NBER WORKING PAPER SERIES

SOCIAL NORMS AND THE ENFORCEMENT OF LAWS

Daron Acemoglu
Matthew O. Jackson

Working Paper 20369
http://www.nber.org/papers/w20369

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
August 2014

We thank Pascual Restrepo for excellent research assistance and comments. We also gratefully acknowledge financial support from the NSF grants SES-0961481 and SES-1155302, and ARO MURI Award No.W911NF-12-1-0509. The views expressed herein are those of the authors and do not necessarily reflect the views of the National Bureau of Economic Research.

Social Norms and the Enforcement of Laws
Daron Acemoglu and Matthew O. Jackson
NBER Working Paper No. 20369
August 2014
JEL No. C72,C73,P16,Z1

ABSTRACT

We examine the interplay between social norms and the enforcement of laws. Agents choose a behavior (e.g., tax evasion, production of low-quality products, corruption, substance abuse, etc.) and then are randomly matched with another agent. An agent's payoff decreases with the mismatch between her behavior and her partner's, as well as average behavior in society. A law is an upper bound (cap) on behavior and a law-breaker, when detected, pays a fine and has her behavior forced down to the level of the law. Law-breaking depends on social norms because detection relies, at least in part, on private cooperation and whistle-blowing. Law-abiding agents have an incentive to whistle-blow because this reduces the mismatch with their partner's behavior as well as the overall negative externality. When laws are in conflict with norms so that many agents are breaking the law, each agent anticipates little whistle-blowing and is more likely to also break the law. Tighter laws (banning more behaviors) have counteracting effects, reducing behavior among law-abiding individuals but inducing more law-breaking. Greater fines for law breaking and better public enforcement reduce the number of law-breakers and behavior among law-abiding agents, but increase levels of law breaking among law-breakers (who effectively choose their behavior targeting other high-behavior law-breakers). Within a dynamic version of the model, we show that laws that are in strong conflict with prevailing social norms may backfire, while gradual tightening of laws can be more effective by changing social norms.

Daron Acemoglu
Department of Economics, E18-269D
MIT
77 Massachusetts Avenue
Cambridge, MA 02139
and CIFAR
and also NBER
daron@mit.edu

Matthew O. Jackson
Department of Economics
Stanford University
Stanford, CA 94305-6072
and CIFAR, and also external faculty of the Santa Fe Institute
jacksonm@stanford.edu

1 Introduction

Laws often go unenforced because they conflict with prevailing social norms. In France, dueling was outlawed by Louis XIII in 1626, and both Louis XIII and Louis XIV attempted to enforce this ban, and went so far as executing officers taking part in duels. Nevertheless, the dueling tradition remained strong for centuries thereafter. For example, Lynn (1997) reports 10,000 of duels among French military officers with over 4000 deaths during the last 30 years of Louis XIV's reign. In the United Kingdom, as in France, dueling also continued to be widely practiced within the aristocracy and the military despite being banned, and several leading British politicians and prime ministers also engaged in dueling at the end of the 18th and early 19th centuries. In the United States, the former Treasury Secretary, Alexander Hamilton, was fatally wounded by the then Vice-President Aaron Burr in a duel, and the future President Andrew Jackson is reported to have taken part in several duels. Even though dueling appears to have declined in northeastern United States after the early 19th century, the tradition remained strong for a long time in the South (e.g., Nisbett and Cohen, 1996, Pinker, 2013). A prime reason why dueling bans were so ineffective, at least for the first several decades of their imposition, appears to be that dueling was part of the (social) norm among the upper classes and soldiers, and the authorities did not directly observe most duels and had to rely on reports from participants, witnesses and bystanders.

Potentially more far-reaching examples of how laws can be ineffective when they conflict with established customs are provided by the many instances in which several British laws and practices failed to be enforced or became badly distorted in the colonies. In many communities, the laws on the books went unenforced both in civil and criminal cases because these laws contradicted prevailing social norms and legal customs (e.g., Barfield, 2010, on Afghanistan, and Parsons, 2010 on India and Kenya). Though lack of enforcement of laws has various causes, in all of these cases, a central economic force appears to have been the fact that people believe that the law would not be obeyed by others, thus undermining the private cooperation necessary for its enforcement.

Other historical examples, however, show that social norms can change in response to laws when these have been designed to work with the prevailing norms and have sufficient resources behind them to change the norms. Perhaps the most famous is the impact of civil rights legislation on norms and practices in the US South, where as recently as the late 1950s, racism, racial stereotypes, discrimination, and racial slurs were highly common (e.g., Woodward, 1955, Wright, 2013). But the enforcement of federal anti-discrimination and anti-racist laws, even if not completely eliminating such behaviors, fundamentally changed the norms, with transformative effects on economic decisions, language, and social relations.[1]

A final example may help motivate our model more closely. Authorities often promulgate laws to discourage tax evasion or production of low-quality, unsafe products by businesses.

[1]Helliwell, Wang and Xu (2014) and Giavazzi, Petkov and Schiantarelli (2014) find that immigrants' views on trust and attitudes toward cooperation and redistribution converge rapidly to the social norms in the country in which they live, suggesting that people adapt to local laws and institutions.

But there are huge differences in the success of such laws across societies. For instance, the IMF estimates that, in 2011, 30% of taxes are evaded in Greece, whereas the same number is 7% in the United Kingdom (IMF, 2013, and HM Revenues and Customs, 2013). This is in part because a large part of economic transactions in Greece take place in the shadow economy (29.5% of GDP in Greece between 1996 and 2006, compared to 12.9% in the United Kingdom, see Schneider, Buehn and Montenegro, 2010). Many commentators relate this to differences in social norms across countries.[2] Part of the reason for the ineffectiveness of laws against tax evasion and regulations against low-quality products is that authorities lack the resources to audit more than a trivial fraction of businesses to enforce these laws. They, instead, rely on whistle-blowing by private citizens and other businesses. Suppose, for example, that after a choice related to the quality of products (or tax evasion), each producer matches with another producer to form a business partnership. Business partners observe each other's behavior and can whistle-blow on behavior outside of the law. Low-quality, unreliable products (or tax evasion) create negative externalities on the rest of society, and in addition, a mismatch between two producers in terms of product quality or how much of their business is illicit creates a cost for each (each will have to adjust to the different behavior of their partner, which tends to be costly). This personal mismatch cost, in addition to general civic duty, creates an incentive for some businesses and individuals to whistle-blow on law-breakers (as it will force law-breakers to bring their behavior in line with the law, reducing the mismatch against a law-abiding agent). But if potential whistle-blowers themselves are law-breakers, such whistle-blowing will not be forthcoming. A society in which laws (of any kind) conflict with social norms will thus have a harder time relying on private enforcement, and thus will tend to have less effective laws.

This paper is a first attempt to formally model the interaction between social norms and the enforcement of laws. We introduce a simple formalization of the idea that most laws cannot just rely on policing or other forms of public enforcement, but need to leverage private enforcement, that is, "whistle-blowing" from private citizens. But when laws are in conflict with prevailing norms, there will be much less whistle-blowing. This will encourage further law-breaking, and as laws are broken by more people, whistle-blowing becomes even less likely, making law-breaking snowball.

