by (B.2). ■

Proof to Corollary 3.5.1. 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 3.6.1. Follows immediately from comparing $\mathcal{C}$, u_{LE} and u_C from Corollaries 3.4.1 and 3.5.1. ■

Proof to Corollary 3.6.1. Follows immediately from comparing $\mathcal{C}$ from Corollaries

3.4.1 and 3.5.1, and from establishing that successful crime $\mathcal{C}$ is strictly decreasing in $\bar{\delta} \in [0, r_A - r_B)$. ■

Proof to Theorem 3.6.2. Follows immediately from comparing $\mathcal{C}$ from Corollaries 3.4.1 and 3.5.1, and from establishing that successful crime $\mathcal{C}$ is strictly decreasing in $\bar{\delta} \in [0, r_A - r_B)$. ■

B.2 Extensions

Social welfare 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. Suppose Function W denotes social welfare, parameter h denotes the social harm that comes from successful criminal activity, and parameter ϕ denotes the relative importance of fairness in the social welfare function, where

$$W = -h\,\mathcal{C} - \frac{\bar{s}^2}{2} - |b - a|\phi. \tag{B.4}$$

Equilibrium social welfare under profiling rule $\bar{\delta} < r_A - r_B$, and Assumption 3.4.1 and Assumption 3.4.2 is

$$W = (1 - \bar{s} - \lambda\bar{\delta})(-h) - \frac{\bar{s}^2}{2} - \bar{\delta}\ \phi,$$

which is strictly increasing in $\bar{\delta}$ when

$$\lambda h > \phi.$$

Banning profiling results in the same effectiveness of law enforcement and a higher level of fairness compared to no restriction. This means that a ban will improve social welfare compared to no restriction. However, this does not mean that a ban is optimal. When the effectiveness of law enforcement is sufficiently important relative to fairness, then social welfare is maximized under the most effective profiling rule, where $\bar{\delta}$ is set marginally below $r_A - r_B$.[25]

Endogenous budget Until now, we have taken the budget of law enforcement as fixed. Here, we endogenize $\bar{s}$, assuming that it is selected by a government planner in an initial stage of play. The planner chooses $\bar{s}$ to maximize social welfare, as defined by (6), while anticipating the effect his choice of $\bar{s}$ has on the strategies of law enforcement and the criminal organization in the next stage.

With endogenous $\bar{s}$, it is no longer appropriate to assume constraints directly on the allowable range of $\bar{s}$ as were imposed by Assumption 3.4.1 and Assumption 3.4.2. However, we still want to focus on the case in which the equilibrium is neither sufficiently large to eradicate all crime, nor sufficiently small that it has no impact on criminal behavior. The following assumption simply combines and restates Assumption 3.4.1 and Assumption 3.4.2 in terms of h, the social harm associated with criminal activity.

Assumption B.2.1

$$(1 - \lambda)(r_A - r_B) < h < h_{max}$$

,

where $h_{max} = 1 - \sqrt{1 - (1 - \lambda r_A - (1 - \lambda) r_B)^2}$.

[25] When fairness is afforded more weight in the social welfare function, it may be optimal to require equal treatment. But doing so *always* decreases the effectiveness of law enforcement compared to a more moderate restriction on the use of profiling.

With this additional stage of the game, we solve for the subgame perfect equilibrium. The equilibrium of the second stage is solved for in the case of exogenous $\bar{s}$ analyzed above. We derive the following result in the Appendix. In the unique equilibrium under Assumption B.2.1, the planner chooses $\bar{s} = h$ in the first stage. The second stage equilibrium is described by Proposition 3.4.1 in the case of unrestricted profiling, and by Proposition 3.5.1 in the case of profiling rule $\bar{\delta} \in [0, r_A - r_B)$.

The endogenous law enforcement budget is independent of the profiling rule. The planner chooses $\bar{s} = h$ regardless of $\bar{\delta}$. This means that the conclusions from the earlier sections continue to hold whenever Assumption B.2.1 is satisfied. The most effective profiling rule involves only minimal restrictions on the use of profiling, and such a profiling rule is socially optimal as long as society is concerned enough about reducting crime relative to improving fairness.

Below, we provide formal analysis of this extention.

The government's expected payoff in equilibrium is defined by

$$u_G = -h(q_A(1-a) + q_B(1-b)) - \frac{1}{2}\bar{s}^2. \tag{B.5}$$

First, the government prefers $\bar{s} = \bar{s}_{nc}$ to all higher $\bar{s}$. This is because any $\bar{s} \geq \bar{s}_{nc}$ eliminates criminal activity in the second stage, and $\bar{s}_{nc}$ does so at the lowest costs. Choosing screening capacity $\bar{s}_{nc}$ leads to expected government payoff

$$u_G = -\frac{1}{2}\bar{s}_{nc}^2 = -\frac{1}{2}(1 - \lambda r_A - (1-\lambda) r_B)^2. \tag{B.6}$$

Second, we consider the potential choice of $\bar{s}$ such that $(1-\lambda)(r_A - r_B) < \bar{s} < \bar{s}_{nc}$.