We first develop a simple static model that encapsulates these ideas in the simplest possible fashion. Agents choose a behavior and then are matched uniformly at random with another agent. Utility depends negatively on the average behavior of other agents and on the mismatch between the behaviors of the two partners. A (simple) law bans behaviors above a certain threshold, denoted by L in the paper, and a law-breaker, when detected, pays a fine and has her behavior forced down to L. Law-abiding agents have an incentive to whistle-blow because this will reduce their partner's behavior, curtailing the negative externality and ameliorating the mismatch. When others break the law, each agent

[2] The New Yorker, for example, writes: "The reason tax reform will be such a tall order for Greece, in sum, is that it requires more than a policy shift; it requires a cultural shift." (2011).

has further incentives to do so as well, because there will be less whistle-blowing. This introduces the first major interaction between social norms and laws, and potentially leads to multiple equilibria. Despite the potential multiplicity of equilibria, the model is tractable and enables a tight characterization of all equilibria in terms of a threshold for law-breaking, and a range of comparative statics of the lowest compliance equilibrium. For example, tighter laws (banning more behaviors) lead to greater law-breaking and lower behavior among law-abiding agents, while greater fines for law-breaking reduce law-breaking but interestingly, increase behavior among law-breakers (because the composition of law-breakers changes towards higher types, and since each law-breaker chooses their behavior with the hope of matching other law-breakers, this changing composition induces each law-breaker to choose a higher behavior).

Though we start with a static model to illustrate the workings of the model, some of the results related to our motivation above come from our dynamic model, in which each individual matches with agents from both previous and future generations. Now prevailing norms are given by the distribution of behavior in the previous generation (as in Acemoglu and Jackson, 2013). After establishing that steady-state equilibria of this dynamic model are identical to the equilibria in our static setup, we study the interaction between social norms and laws. Echoing some of our discussion above, we show that laws that are in strong conflict with existing norms backfire: abrupt tightening of laws causes significant lawlessness, while gradual imposition of laws that are more in accord with prevailing norms can successfully change behavior and thus future norms.[3] The dynamic model also generates "social multipliers" in law-breaking (as emphasized in, inter alia, Glaeser, Sacerdote and Scheinkman, 1996): once there is high law-breaking, then next period there will be less private corporation with law enforcement, increasing law-breaking further.

We also show how different types of laws interact when law-breakers in one type of behavior are discouraged from whistle-blowing on another type of behavior. This interaction leads to less law-breaking in one behavior when there is a loose law (as opposed to no law) in the other behavior because law-abiding gives an option to the agent to whistle-blow on her partner in the other behavior if her partner's action is very high. However, our analysis also shows that badly-designed — excessively tight — laws for one type of behavior (e.g., small-scale drug crime in inner cities) can make laws against other types of behaviors completely ineffective (e.g., laws against larceny or gangs). This extension thus provides a potentially new perspective on the debate on the broken windows theory of Kelling and Wilson (1982), which claimed that the high incidence of serious crime in inner cities was a result of permissive attitudes towards small-scale crimes such as vandalism, graffiti, fare-dodging on the subway, or certain types of anti-social behavior. This theory calls for much stricter enforcement of laws against small-scale crimes, and was the inspiration of the tough policing strategies used in high-crime cities such as New York. Our theory suggests that pervasive law-breaking on

[3] Using the French Revolution as an example, Acemoglu, Cantoni, Johnson and Robinson (2012) point to potential effectiveness of radical institutional change related to breaking the existing political equilibrium. The advantage of gradual changes in laws here abstracts from this political channel.

such things as drugs or small-scale vandalism can indeed spill into law-breaking in other dimensions. Yet crucially, it sees the faultline not in the fact that there is such behavior in inner cities, but in the presence of laws that criminalize a large fraction of society in these areas. It would be much more effective, according to our theory, to decriminalize such behaviors, so that a large fraction of individuals do not automatically become law-breakers and can have greater willingness to cooperate with law enforcement in other dimensions of behavior of greater import to society.

Our theory also suggests why laws relying on private enforcement (whistle-blowing) can be more effective in some activities than others depending on the degree of "assortative matching". When law-breakers are more likely to match with law-breakers (which is typically the case in activities such as dueling, smuggling, or racketeering), the power of private enforcement is more limited than in other activities (such as tax evasion or investment in the safety and reliability of products), where businesses breaking the law are more likely to match with law-abiding businesses.

Our paper relates to a number of distinct literatures. First, there is a large law and economics literature focusing on the design of rules, punishments and monitoring structures in order to discourage certain types of behavior. This literature pioneered by Becker (1968) and Becker and Stigler (1974), and surveyed for example in Shavell (2004), typically does not investigate how private attitudes affect enforcement.

Our paper is more closely related to a small literature on the interactions between social norms and laws.[4] One branch of this literature (e.g., Acemoglu, 1995, Calvo-Armengol and Zenou, 2004, Ferer, 2008, Glaesar, Sacerdote and Scheinkman, 1996, Rasmusen, 1996, Sah, 1991, Aldashev et al., 2012) shows how law-breaking, corruption and rent-seeking type activities become profitable when others engage in such behavior, potentially leading to multiple equilibria. Another branch shows how certain social norms can emerge even without formal legal institutions (e.g., Ellickson, 1991, Bernstein, 1992, Pistor, 1996).

A more recent third branch is even more closely related to our work, and investigates the interactions between laws and social norms. Benabou and Tirole (2011) develop a model in which norms encourage certain types of behavior because of agents' desire to signal their intrinsic types to others or to themselves, and laws in this context both interact with this signaling role of norms and may themselves signal the society's attitudes to individuals (see also Posner, 1997, Cooter, 1998, and Posner, 2002, for related perspectives). Hay, Shleifer and Vishny (1996) and Hay and Shleifer (1998) mention — among several other factors — the importance of achieving congruence between prevailing social norms and laws, especially

[4] There is also a vast literature on social norms and culture, with roots in the writings of Simmel (1903, 1908), Sorokin (1947), Morris (1956), Williams (1960), Bierstedt (1963), and Gibbs (1965) and a substantial literature in social psychology on law-abiding behavior, for example discussed in Tyler (1990). The different approaches to social norms within economics are discussed in Mailath and Samuelson (2006). But these literatures inside or outside economics do not focus on the interplay between norms and the enforcement of laws.

in the context of the transition from socialism to a market economy.[5] Akerlof and Yellen (1994) anticipate the same point in their analysis of criminal behavior, and write "the major deterrent to crime is not an active police presence but rather presence of knowledgeable civilians, prepared to report crimes and cooperate in police investigations." Berkowitz, Pistor and Richard (2003) also touch on these issues in their discussion of how transplantation of common law legal systems may not work in the context of certain prevailing customs. Nevertheless, none of these papers, and no others that we are aware of, consider the two-way interactions between social norms and the enforcement of laws, which is our main focus here.

Finally, our work is also related to several recent works modeling the evolution of culture, social norms and cooperation, such as Acemoglu and Jackson (2013), Bisin and Verdier (2001), Doepke and Zilibotti (2008), Galor (2011), Tabellini (2008), and Voth and Voigtlander (2012). In Tabellini, for example, moral values affect whether there is cooperation in a prisoner's dilemma type game, and parents decisions concerning which types of values to inculcate in their children, along the lines of Bisin and Verdier's (2001) approach, is affected by the prevailing set of values in other agents in society.

The rest of the paper is organized as follows. The next section introduces our baseline static model. Section 3 presents the analysis of the static model and contains our main results. We extend this baseline model to a dynamic setup in Section 4, and discuss the interplay between historically-determined norms and laws and how laws in conflict with norms may backfire. Section 5 contains several extensions, including the one concerning the interplay between laws regulating different types of behavior. Section 6 briefly discusses welfare properties of the simple laws we focus on in this paper, while Section 7 concludes. All of the proofs are contained in the Appendix.

2 The Static Model

We first present our baseline static model, which introduces the main economic forces.

2.1 Agents, Matching, Laws and Payoffs

There is a finite population of agents, $N = \{1, \ldots, n\}$, with $n \geq 2$ taken to be even. In the baseline model, we consider a simple (uniformly random) pairwise matching of the agents represented by a matching function $m : N \to N$. Throughout, $m(i)$ denotes the match partner of agent i, with $m(i) \neq i$ (and with the usual convention that $m(m(i)) = i$).

Agent i has type $\theta_i \in [0, 1]$, distributed according to a cumulative distribution function F. Type draws are i.i.d. across agents, and for simplicity, we assume that F is strictly

[5] For example, the latter paper writes, "A further reason that private parties in Russia refuse to use the legal system is that they operate to some extent extralegally to begin with and, hence, do not want to expose themselves to the government" (p. 399) and conclude by stating "whenever possible, laws must agree with the prevailing practice or custom. If public laws violate the practice, then private parties may refuse to enforce them either on their own or with ultimate referenced courts." (p. 402).

increasing and continuous on $[0, 1]$ with $F(0) = 0$ and $F(1) = 1$.

In the baseline model, we focus on a single dimensional behavior. In particular, agent i chooses a base behavior $b_i \in [0, 1]$ before the matching stage (thus agent i does not know $m(i)$ when choosing b_i). We refer to b_i as the *base behavior* because the agent's *actual behavior* may be forced away from this level ex post to some B_i because of the enforcement of a law.

We model laws in a simple way. A law, $L \in [0, 1]$, is set by the government and is an *upper bound* on the behaviors of agents. This means that any behavior above L is prohibited.[6] However, the government only has limited ability to enforce laws without private cooperation (because it does not always observe individual behaviors). In particular, we assume that the government observes behavior in any pair with probability $\eta \in [0, 1)$, and in this case, the behavior of any law-breaking party in the relationship will be pushed down to L. In addition, when there is no law enforcement (with probability $1 - \eta$), an agent can whistle-blow to the government that her partner's behavior is above the law L. Agent i can only do so if her partner indeed has behavior exceeding L; i.e., if $b_{m(i)} > L$. We also assume that the agent herself must be law-abiding to be able to whistle-below; i.e., $b_i \leq L$.[7] We denote the whistle-blowing decision of agent i by $w_i \in \{0, 1\}$, with 1 indicating whistle-blowing.

If $b_i > L$ and $w_{m(i)} = 1$, meaning that agent i is breaking the law and her match whistle-blows (which, as just stated, presumes that $b_{m(i)} \leq L$), then her behavior is adjusted down to the highest level consistent with the law, L, and she ends up paying a fine $\phi > 0$.[8]

Thus, the resulting action of agent i can be written as

$$B_i\left(w_{m(i)}, b_i\right) = \begin{cases} L & \text{if } b_i > L, \text{ and } w_{m(i)} = 1 \text{ or if there is public enforcement (probability } \eta) \\ b_i & \text{otherwise.} \end{cases}$$

With this notation, agent i's payoff is given by

$$u_i(\theta_i, B_i) = -a\left(B_i - \theta_i\right)^2 - (1-a)\left(B_i - B_{m(i)}\right)^2 - \zeta \overline{B}_i - \left(\eta + (1-\eta)\, w_{m(i)} \mathbf{I}_{\{b_i > L\}}\right)\phi, \quad (1)$$

where

$$\overline{B}_{-i} \equiv \frac{\sum_{j \neq i} B_j}{n-1}$$

is the average behavior of agents other than i. The parameter $\zeta \geq 0$ captures negative externalities of the behaviors across the population. The parameter $a \in (0, 1)$ is an (inverse) measure of "social sensitivity," and regulates the relative importance of own preference versus matching the prevailing "norm," which in the static model simply corresponds to "expected

[6] That laws only prohibit high behaviors is for simplicity. One could also allow for laws that ban both high and low behaviors, such as speed limits on highways.

[7] This is easy to motivate (in the presence of nontrivial fines), as when the authorities come to enforce the behavior within the partnership they could observe the behavior of both agents and thus the whistle-blowing agent could face punishment if not abiding by the law. We relax the assumption that law-breakers cannot whistle-blow and also discuss the issue of amnesty for whistle-blowers in Section 5.4.

[8] Fines can be interpreted as deadweight losses or transfers. If fines are transferred back to the population, then there will be an additional term in the utility function. These would create an additional incentive to whistle-below (similar to the externality term), without any substantive implications for our analysis.

behavior" of other agents in the economy that each player would partially like to match.[9] The last term subtracts the fine imposed on law-breakers conditional on public enforcement (probability η) or when there is no public enforcement (probability $1-\eta$) but there is private whistle-blowing.

Because high behaviors have negative externalities on the population, there is a reason for the government to discourage such behaviors, and laws acting as upper bounds on behavior are the government policy on which we focus. Equation (1) also clarifies the two reasons why an agent may whistle-blow on the high behavior of her partner: first, she reduces the negative externality she (and everybody else) suffers (from the term $\zeta \overline{B}_{-i}$); and second, she may be able to reduce the mismatch between her behavior and her partner's (from the term $(1-a)\left(B_i - B_{m(i)}\right)^2$).[10]

2.2 Motivating Examples

It is useful to have some running examples to fix ideas. One simple application illustrating some of the main trade-offs is that of a business partnership.

Suppose that each of the partners can choose a level of compliance with a tax, for instance a value-added tax. The nature of the business affects the ease of tax evasion (e.g., how much of the business is based on cash), which can be thought of as the agent's type. Evading taxes is easier if the companies involved in a transaction are evading at equal levels, since it is more difficult to disguise transactions to the extent that the reports of the partners regarding the transaction differ. Thus, there is an improvement in payoffs by matching a partner's level of tax evasion. Because tax authorities cannot police all balance sheets, whistle-blowing plays a critical role in the detection and prevention of tax evasion. Each agent's tax evasion leads to negative externalities on other agents, through lost tax receipts.

As a related example, suppose that each agent decides how much effort to exert to produce a high-quality, safe and reliable product, and then matches with another agent. The matched partners then combine their products to produce a consumer good, the quality of which will be a combination of the qualities of the two products. Low-quality, unreliable products create a negative impact on the utility of the population, but are potentially profitable for the producer because producing them is less costly and some fraction of customers do not observe the quality of the consumer good they purchase.