Here, the government's expected payoff is

$$u_G = -(1-\bar{s})h - \frac{1}{2}\bar{s}^2.$$

The first order condition gives us

$$\bar{s} = h.$$

A check of second order conditions shows that this is a maximum. This means the global maximum is achieved at $\bar{s} = h$; however, the equation for u_G requires a moderate value of $\bar{s}$. If $(1-\lambda)(r_A - r_B) < h < 1 - \lambda r_A - (1-\lambda)r_B$, the global maximum is achieved on the range of $\bar{s}$, and the government chooses $\bar{s} = h$ to any other $\bar{s}$ in this range. This leads to expected government payoff

$$u_G = -h + \frac{1}{2}h^2. \tag{B.7}$$

We must also compare u_G when $\bar{s} = h$ to its value when the government chooses the minimum $\bar{s}$ which eliminates crime. The two values of u_G in (B.6) and (B.7) are equal when

$$h = 1 - \sqrt{1 - (1 - \lambda r_A - (1-\lambda)r_B)^2} \ \ (\equiv h_{max}).$$

Therefore, when $h \geq h_{max}$, the government prefers to set $\bar{s}_{nc}$, resulting in no second stage crime. When $(1-\lambda)(r_A - r_B) < h < h_{max}$, the government prefers to set $\bar{s} = h$, leading to the mixed strategy second stage equilibrium.

Third, we consider the choice of $\bar{s} \leq (1-\lambda)(r_A - r_B)$. Note that for the case of $\bar{s} = (1-\lambda)(r_A - r_B)$, we focus on the equilibrium that corresponds to the highest government payoff (i.e. $q_A = 0$ and $q_B = 1$). Therefore, when $\bar{s} \leq (1-\lambda)(r_A - r_B)$

the government's expected payoff is

$$u_G = -(1 - \frac{\bar{s}}{1-\lambda})h - \frac{1}{2}\bar{s}^2.$$

The first order condition gives

$$\bar{s} = \frac{h}{1-\lambda}.$$

A check of second order conditions shows that this is a maximum. This means the global maximum is achieved at $\bar{s} = \frac{h}{1-\lambda}$; however, the equation for u_G holds only when $\bar{s} \leq (1-\lambda)(r_A - r_B)$. If $\frac{h}{1-\lambda} \leq (1-\lambda)(r_A - r_B)$, the global maximum is achieved. If $\frac{h}{1-\lambda} > (1-\lambda)(r_A - r_B)$, the local maximum is achieved at $\bar{s} = (1-\lambda)(r_A - r_B)$. Therefore, the government chooses

$$\bar{s} = \begin{cases} \frac{h}{1-\lambda} & \text{when} \quad h \leq (1-\lambda)^2(r_A - r_B) \\ (1-\lambda)(r_A - r_B) & \text{when} \quad (1-\lambda)^2(r_A - r_B) < h \leq (1-\lambda)(r_A - r_B) \\ h & \text{when} \quad (1-\lambda)(r_A - r_B) < h < h_{max} \\ \bar{s}_{nc} & \text{when} \quad h \geq h_{max}. \end{cases}$$

These are the unique solutions to the government's first stage maximization problem given the subgame perfect strategies in the second stage. In the unique equilibrium under Assumption B.2.1, the government decision maker chooses $\bar{s} = h$.

Similar to the game with unconstrained profiling, when the government chooses a screening capacity that eliminates crime, it chooses lowest $\bar{s}$ that does so. That is the government prefers $\bar{s} = \bar{s}'_{nc}$ to all higher $\bar{s}$. Choosing screening capacity $\bar{s}'_{nc}$ leads to expected government payoff

$$u_G = -\frac{1}{2}\bar{s}'^{\,2}_{nc} = -\frac{1}{2}(1 - r_B - \lambda\bar{\delta})^2. \tag{B.8}$$

Second, we consider the potential choice of $\bar{s}$ such that $(1-\lambda)\bar{\delta} < \bar{s} < \bar{s}'_{nc}$. Here, the government's expected payoff is

$$u_G = -(1-b)h - \frac{1}{2}\bar{s}^2 = -(1-\bar{s}-\lambda\bar{\delta})h - \frac{1}{2}\bar{s}^2.$$

The first order condition gives us

$$\bar{s} = h.$$

A check of second order conditions shows that this is a maximum. This means the global maximum is achieved at $\bar{s} = h$; however, the equation for u_G requires a moderate value of $\bar{s}$. If $(1-\lambda)\bar{\delta} < \bar{s} < \bar{s}'_{nc}$, the global maximum is achieved on the range of $\bar{s}$, and the government chooses $\bar{s} = h$ to any other $\bar{s}$ in this range. This leads to expected government payoff

$$u_G = -h + \frac{1}{2}h^2 + h\lambda\bar{\delta}. \tag{B.9}$$

Instead of choosing $\bar{s} = h$, the government may prefer to deviate to $\bar{s}'_{nc}$ since doing so eliminates crime (but also requires greater costs). The government is indifferent between setting $\bar{s}$ equal to h or equal to $\bar{s}'_{nc}$ when

$$h = 1 - \lambda\bar{\delta} - \sqrt{r_B(2 - r_B - 2\lambda\bar{\delta})} \;\; (\equiv h'_{max}).$$

When $h \geq h'_{max}$, the government prefers to set $\bar{s}'_{nc}$, resulting in no second stage crime. When $(1-\lambda)\bar{\delta} < h < h'_{max}$, the government prefers to set $\bar{s} = h$, leading to the organization always recruiting a type B operative in the second stage equilibrium.

Third, we consider the choice of $\bar{s} \leq (1-\lambda)\bar{\delta}$. In this case, the government's expected payoff is

$$u_G = -(1 - \frac{\bar{s}}{1-\lambda})h - \frac{1}{2}\bar{s}^2$$

The first order condition gives

$$\bar{s} = \frac{h}{1-\lambda}.$$

A check of second order conditions shows that this is a maximum. This means the global maximum is achieved at $\bar{s} = \frac{h}{1-\lambda}$; however, the equation for u_G holds only when $\bar{s} \leq (1-\lambda)\bar{\delta}$. If $\frac{h}{1-\lambda} \leq (1-\lambda)\bar{\delta}$, the global maximum is achieved. If $\frac{h}{1-\lambda} > (1-\lambda)\bar{\delta}$, the local maximum is achieved at $\bar{s} = (1-\lambda)\bar{\delta}$. Therefore, the government chooses

$$\bar{s} = \begin{cases} \frac{h}{1-\lambda} & \text{when} \quad h \leq (1-\lambda)^2\bar{\delta} \\ (1-\lambda)\bar{\delta} & \text{when} \quad (1-\lambda)^2\bar{\delta} < h \leq (1-\lambda)\bar{\delta} \\ h & \text{when} \quad (1-\lambda)\bar{\delta} < h < h'_{max} \\ \bar{s}'_{nc} & \text{when} \quad h \geq h'_{max}. \end{cases}$$

These are the unique solutions to the government's first stage maximization problem given the subgame perfect strategies in the second stage. Notice that $\bar{\delta} < r_A - r_B$ implies that $h'_{max} > h_{max}$. This suggests that Assumption B.2.1 will also restrict attention to the case where $h < h'_{max}$. Also, $(1-\lambda)\bar{\delta} < (1-\lambda)(r_A - r_B)$, meaning that Assumption B.2.1 also restricts attention to the case where $(1-\lambda)\bar{\delta} < h$. Therefore Assumption B.2.1 guarantees that the government decision maker chooses $\bar{s} = h$ in the restricted profiling game.

Endogenous recruitment costs In the paper, we treat r_A and r_B as fixed, exogenous recruitment costs. Here, we present two alternative frameworks with endogenous recruitment costs. Both models are kept as simple as possible, designed to illustrate how endogenizing recruitment costs needs not change our qualitative results.

We first consider a refinement of the model in which the reservation wage of a criminal recruit depends on the probability of being caught. Suppose that the criminal organization has access to a type A recruit and a type B recruit. The type $t \in \{A, B\}$ recruit has opportunity cost of engaging in crime equal to c_t and expects to face punishment equal to ℓ_t if caught engaging in crime. We assume that a type A recruit is more costly on both dimensions, $c_A \geq c_B$ and $\ell_A \geq \ell_B$. This is consistent with population A having higher opportunity costs of both engaging in crime and being in prison. A type A recruit faces expected costs $c_A + a\ell_A$ from engaging in the criminal activity. To recruit a type A operative, the criminal organization must offer a minimum wage of $r_A(a) = c_A + a\ell_A$. Similarly, to recruit a type B operative, it must offer $r_B(b) = c_B + b\ell_B$. Notice that the costs of recruiting a type t operative are strictly increasing in the resources law enforcement devotes to screening that population group.

We solve the game using the same method as in the previous sections considering the case in which the screening budget $\bar{s}$ is neither so large that it fully eradicates crime nor so small that it has no impact on criminal activity. The equilibrium of the unconstrained game is in mixed strategies:

$$q_A = \lambda \qquad q_B = 1 - \lambda, \quad \text{and}$$

$$a = \frac{\bar{s} + \ell_B \bar{s} - (1-\lambda)(c_A - c_B)}{1 + \ell_A(1-\lambda) + \ell_B \lambda} \qquad b = \frac{\bar{s} + \ell_A \bar{s} + \lambda(c_A - c_B)}{1 + \ell_A(1-\lambda) + \ell_B \lambda}.$$

When ℓ_A and ℓ_B are zero, the screening probabilities equal the screening probabilities in the body of the paper. For all $c_A \geq c_B$ and $\ell_A \geq \ell_B$, law enforcement screens population B more intensely than it screens population A. In equilibrium, the crime is $\mathcal{C} = 1 - \bar{s}$, the same value as in Section 4.