In this example as well, there are natural reasons for why each agent would like their behavior (quality of product) to match that of their partner. In particular, those with high-quality products would not like to see the quality of the consumer good they produce being brought down by the low-quality product of their partner. Conversely an agent with

[9]This is in line with some of the common definitions of norms and sociology, for example, "A norm, then, is a rule or a standard that governs our conduct in the social situations in which we participate. It's a societal expectation." (Bierstedt, 1963, p. 222).

[10]If fines are transfers, there would also be a third reason, as whistle-blowing will generate revenues from fines, which as noted above, could be redistributed to the agents.

a low-quality product will suffer additional costs because of the incompatibility between its product and the high-quality product of their partner.[11]

Though the government would like to regulate product quality, it has an imperfect ability to do so because it does not always directly observe qualities. It can legislate a minimum quality standard on each product, and then enforce it through random inspections and whistle-blowing behavior of business partners. If an agent is detected to have a low-quality or unsafe product, they will be subject to a fine and will also have to take costly action to bring their product into compliance with the law. The business context also motivates our assumption that whistle-blowers who are law-breakers will themselves be detected. For example, if a law-breaking firm whistle-blows on their partner's low-quality product or tax evasion, the subsequent investigation will likely reveal their own transgressions.

Both examples further clarify the meaning of "norms" in our model. The simplest interpretation is that norms here are "external norms" corresponding to expected behavior with important payoff consequences, i.e., whether an agent expects their partner to have a low-quality or high-quality product. In the dynamic version of the model we study below, instead of this expectation, external norms correspond to the *historical* distribution of behavior (quality of products).[12]

It is straightforward to see that many other types of behaviors also fit the model, for example, dueling, tax compliance, consumption of illegal substances, disruptive behavior, corruption, and so on. In all of these cases, behaviors are not typically observable directly by the government but are more commonly observed by some other agents (roommates, business partners, employees, etc.), and agents care about the behavior of those they are closely associated (match) with.

2.3 Equilibrium

The game we have set up consists of two stages: in the first, each agent chooses a behavior conditional on their type, and then in the second stage, they decide whether to whistle-blow on their partner.

It is straightforward to observe that, in our baseline model it is a strictly dominant strategy for an agent with $b_i \leq L$ and $b_{m(i)} > L$ to whistle-blow (because this reduces both the externality and the mismatch with the partner's behavior). As a consequence, in this

[11] Though producers might also have an incentive to whistle-blow on competitors, this will be limited by the fact that they will not have closely observed the behavior of their competitors and whistle-blowing is only possible given hard information.

[12] In addition to external norms, our model could also be used to study the interplay between laws and "internal norms" (that is, norms that individuals adhere to for moral reasons, e.g., Hoffman, 1977, or Tyler, 1990). In this case, individuals would whistle-blow because the behavior of their partners or of others that they observe are in dissonance with their moral values and expectations. For example, one could assume that internal norms adapt to an individual's own behavior and some function of average behavior in society, and if an individual sees a behavior very far from their internal norms, they feel compelled to try to prevent it.

multi-stage complete information game, any sequential equilibrium will have whistle-blowing as part of the equilibrium whenever the opportunity arises. Given this observation, we define an equilibrium for the first stage only, using the standard notion of a pure-strategy symmetric Bayesian equilibrium. Such an equilibrium is given by $\beta : [0,1] \to [0,1]$, with $\beta(\theta_i)$ indicating the action taken by type θ_i.[13]

In what follows, whenever we refer to *equilibrium*, it is to such a pure-strategy symmetric Bayesian equilibrium of the induced one-stage game.

3 Analysis of the Static Model

In this section, we characterize the equilibria of the static model presented in the previous section, and present our main comparative static results.

3.1 Existence of Equilibrium

Strategies are said to be *monotone* if $\beta(\theta_i) \geq \beta(\theta_i')$ whenever $\theta_i > \theta_i'$. Our first result shows that all equilibria are in monotone strategies. An implication of monotone strategies is that, in any equilibrium, there will exist some threshold type θ^* such that all types below θ^* are law-abiding, and all types above θ^* are law-breaking (and this threshold can be one or zero, corresponding, respectively, with all agents being law-abiding and law-breaking).

Proposition 1 *An equilibrium exists, and all equilibria are in monotone strategies and are characterized by a threshold θ^* above which all types break the law and below which they obey the law.*

Like all of other propositions, the proposition's proof is given in the Appendix. There, Lemma 1 establishes the monotonicity of strategies, and existence follows straightforwardly given the threshold characterization in Proposition 4 below.

It is important to note that ours is not a game of strategic complementarities because a higher behavior of an agent's (potential) partner can encourage her to obey the law in order to be able to whistle blow.

3.2 Equilibrium without Laws

We next characterize the equilibria without laws, or equivalently the case where $L = 1$ (so that laws are not binding). In this benchmark case, there is a unique equilibrium given in the next proposition.

[13] We take strategies to be measurable functions of type. Since F is continuous (and thus does not have any atoms) and agents are only indifferent at one type, there will be no non-trivial mixing, so the focus on pure-strategy equilibria is essentially without loss of any generality. The possibility for asymmetric equilibria (and hence the qualifier "symmetric") is a consequence of having a finite number of agents. With a continuum, all equilibria are in symmetric strategies.

Proposition 2 *Without any law ($L = 1$), there is a unique equilibrium and it is linear in own type and described by*

$$\beta(\theta_i) = a\theta_i + (1-a)\mathbb{E}[\theta].$$

Equilibrium strategies are depicted in Figure 1 as a function of own type, θ_i. Linearity here is a simple consequence of the fact that, without laws, payoffs are quadratic.

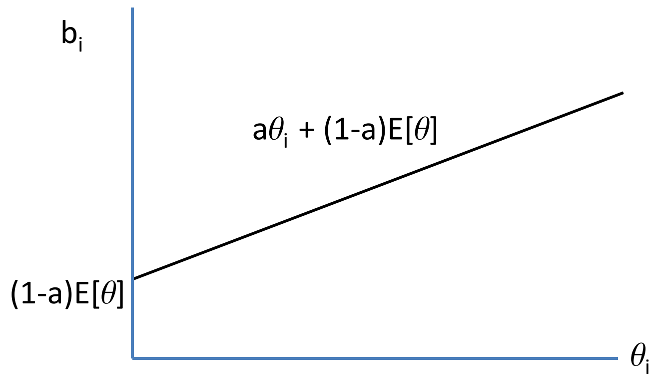


Figure 1: Equilibrium without laws.

A feature which is paralleled by equilibria with laws is that the parameter a, regulating the "social sensitivity" of payoffs, determines the slope of equilibrium strategies. The distribution of types F only affects the form of the equilibrium via the threshold value of θ between law-abiding and law-breaking (which is not relevant here), and via $\mathbb{E}[\theta]$ (and thus the intercept in Figure 1). This implies that agents always choose a convex combination, with weights a and $1 - a$, between their preferred action given by their type, θ_i, and "expected behavior" (or "norm") in society, given by $\mathbb{E}[\theta]$.