Although the equations for a and b become more complicated, the intuition for the main results remains unchanged. When officers are unconstrained in their ability to screen different population groups with unequal probability, they screen the two groups at rates that make the criminal organization indifferent between recruiting a type A or a type B operative. As soon as you require the officers to treat the groups more fairly than they choose to in equilibrium, the officers are constrained to play a screening strategy for which the criminal organization's best response is *always* to recruit a type B agent. This discontinuous shift in recruitment behavior due to a small change in fairness rule is the necessary result for our conclusions, and is present here. This means that our qualitative results will continue to hold even if we allow the recruitment costs to depend on screening probabilities.

In the equilibrium of the game with unrestricted profiling, $\delta = b - a = (\bar{s}(\ell_A - \ell_B) + c_A - c_B)/(1 + (1-\lambda)\ell_A + \lambda\ell_B)$. Any $\bar{\delta}$ below this value prevents law enforcement from screening in a manner consistent with the mixed strategy equilibrium, which prompts the criminal organization to focus on recruiting from population B which is both easier to recruit and more heavily screened. The optimal profiling rule is to require law enforcement to treat the two population groups only marginally more fairly than it chooses to do in the unconstrained equilibrium. Banning profiling leads law enforcement to be no more effective than when profiling is unconstrained, and strictly less effective compared to any more moderate restriction.

We next consider a simplified model of search in which the criminal organization can easily either recruit a type B operative, or can take time to search for a type A operative. For this example, we set $r_B = 0$. That is, to select a type B operative is to use, for example, a junior member of the drug cartel or terrorist cell. The criminal organization decides whether to rely on the low-cost type B operative, or to expend effort searching for a type A operative instead. Members of the type A population are defined by their individual opportunity cost of engaging in criminal activity, c_i, and a common loss if caught ℓ. A recruit's opportunity cost is not publicly observable, although it is commonly known that c_i is uniformly distributed on $[0, 1]$.

The recruitment game takes place as follows. First, the criminal organization chooses whether to recruit a type B operative, or to search for a type A operative. If it recruits a type B operative, the game takes place as it did in the body of the paper. If it recruits from the type A population, then the organization chooses a wage w_A to offer type A recruits. After announcing the wage, the organization searches for a type A recruit until it finds one willing to accept wage w_A. Formally, the criminal organization randomly draws one potential recruit, that recruit either accepts or rejects offer w_A, and then if the offer is turned down the criminal organization draws another recruit. The process continues until a recruit accepts the offer.[26] Finding and making an offer to a recruit is costly to the criminal organization, and total recruitment costs equal w_A plus τ times the number of recruits sampled before finding one willing to accept the offer.

A recruit will accept offer w_A if his opportunity cost of criminal activity, c_i, is not too large. This is the case if $w_A \geq c_i + a\ell$, or equivalently $c_i \leq w_A - a\ell$. The number of recruits that the criminal organization must give offers to before finding one willing to accept wage w_A follows a geometric distribution. As a standard property of a geometric distribution, the expected number of offers equals $1/F(w_A - a\ell)$, where F is the distribution of c_i. Given that c_i is distributed uniformly on the unit interval, expected search costs equals $\tau/(w_A - a\ell)$. When the organization decides to recruit a type A operative, it expects payoff

$$u_C(A) = 1 - a - w_A - \frac{\tau}{w_A - a\ell}.$$

After deciding to recruit a type A operative, the organization chooses w_A to maximize

[26] The results do not change if we allow the organization to give up looking for a type A recruit during the search process.

this expression. Increasing w_A decreases expected recruitment time, but increases the payment made to the operative. Anticipating a, the best response wage offer is $w_A = \sqrt{\tau} + a\ell$, which results in total expected recruitment costs equal to

$$r_A(a) = 2\sqrt{\tau} + a\ell.$$

This expression is similar to r_A in the previous example, except here c_A is replaced with a value $2\sqrt{\tau}$, which incorporates the maximum recruit opportunity cost and the search costs associated with recruiting a type A operative. We solve the game using the same method as in the previous sections considering the case in which the screening budget $\bar{s}$ is neither so large that it fully eradicates crime nor so small that it has no impact on criminal activity. The equilibrium of the unconstrained game is in mixed strategies:

$$q_A = \lambda \qquad q_B = 1 - \lambda, \quad \text{and}$$

$$a = \frac{\bar{s} - 2(1-\lambda)\sqrt{\tau}}{1 + \ell(1-\lambda)} \qquad b = \frac{\bar{s} + \ell\bar{s} + 2\lambda\sqrt{\tau}}{1 + \ell(1-\lambda)}.$$

Just as in the previous example and in the body of the paper, without a profiling rule, officers screen the two groups at rates that make the criminal organization indifferent between recruiting a type A or a type B operative. When officers are required to treat the groups "more fairly," the officers are constrained to play a screening strategy for which the criminal organization's best response is *always* to recruit a type B agent. Because of this, our qualitative results from the body of the paper continue to hold. Law enforcement is most effective when it faces only a weak restriction on its ability to profile. Banning profiling is never as effective as a more moderate restriction.