3.3 Equilibrium with Laws

With this benchmark in place, for the remainder of the paper we focus on the case in which laws are binding, i.e., $L < 1$. The next two propositions characterize the equilibria in this case, showing that, compared to the case without laws, there is a crucial choice between law-abiding and law-breaking behavior, and the impact of laws on the behavior of others will also change the expected behavior that enters into the calculations of law-abiding and law-breaking agents.

Proposition 3 *For any $L \in (0, 1)$, there exists $\overline{\phi} \geq 0$, such that*

- *if $\phi > \overline{\phi}$, then there is a unique equilibrium, which involves full compliance (all types obey the law);*

- *if $\phi < \overline{\phi}$, then there are multiple equilibria: one with full compliance and (at least two) other equilibria ordered by the threshold above which all types break the law.*

When the fine against law-breakers that are detected is sufficiently large, i.e., $\phi > \overline{\phi}$, the unique equilibrium involves law-abiding behavior (full compliance) by all agents. The intuition for this case is instructive. For any $L > 0$, there will be some agents who always obey the law (because their type, θ, is sufficiently low). This translates into a positive probability of paying the fine ϕ for any law-breaking agent (even if the direct government detection of law breaking is 0), discouraging law-breaking for very large fines. Even when $\phi < \overline{\phi}$, the full compliance equilibrium continues to exist. In this case, even though the fine is not large enough to discourage law-breaking with only a small fraction of agents obeying the law and whistle-blowing, when all agents are law-abiding a law-breaker will be reprimanded with probability 1 (either due to public enforcement or whistle-blowing by her partner), and will also be induced to choose a behavior less than L. Nevertheless, when $\phi < \overline{\phi}$, there are also equilibria in which a non-trivial fraction of the population breaks the law.[14]

It is useful to note that the multiplicity of equilibria highlighted in this proposition has a different economic intuition than the multiplicities already emphasized in the literature (e.g., congestion effects in policing or the legal system, or peer effects). In particular, it is a consequence of the fact that when others are breaking the law, there will be little private cooperation with law enforcement, encouraging yet others to do likewise.

Although the equilibrium threshold for law-breaking and the fraction of law-breakers may not be unique, the next proposition shows that the form of the equilibrium is the same in all equilibria.

Proposition 4 *All equilibria are of the following form. There exists $\theta^* \in [L, 1]$ such that*

$$\beta(\theta_i) = \beta_{abiding}(\theta_i) \equiv \min[a\theta_i + (1-a)x, L] \quad \text{if} \quad \theta_i < \theta^* \tag{2}$$

and

$$\beta(\theta_i) = \beta_{breaking}(\theta_i) \equiv a\theta_i + (1-a)\mathbb{E}[\theta|\theta > \theta^*] \quad \text{if} \quad \theta_i > \theta^*, \tag{3}$$

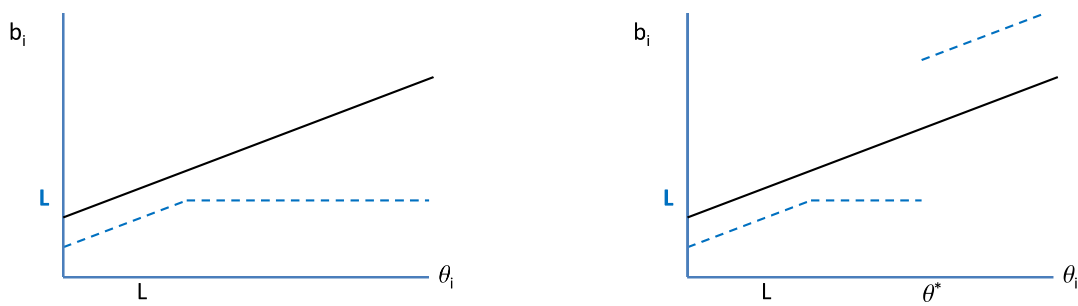
where x is the unique solution to $x = \mathbb{E}[\min \beta(\theta), L]$.

The general form of equilibria is depicted in Figure 2. The form of the strategies $\beta_{\text{abiding}}(\theta_i)$ and $\beta_{\text{breaking}}(\theta_i)$ is intuitive. Recall that without laws (cfr. Proposition 2), an agent chose a convex combination of her preferred behavior given by her type, θ_i, and expected behavior in society. For law-abiding agents, the calculus is still similar, except that as shown by the expression, $a\theta_i + (1-a)x$, the expected behavior is replaced by x.[15] This

[14]Note, however, that $\overline{\phi}$ can be equal to zero, in which case such equilibria will not exist. A trivial example is when L is arbitrarily close to 1.

[15]Note that x is implicitly defined as a fixed point of an increasing mapping, since $\beta(\theta)$ is itself an increasing function of x. This implies that x may not be unique. However, we show in the Appendix that is defined uniquely.

is the expectation of the actual behavior of other agents (rather than their base behavior, b_i) and thus takes into account that the agent herself can whistle-blow (or there is public enforcement) on any partner who chooses the behavior above L and force them down to L. By definition of these agents being law-abiding, their behavior is equal to $a\theta_i + (1-a)x$ only if this expression is below L (and otherwise their behavior is capped at L).



(a) Law fully obeyed

(b) Law partially obeyed

Figure 2: Multiple Equilibria: The black line is the equilibrium without any law. The blue dashed lines indicate equilibrium behavior. These are the two extreme equilibria. In (a) everyone obeys, and in (b) it is those below θ^* who obey, where θ^* is the lowest compliance equilibrium threshold. Equilibria can be ordered in terms of θ^*.

The calculation of law-breaking agents is different. These agents know that their partner, if she is law-abiding, will whistle-blow on them, setting their behavior down to L. Thus, when choosing their behavior, these agents only reason *conditionally* — conditional on matching with another law-breaking agent and not being subject to public enforcement. As a result, their behavior is a convex combination of their own type, θ_i, and the expected behavior of their partners conditional on their partner being law-breaking, which is $\mathbb{E}[\theta|\theta > \theta^*]$. Note that the parameter η does not explicitly enter equations (2) and (3). This is because, as just explained, law-abiding agents can always whistle-blow on a law-breaking partner, while law-breaking agents are reasoning conditionally. The law-breaking threshold θ^* naturally depends on the probability of public enforcement, η.

Equilibria in Proposition 4 are conditional on the law-breaking threshold θ^*. It is also straightforward to derive an expression for this threshold, which balances out the costs and benefits of law-breaking for the threshold agent at θ^*, and this is given by equation (A10) in the Appendix.

Although Proposition 3 highlights that there are multiple equilibria (in the case where $\phi > \overline{\phi}$), Proposition 4 shows that all equilibria are characterized by a law-breaking threshold θ^* (which may be equal to one, in which case all obey the law). Equations (2) and (3) also indicate that different equilibria are ranked in terms of their threshold for law-breaking, θ^*. If we consider two equilibria with different levels of θ^* (for given levels of L and ϕ), then in the one with lower θ^*, the behavior of all law-abiding citizens will be the same (because x does not change); there will be more law-breaking (more agents above θ^*); but law-breakers will choose lower behaviors (because $\mathbb{E}[\theta|\theta > \theta^*]$ is lower). In what follows, we often focus on the *lowest compliance equilibrium*, meaning the equilibrium with the lowest θ^* and thus the highest amount of law-breaking.[16]

3.4 Comparative Statics

We now provide some simple comparative statics for the lowest compliance equilibrium.