We could extend the previous example to allow for positive recruitment costs and heterogenous preferences amongst both population groups, assuming for example that one group's opportunity cost distribution first-order stochastically dominates the other group's distribution. Then, in each period of the search game, the criminal organization decides whether to attempt to recruit a type A or type B operative, drawing a potential recruit from the respective distribution, and offering them wage w_A or w_B. Again, the qualitative results from the model will continue to hold.

APPENDIX C
Appendix for Chapter 4

C.1 Proofs

Proof of Lemma 4.4.1. In this section, we consider a partial deterrence equilibrium in which J never dismisses a lawsuit. We first show that in such a partial deterrence equilibrium, P must play mixed strategies.

Suppose that P always sues D after he experiences harm. In this case, D expects payoff $v_1 - h - c_{\mathsf{D}} = v - h - c_{\mathsf{D}}$ from the unlawful action, and expects payoff $v_0 - \eta c_{\mathsf{D}} = -\eta c_{\mathsf{D}}$ from the lawful action. Assumption 4.3.1 implies that $v - h - c_{\mathsf{D}} < -\eta c_{\mathsf{D}}$, so D prefers to always take the lawful action. This contradicts that D plays mixed strategies in a partial deterrence equilibrium.

Suppose that P never sues D . In this case, D expects payoff $v_1 = v > 0$ from the unlawful action, and expects payoff $v_0 = 0$ from the lawful action. Since $v_1 > v_0$, D prefers to always take the unlawful action. This contradicts that D plays mixed strategies in a partial deterrence equilibrium.

We have ruled out the possibility that P plays mixed strategies in a partial deterrence equilibrium. Now let's suppose that D takes the unlawful action with probability ρ_ℓ, and P sues D with probability ρ_s. After experiencing harm h, P is indifferent between suing and not suing when

$$\frac{\rho_\ell}{\rho_\ell + \eta(1-\rho_\ell)} h - c_{\mathsf{P}} - h = -h. \tag{C.1}$$

The left hand side of the above equation represents P's expected payoff from suing, while the right hand side of the above equation equals his expected payoff from not suing. Solving this equation, we have D's equilibrium strategy

$$\rho_\ell = \frac{\eta c_{\mathsf{P}}}{h - (1-\eta)c_{\mathsf{P}}}. \tag{C.2}$$

Assumption 4.3.2 ensures ρ_ℓ is between 0 and 1.

D expects payoff $v_1 - \rho_s(h + c_{\mathsf{D}}) = v - \rho_s(h + c_{\mathsf{D}})$ from the unlawful action, and anticipates payoff $v_0 - \eta\rho_s c_{\mathsf{D}} = -\eta\rho_s c_{\mathsf{D}}$ from the lawful action. In a partial deterrence equilibrium, D is indifferent between the unlawful action and the lawful action. This is the case when

$$v - \rho_s(h + c_{\mathsf{D}}) = -\eta\rho_s c_{\mathsf{D}}. \tag{C.3}$$

Solving this equation, we have P's equilibrium strategy

$$\rho_s = \frac{v}{h + (1-\eta)c_{\mathsf{D}}}. \tag{C.4}$$

Assumption 4.3.1 ensures ρ_s is between 0 and 1.

It remains to show that J prefers to always bring a case to trial. Given D's equilibrium strategy ρ_ℓ, P and J's posterior belief is

$$\mu = \frac{\rho_\ell}{\rho_\ell + \eta(1-\rho_\ell)} = \frac{c_{\mathsf{P}}}{h}. \tag{C.5}$$

J prefers to bring a lawsuit to trial when she believes D is very likely to be liable. This is the case when

$$\bar{\mu} < \frac{c_{\mathsf{P}}}{h}. \tag{C.6}$$

When this condition is satisfied, there exists a partial deterrence equilibrium in which J always brings a case to trial, and D and P play the strategies specified above. ■