PROPOSITION **5** *Consider the lowest compliance equilibrium. Then:*

1. *A small increase in ϕ (higher fine), ζ (greater externality), and/or η (higher likelihood of public enforcement):*[17]

    - *increases θ^* and so lowers the fraction of agents breaking the law;*
    - *leaves behavior by each agent who was obeying the law unchanged;*
    - *but leads to higher behavior among those still breaking the law.*

2. *A large increase in ϕ, ζ, and/or η shifts the equilibrium to full compliance and reduces overall average behavior.*

3. *There exists $\overline{\zeta} > 0$ such that if $\zeta < \overline{\zeta}$, a small decrease in L (a stricter law):*

    - *decreases θ^*, increasing the fraction of agents breaking the law;*
    - *leads to lower behavior by each agent who was already breaking the law; and*
    - *leads to lower average behavior by those obeying the law.*

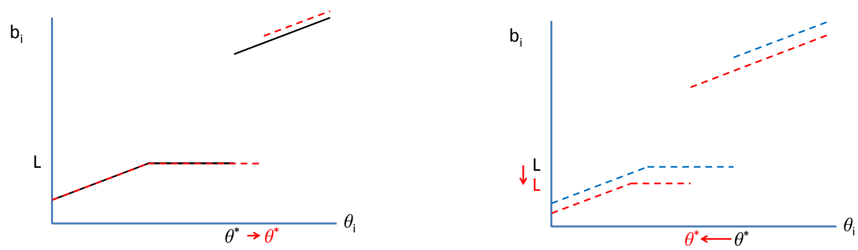
4. *If $\zeta > \overline{\zeta}$, then the comparative statics of a stricter law are reversed.*

[16] One might also study the stability of equilibria under best-response dynamics to investigate which equilibria are more likely to be robust to small perturbations. Under some regularity conditions, both the full compliance equilibrium and the lowest compliance equilibrium are stable under this notion of stability.

[17] A small increase is defined to be such that, after this change, the lowest compliance equilibrium has a law-breaking threshold in a small neighborhood of θ^* (the law-breaking threshold before the change). In particular, suppose that there exists a neighborhood $\mathcal{N}$ of the parameter vector $(L, a, \phi, \eta, \zeta)$ and a continuous function $\Theta^* : \mathcal{N} \to [0, 1]$ such that $\theta^* = \Theta^*(L, a, \phi, \eta, \zeta)$ and there is an equilibrium with law-breaking threshold $\Theta^*(L', a', \phi', \eta', \zeta')$ for all $(L', a', \phi', \eta', \zeta') \in \mathcal{N}$. Then there always exists small changes in ϕ, η and ζ (within $\mathcal{N}$) that still lead to an equilibrium nearby, and the statements here refer to comparisons to this nearby equilibrium. This requirement holds generically and simply rules out situations in which the lowest compliance equilibrium is defined by a point of tangency rather than the intersection of the two curves defined in the proof of Proposition 4. When this requirement is not satisfied, any change in parameters is a "large" change in terms of this proposition.

The proposition focusses on the lowest compliance equilibrium, but the same comparative statics apply to all equilibria that are stable under best-response dynamics as discussed in footnote 16.

Several aspects of this proposition are worth stressing. First, higher fines, greater public enforcement and tighter (more restrictive) laws all have unambiguous effects on the fraction of law-breakers, as depicted in Figure 3, but more nuanced impacts on levels of behavior.



(a) An increase in fine, ϕ; externality, ζ; or public enforcement, η.

(b) A decrease in the (tightening of the) law L

Figure 3: Comparative Statics

In particular, starting from $\phi < \overline{\phi}$, a small increase in ϕ (which keeps us in the same region) reduces the fraction of law-breakers because the penalty is now higher. The impact of this increase in fines on behavior is more subtle, highlighting the rich interactions between laws and behavior in our model. A higher ϕ has no impact on β_{abiding} (x is independent of both ϕ and θ^* as noted above), but increases θ^* and thus $\mathbb{E}[\theta|\theta > \theta^*]$. This implies that the function β_{breaking} shifts up, highlighting that even though all strategies are monotone, the impact on the behavior of law-breakers is non-monotone. Intuitively, some law-breakers switch to law-abiding behavior in response to the higher fine, and the remaining law-breakers now expect to match with a relatively higher θ (with consequently higher behavior) and so they adjust their behavior upward. So, fewer agents break the law, but do so by a greater amount (i.e., law-breakers increase their behavior). This leads to an ambiguous average effect that depends on the specifics of the distribution (as illustrated in Figure 4 below for the case of changes in L).

A large increase in ϕ, on the other hand, takes us above the threshold $\overline{\phi}$ thus destroying all equilibria except the full compliance equilibrium (and thus avoiding the somewhat paradoxical effect of encouraging high behavior among law-breakers).

Greater public enforcement (higher η) has the same effects as a greater fine for law-breaking, increasing the law-breaking threshold and also increasing behavior among law-breakers. A greater externality in behavior (higher ζ) also acts similarly to a greater fine, although for different reasons: it induces people to obey the law so that they can whistle-blow on others.

A stricter law acts quite differently from increasing fines or public enforcement. Let us first focus on the case where the externality is small, i.e., $\zeta < \bar{\zeta}$. In this case, a stricter law increases the fraction of law-breakers, because obeying the law is now more onerous (requires lower behavior). However, now in addition to having more law-breakers (with lower average law-breaking behavior), a tighter law also reduces the behavior of each law-abiding agent (because L is lower), and switches the highest types — who were choosing the highest behavior among the law-abiding agents — to law-breaking, thus reducing average behavior among law-abiding agents through both channels.

Nevertheless, because those switching from law-abiding to law-breaking increase their behavior, the impact on overall average behavior is again ambiguous. The effect of a tighter law on average behavior is shown in Figure 4. In particular, this figure illustrates that, compared to no law, a very permissive law — which is associated with a unique full compliance equilibrium — necessarily reduces average behavior. But a further tightening of the law may eventually lead to a discontinuous jump in average behavior at the point where full compliance ceases to be the unique equilibrium and there emerges a low compliance equilibrium with a positive fraction of agents breaking the law. Yet further tightening of the law reduces average behavior in the lowest compliance equilibrium, but this effect is again reversed eventually, when the increase in law-breaking starts to overwhelm the reduction in behavior among law-abiding and law-breaking agents. These results highlight the possibility that excessively tight laws may achieve the opposite of their objectives: increasing, rather than reducing, average behavior in society. We further discuss the potential paradoxical effects of strict laws in the context of our analysis of dynamic settings and settings with multiple types of beh

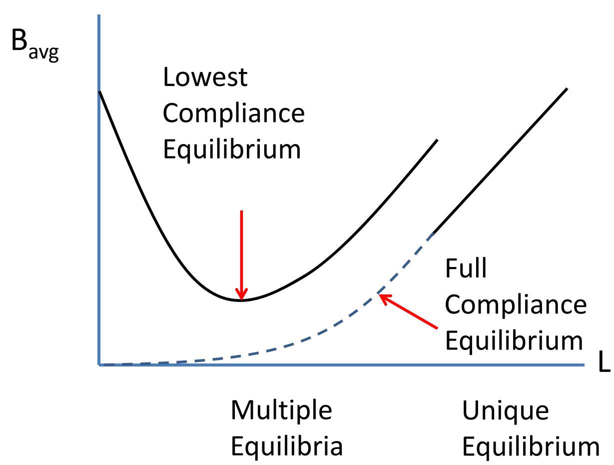


Figure 4: Average behavior as a function of the law. Average behavior decreases in the full compliance equilibrium, but may increase or decrease in the lowest compliance equilibrium.

Also worth noting is that the impact of a change in law reverses for high enough externalities ζ (i.e., when $\zeta > \bar{\zeta}$). This reversal is a consequence of the fact that when the externality is large, the desire to whistle-blow on other agents and reduce the externality they create overwhelms the other effects, and so agents prefer to obey the law in order to be able to whistle-blow and reduce the behavior of others. In large societies the externality for any particular individual becomes small, and this effect becomes unimportant (and we are always in the $\zeta < \overline{\zeta}$ region).[18]

We finally note that the impact of a change in the parameter a, which regulates the social sensitivity of behavior, is more subtle because this parameter affects both the slope of the equilibrium and the

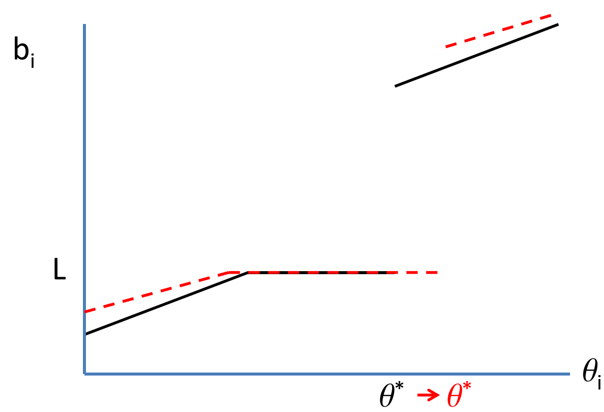


Figure 5: Increasing the sensitivity to the partner's action (a decrease in a)

4 Dynamics

The static model transparently exposits how laws and expected behavior of other agents influence behavior. Though the expected behavior of other agents acts as a "norm," anchoring the behavior of each individual in society, the static setup does not permit an analysis of how past "norms" (patterns of behavior) influence the evolution of future behavior. In this section, we consider a dynamic generalization of the static model, which enables us to demonstrate how laws that are in conflict with prevailing norms can backfire, while more moderate laws can be successful in changing behavior and norms in society.

4.1 Dynamic Model

Our dynamic model is a straightforward generalization of our static setup. We consider an overlapping generations model, with each generation consisting of n agents. An agent i of generation t, denoted (i, t), when born, chooses a base behavior $b_{(i,t)}$, and then matches with

[18] In particular, $\overline{\zeta}$ increases with n, and becomes arbitrarily large when n tends to infinity.

an agent of the previous generation, $t-1$, and an agent of the next generation, $t+1$.[19] We denote the matching partner of agent (i,t) at time t (from generation $t-1$) by $m_t(i,t)$ and at time $t+1$ (from generation $t+1$) by $m_{t+1}(i,t)$.

We assume that the base behavior of each agent is "sticky," in particular meaning that it is chosen only once by each agent.[20] For instance, using one of our our motivating examples, each agent decides how much investment to make in a high-quality product at the beginning of their business life.

The rest of the setup closely follows our static model (and in fact is chosen to maximize this parallel). In particular, there is a law L_t that governs the play in period t. To begin with, we assume that the sequence of laws is known to all agents, but we also consider an unanticipated change in the sequence of laws below. Each agent can whistle-blow against either/both her partner from the previous and the next generation, and we assume that an agent who is caught breaking the law (either because of whistle-blowing or public enforcement) is only forced to change her behavior in the specific interaction in which her behavior is detected.[21] In other words, even though the base behavior, $b_{(t,i)}$, is constant, the actual behaviors of agent (i,t) against her partner from the previous and the next generations can be different, and are denoted, respectively, by $B^t_{(i,t)}$ and $B^{t+1}_{(i,t)}$ (where we are using the natural convention that the interaction between generations $t-1$ and t takes place at time t). We also assume that, when laws are time-varying, individuals are bound by the laws that were in operation in their youth. So an individual born at time t will have broken the law in both of her interactions at time t and $t+1$ if her base behavior $b_{(i,t)}$ is above L_t. And if she is caught in either period, her behavior is forced down to L_t (and she pays the fine ϕ_t). This assumption also implies that when there is a change in laws, a generation is automatically grandfathered provided that they obeyed the law in place at the time of their birth.[22]

Behavior at time 0 is taken as given and described by some strategy $\beta_0(\cdot)$. Let $w^k_{m_k(i,t)} = 1$ designate that agent (i,t)'s partner at time k whistle-blows on her in time period k, and

[19] Matching with own generation, as well as previous and next generations, complicates the analysis further, without modifying any of our main results, so we simplify matters by focusing on an environment in which matching is only with previous and next generations.

[20] While full stickiness makes the analysis transparent, a partial friction still produces similar effects, though with additional complications (see Acemoglu and Jackson, 2013, for a more detailed discussion).

[21] This implies that the government cannot automatically force an individual to change her behavior in future interactions just because she was whistle-blown in her "youth". This could be, for example, because the government cannot direct its enforcement towards monitoring certain agents more closely, and we can imagine that an agent can in fact change her behavior in the future by paying some fixed costs, so that the government cannot be sure that this past transgressor has indeed broken the law again without monitoring her. The extension to this more general case complicates the model, but does not affect the main insights.

[22] All of our major insights also hold with the alternative assumption of no grandfathering, which makes each agent responsible to match the current law (in fact, all of the results with constant laws are trivially the same). More importantly, a version of one of our key results in this section, Proposition 8, also holds in this case, and in fact becomes somewhat more obvious, since a tightening of the law automatically makes many people in the previous generation law-breakers and thus unable to whistle-blow on the next generation. This mechanical effect is eliminated with our grandfathering assumption.

$w^k_{m_k(i,t)} = 0$ indicate that her partner does not whistle-blow.