Proof of Lemma 4.4.2. In this section, we consider a partial deterrence equilibrium in which J dismisses a lawsuit with probability ρ_d. Suppose that in equilibrium D takes the unlawful action with probability ρ_ℓ. Given D's equilibrium strategy ρ_ℓ, P and J's posterior beliefs are

$$\mu = \frac{\rho_\ell}{\rho_\ell + \eta(1-\rho_\ell)}. \tag{C.7}$$

J is indifferent between trying and dismissing a case when $\mu = \bar{\mu}$, or equivalently

$$\frac{\rho_\ell}{\rho_\ell + (1-\rho_\ell)\eta} = \bar{\mu}. \tag{C.8}$$

Solving for ρ_ℓ, we have D's equilibrium strategy

$$\rho_\ell = \frac{\eta\bar{\mu}}{1-(1-\eta)\bar{\mu}}. \tag{C.9}$$

Given D's equilibrium strategy, P's expected benefit from suing D is

$$\bar{\mu}h - c_{\mathsf{P}}. \tag{C.10}$$

When $\bar{\mu}h - c_{\mathsf{P}} < 0$ or equivalently $\bar{\mu} < c_{\mathsf{P}}/h$, P prefers not to sue D . Given P's strategy, D anticipates payoff $v_1 = v > 0$ from the unlawful action, and anticipates payoff $v_0 = 0$ from the lawful action. Therefore, D prefers to always take the unlawful action. This contradicts that D mixes between action x_1 and x_0 in a partial deterrence equilibrium. So we don't have a partial deterrence equilibrium when $\bar{\mu} < c_{\mathsf{P}}/h$.

When $\bar{\mu}h - c_{\mathsf{P}} > 0$ or equivalently $\bar{\mu} > c_{\mathsf{P}}/h$, P prefers to sue D . Given P and J's strategy, D expects payoff $v_1 - (1-\rho_d)(h+c_{\mathsf{D}}) = v - (1-\rho_d)(h+c_{\mathsf{D}})$ from the unlawful action, and anticipates payoff $v_0 - \eta(1-\rho_d)c_{\mathsf{D}} = -\eta(1-\rho_d)c_{\mathsf{D}}$ from the lawful action. In a partial deterrence equilibrium, D is indifferent between the unlawful action and the lawful action. This is the case when

$$v - (1 - \rho_d)(h + c_{\mathsf{D}}) = -\eta(1 - \rho_d)c_{\mathsf{D}}. \tag{C.11}$$

Solving this equation, we have J's equilibrium strategy

$$\rho_d = 1 - \frac{v}{h + (1 - \eta)c_{\mathsf{D}}}. \tag{C.12}$$

Assumption 4.3.1 ensures that ρ_d is between 0 and 1. Therefore, when $\bar{\mu} > c_{\mathsf{P}}/h$, we have a partial deterrence equilibrium in which D takes the unlawful action with probability $\rho_\ell = \frac{\eta\bar{\mu}}{1-(1-\eta)\bar{\mu}}$, P sues with probability 1, and J dismisses a case with probability $\rho_d = 1 - \frac{v}{h+(1-\eta)c_{\mathsf{D}}}$.

When $\bar{\mu}h - c_{\mathsf{P}} = 0$ or equivalently $\bar{\mu} = c_{\mathsf{P}}/h$, P is indifferent between suing and not suing D . Suppose P sues D with probability ρ_s. Given P and J's strategy, D expects payoff $v_1 - \rho_s(1 - \rho_d)(h + c_{\mathsf{D}}) = v - \rho_s(1 - \rho_d)(h + c_{\mathsf{D}})$ from the unlawful action, and anticipates payoff $v_0 - \eta\rho_s(1 - \rho_d)c_{\mathsf{D}} = -\eta\rho_s(1 - \rho_d)c_{\mathsf{D}}$ from the lawful action. In a partial deterrence equilibrium, D is indifferent between the unlawful action and the lawful action. This is the case when

$$v - \rho_s(1 - \rho_d)(h + c_{\mathsf{D}}) = -\eta\rho_s(1 - \rho_d)c_{\mathsf{D}}. \tag{C.13}$$

Solving this equation, we have

$$\rho_s(1 - \rho_d) = \frac{v}{h + (1 - \eta)c_{\mathsf{D}}}. \tag{C.14}$$

Assumption 4.3.1 ensures that $\rho_s(1 - \rho_d)$ is between 0 and 1. Therefore, when $\bar{\mu} = c_{\mathsf{P}}/h$, we have a continuum of partial deterrence equilibria in which D takes the unlawful action with probability $\rho_\ell = \frac{\eta\bar{\mu}}{1-(1-\eta)\bar{\mu}}$, P sues with probability ρ_s, and J dismisses a case with probability ρ_d. In this equilibrium, ρ_s and ρ_d must satisfy equation (C.14). ■

C.2 Extension with Nuisance Suits

To start, we consider the subgame after the judge allows a lawsuit to proceed to discovery and trial. P rationally anticipates that D will accept a higher settlement offer when liable than when not liable, but even a non-liable D will accept a settlement offer of up to $s = c_{\mathsf{D}}$ as doing so is no more costly than paying trial costs. P prefers to pursue settlement strategy targeting non-liable defendants when attracting a settlement of $s = c_{\mathsf{D}}$ for sure provides a higher payoff than offering $s = h+c_{\mathsf{D}}$, which is accepted only by a liable D . This higher settlement is the maximum value that a liable D is willing to accept rather than go to trial. Offering $s = c_{\mathsf{D}}$ is preferable to P when

$$-h + c_{\mathsf{D}} \geq -h - (1 - Pr(\ell = 1|\rho_\ell; \eta, \phi))c_{\mathsf{P}} + Pr(\ell = 1|\rho_\ell; \eta, \phi)\,(h + c_{\mathsf{D}}) \tag{C.15}$$

or equivalently

$$Pr(\ell = 1|\rho_\ell; \eta, \phi) \leq \frac{c_{\mathsf{D}} + c_{\mathsf{P}}}{h + c_{\mathsf{D}} + c_{\mathsf{P}}}. \tag{C.16}$$

The posterior probability that D is liable must be consistent with Bayes rule given the priors and ρ_ℓ, the probability that D chooses action x_1 when he has the opportunity to do so. Therefore,

$$Pr(\ell = 1|\rho_\ell; \eta, \phi) = \frac{\phi\rho_\ell}{\phi\rho_\ell + (1 - \phi\rho_\ell)\eta} \tag{C.17}$$

Pooling Equilibrium In this section, we consider a pooling equilibrium in which D always takes the lawful action x_0 regardless of the availability of action x_1. In this equilibrium, J's posterior belief is

$$Pr(\ell = 1|\rho_\ell = 0; \eta, \phi) = 0, \tag{C.18}$$

and she always dismisses a lawsuit. Given J's equilibrium strategy, D has an incentive to take the unlawful action x_1 when he has the opportunity to do so. Therefore, a pooling equilibrium does not exist.

Seperating Equilibrium In this section, we consider a separating equilibrium in which D takes the unlawful action x_1 when he has the opportunity to do so, and takes the lawful action x_0 when action x_1 is not available. In this equilibrium, P and J's posterior beliefs are

$$Pr(\ell = 1|\rho_\ell = 1; \eta, \phi) = \frac{\phi}{\phi + (1-\phi)\eta}. \tag{C.19}$$

When $Pr(\ell = 1|\rho_\ell = 1; \eta, \phi) < \bar{\mu}$, J always dismisses a case, and D takes the unlawful action x_1 when he has the opportunity to do so. Therefore, a separating equilibrium exists when

$$\bar{\mu} > \frac{\phi}{\phi + (1-\phi)\eta}. \tag{C.20}$$

When $Pr(\ell = 1|\rho_\ell = 1; \eta, \phi) > \bar{\mu}$, J never dismisses a case. We have shown that after J allows a case to proceed, P prefers to offer $s = c_{\mathsf{D}}$ when $Pr(\ell = 1|\rho_\ell; \eta, \phi) \leq \frac{c_{\mathsf{D}}+c_{\mathsf{P}}}{h+c_{\mathsf{D}}+c_{\mathsf{P}}}$. When this condition is satisfied, D anticipates payoff $v_1 - c_{\mathsf{D}}$ from the unlawful action, and expects payoff $v_0 - \eta c_{\mathsf{D}}$ from the lawful action. In a separating equilibrium, D must prefer to take the unlawful action x_1 when he has the opportunity to do so. This is the case when $v_1 - c_{\mathsf{D}} > v_0 - \eta c_{\mathsf{D}}$ or equivalently $\nu > (1-\eta)c_{\mathsf{D}}$. Since this contradicts Assumption 4.6.1, a separating equilibrium does not exist in this case. After J allows a case to proceed, P prefers to offer $s = h + c_{\mathsf{D}}$ when $Pr(\ell = 1|\rho_\ell; \eta, \phi) > \frac{c_{\mathsf{D}}+c_{\mathsf{P}}}{h+c_{\mathsf{D}}+c_{\mathsf{P}}}$. When this condition is satisfied, D anticipates payoff $v_1 - h - c_{\mathsf{D}}$ from the unlawful action, and expects payoff $v_0 - \eta c_{\mathsf{D}}$ from the lawful action. In a separating equilibrium, D must prefer to take the unlawful action x_1 when he has the opportunity to do so. This is the case when $v_1 - h - c_{\mathsf{D}} > v_0 - \eta c_{\mathsf{D}}$ or equivalently $v > h + (1-\eta)c_{\mathsf{D}}$. Since this contradicts Assumption 4.6.1, a separating equilibrium does not exist in this case.

Semi-pooling Equilibrium In this section, we consider a semi-pooling equilibrium in which D mixes between action x_1 and x_0 when action x_1 is available, and takes the lawful action x_0 when action x_1 is not available.

When $Pr(\ell = 1|\rho_\ell; \eta, \phi) < \bar{\mu}$, J always dismisses a case. Anticipating this, D prefers to choose the unlawful action x_1 when he has the opportunity to do so. Therefore, a semi-pooling equilibrium does not exist in this case.

When $Pr(\ell = 1|\rho_\ell; \eta, \phi) > \bar{\mu}$, J never dismisses a case. We have shown that after J allows a case to proceed, P prefers to offer $s = c_{\mathsf{D}}$ when $Pr(\ell = 1|\rho_\ell; \eta, \phi) \leq \frac{c_{\mathsf{D}}+c_{\mathsf{P}}}{h+c_{\mathsf{D}}+c_{\mathsf{P}}}$. When this condition is satisfied, D anticipates payoff $v_1 - c_{\mathsf{D}}$ from the unlawful action, and expects payoff $v_0 - \eta c_{\mathsf{D}}$ from the lawful action. Assumption 4.6.1 ensures that $v_1 - c_{\mathsf{D}} < v_0 - \eta c_{\mathsf{D}}$, so D prefers to take the lawful action when action x_1 is available. Therefore, a semi-pooling equilibrium does not exist in this case.

After J allows a case to proceed, P prefers to offer $s = h + c_{\mathsf{D}}$ when $Pr(\ell = 1|\rho_\ell; \eta, \phi) > \frac{c_{\mathsf{D}}+c_{\mathsf{P}}}{h+c_{\mathsf{D}}+c_{\mathsf{P}}}$. When this condition is satisfied, D anticipates payoff $v_1 - h - c_{\mathsf{D}}$ from the unlawful action, and expects payoff $v_0 - \eta c_{\mathsf{D}}$ from the lawful action. Assumption 4.6.1 ensures that $v_1 - h - c_{\mathsf{D}} < v_0 - \eta c_{\mathsf{D}}$, so D prefers to take the lawful action when action x_1 is available. Therefore, a semi-pooling equilibrium does not exist in this case.

When $Pr(\ell = 1|\rho_\ell; \eta, \phi) = \bar{\mu}$, J is indifferent between dismissing and trying a case. In this case, D takes the unlawful action with probability ρ_ℓ such that

$$\frac{\phi\rho_\ell}{\phi\rho_\ell + (1-\phi\rho_\ell)\eta} = \bar{\mu} \Leftrightarrow \rho_\ell = \frac{\eta\bar{\mu}}{\phi(1-(1-\eta)\bar{\mu})}. \tag{C.21}$$

ρ_ℓ is between 0 and 1 when

$$\bar{\mu} < \frac{\phi}{\phi + (1-\phi)\eta}. \tag{C.22}$$

Suppose that J dismisses a case with probability ρ_d. We have shown that after J allows a case to proceed to discovery and trial, P prefers to offer $s = c_{\mathsf{D}}$ when

$$Pr(\ell = 1|\rho_\ell; \eta, \phi) \leq \frac{c_{\mathsf{D}} + c_{\mathsf{P}}}{h + c_{\mathsf{D}} + c_{\mathsf{P}}} \Leftrightarrow \bar{\mu} \leq \frac{c_{\mathsf{D}} + c_{\mathsf{P}}}{h + c_{\mathsf{D}} + c_{\mathsf{P}}}. \tag{C.23}$$

In this case, D anticipates payoff $v_1 - (1-\rho_d)c_{\mathsf{D}}$ from the unlawful action, and expects payoff $v_0 - \eta(1-\rho_d)c_{\mathsf{D}}$ from the lawful action. When action x_1 is available, D is willing to mix between action x_1 and x_0 if

$$v_1 - (1-\rho_d)c_{\mathsf{D}} = v_0 - \eta(1-\rho_d)c_{\mathsf{D}} \Leftrightarrow \rho_d = 1 - \frac{v}{(1-\eta)c_{\mathsf{D}}}. \tag{C.24}$$

Assumption 4.6.1 ensures that ρ_d is between 0 and 1.

We have also shown that after J allows a case to proceed to discovery and trial, P prefers to offer $s = h + c_{\mathsf{D}}$ when

$$Pr(\ell = 1|\rho_\ell; \eta, \phi) > \frac{c_{\mathsf{D}} + c_{\mathsf{P}}}{h + c_{\mathsf{D}} + c_{\mathsf{P}}} \Leftrightarrow \bar{\mu} > \frac{c_{\mathsf{D}} + c_{\mathsf{P}}}{h + c_{\mathsf{D}} + c_{\mathsf{P}}}. \tag{C.25}$$

In this case, D anticipates payoff $v_1 - (1-\rho_d)(h + c_{\mathsf{D}})$ from the unlawful action, and expects payoff $v_0 - \eta(1-\rho_d)c_{\mathsf{D}}$ from the lawful action. When action x_1 is available, D mixes between action x_1 and x_0 if

$$v_1 - (1-\rho_d)(h + c_{\mathsf{D}}) = v_0 - \eta(1-\rho_d)c_{\mathsf{D}} \Leftrightarrow \rho_d = 1 - \frac{v}{h + (1-\eta)c_{\mathsf{D}}}. \tag{C.26}$$

Assumption 4.6.1 ensures that ρ_d is between 0 and 1.