The payoffs to agent (i,t) are a natural generalization of those in the static model and are given by

$$\begin{aligned} u_{(i,t)} &= (1-\lambda)\,[\, a\left(B^t_{(i,t)} - \theta_{(i,t)}\right)^2 + (1-a)\left(B^t_{(i,t)} - B^t_{m_t(i,t)}\right)^2 \\ &\quad -\zeta\overline{B}^t_{(i,t)} - (\eta + (1-\eta)\, w^t_{m_t(i,t)}\mathbf{I}_{\{b_{(i,t)}>L_t\}})\phi_t \,] \\ &\quad +\lambda\,[\, a\left(B^{t+1}_{t,i} - \theta_{t,i}\right)^2 + (1-a)\left(B^{t+1}_{(i,t)} - B^{t+1}_{m_{t+1}(i,t)}\right)^2 \\ &\quad -\zeta\overline{B}^{t+1}_{(i,t)} - (\eta + (1-\eta)\, w^{t+1}_{m_{t+1}(i,t)}\mathbf{I}_{\{b_{(i,t)}>L_t\}})\phi_t \,]\,. \end{aligned} \tag{4}$$

Here $1-\lambda$ and λ are the payoff weights on, respectively, past and future interactions, and are inclusive of time-discounting. Laws and fines are allowed to be time-varying as noted above (and to interpret the timing of the terms at the end of each line, recall the convention that the interaction between generations $t-1$ and t takes place at time t, and that an agent born at time t is subject to the laws and fines imposed at time t).

In addition, we define externality terms on generation t as

$$\overline{B}^t_{(i,t)} \equiv \frac{\sum_j B^t_{(j,t-1)} + \sum_{j\neq i} B^t_{(j,t)}}{2n-1} \text{ and } \overline{B}^{t+1}_{(i,t)} \equiv \frac{\sum_j B^{t+1}_{(j,t+1)} + \sum_{j\neq i} B^{t+1}_{(j,t)}}{2n-1}$$

are the analogues of the negative externality term in the static model. The relationship between base and actual behaviors is given by

$$B^k_{(i,t)}\left(w^k_{m_k(i,t)}, b_{(i,t)}\right) = \begin{cases} L_t & \text{if } b_{(i,t)} > L_t, \text{ and } w^k_{m_k(i,t)} = 1 \text{ or there is public enforcement (prob. } \eta) \\ b_{(i,t)} & \text{otherwise,} \end{cases}$$

where $k = t$ or $t+1$.

Whistle-blowing is no longer automatic in cases in which laws differ across periods. For example, an agent obeying a less tight law may wish to allow an agent of the next or previous generation to break a more stringent law. Thus, strategies now must include not only the base behavior as a function of an agent's type, but also the whistle-blowing choices of a law-abiding agent as a function of the behavior of her matches from the previous and the next generations.

A *dynamic equilibrium* is then defined as a pure-strategy perfect Bayesian equilibrium that is symmetric with respect to the agents of any given generation,[23] and is summarized

[23] Because, as mentioned above, whistle-blowing behavior now occurs after observing other agents' behaviors, our equilibrium notion incorporates sequential rationality. With just the requirement of Bayesian equilibrium (without perfection), there exist trivial equilibria in which all agents obey laws and whistle-blow on any deviations (even though this may not be in their interest ex post, since whistle-blowing then ends up off the equilibrium path). Because aspects related to Bayesian updating of beliefs are not relevant in our context, we essentially just use Bayesian equilibrium strengthened with subgame perfection (thus avoiding technical details related to updating beliefs on sets of measure zero).

by a collection of functions $\{\beta_t(\theta)\}_{t=0}^{\infty}$ describing base behavior choices, as well as whistle-blowing decisions.[24]

A *steady-state equilibrium* is a dynamic equilibrium in which $\beta_t(\theta) = \beta^*(\theta)$ for all t (in settings in which laws, fines, and other parameters are constant over time).

4.2 Steady-State Equilibria

Because steady-state equilibria of this dynamic model (with $\phi_t = \phi$ and $L_t = L$ for some ϕ and L and all t) coincide with the equilibria of the static model, we start with steady-state equilibria, turning to dynamic equilibria in the next subsection.

Proposition **6** *Let $\mathcal{B}$ be the set of equilibria of the static game, and $\mathcal{B}^*$ be the set of steady-state equilibria of the dynamic game (with the same parameter values as the static game and with $L_t = L$ and $\phi_t = \phi$ for all t). Then $\mathcal{B} = \mathcal{B}^*$, and every steady-state equilibrium is given by a strategy of the form*

$$\beta^*(\theta_i) = \begin{cases} \beta_{abiding}(\theta_i) & \text{if } \theta_i < \theta^* \\ \beta_{breaking}(\theta_i) & \text{if } \theta_i > \theta^* \end{cases}$$

for some threshold θ^*, where $\beta_{abiding}(\theta_i)$ and $\beta_{breaking}(\theta_i)$ are as defined in (2) and (3) in Proposition 4.

In steady state, all generations have the same distribution of behavior, and thus the matching facing each agent with respect to the previous and the next generations is entirely analogous to that in the static model. Proposition 6 then implies that the comparative statics from the static model generalize to steady-state equilibria.

4.3 Dynamic Equilibria

Next, we establish the existence of and monotonicity of strategies in dynamic equilibria using the same arguments used for proving Proposition 1.

Proposition **7** *A dynamic equilibrium exists, and all dynamic equilibria are in monotone strategies (i.e., $\beta_t(\theta_i)$ is nondecreasing in θ_i for each t). Moreover, a dynamic equilibrium is characterized by a sequence of thresholds, $\{\theta_t^*\}_{t=0}^{\infty}$, and behavior of each generation is given by*

$$\beta_t(\theta_i) = \min[a\theta_i + (1-a)((1-\lambda)x_{t-1} + \lambda x_{t+1}), L] \quad \text{if} \quad \theta_i < \theta_t^*,$$

[24] β_0 is an initial condition, and need not be a best response to the future plays, but can be (as in the case of a steady-state equilibrium). We focus on equilibria in which play is symmetric within a generation, as equilibrium strategies are only subscripted by time and not players' identities. There is no similar requirement of symmetry across generations.

and

$$\beta_t(\theta_i) = a\theta_i + (1-a)\frac{(1-\lambda)\Pr(\theta > \theta^*_{t-1})z_{t-1} + \lambda \Pr(\theta > \theta^*_{t+1})z_{t+1}}{(1-\lambda)\Pr(\theta > \theta^*_{t-1}) + \lambda \Pr(\theta > \theta^*_{t+1})} \quad \text{if} \quad \theta_i > \theta^*_t,$$

where $x_t = \mathbb{E}\min[\beta_t(\theta), L]$ *and* $z_t = \mathbb{E}[\beta_t(\theta)|\theta > \theta^*_t]$.

Several features are worth noting. First, the characterization of equilibrium in Proposition 7 is similar to Propositions 4 and 6, with the only difference that the terms x and z can no longer be directly computed in terms of primitives (the distribution of θ), but are determined recursively, starting with an initial condition given by the behavior of an exogenous starting generation and another boundary condition pertaining to the limit of the distribution of behavior as t goes to infinity.

Second, though the characterization applies to all dynamic equilibrium, it is silent on whether the dynamic equilibrium is unique or there are multiple equilibria. When $\lambda = 0$, each generation best-responds to the behavior of the previous generation, which ultimately ties back to a starting condition, and thus at one extreme there is uniqueness. When λ is high, there can be a multiplicity of equilibria because of the expectation of how the next generation will behave, which may vary as laws change with time, and so this is a source of multiplicity which is distinct from the multiplicity of steady-states.

Finally, note that the dynamic equilibria of this model also generate a type of "social multiplier" (e.g., Glaeser, Sacerdote and Scheinkman, 1996). In particular, if there is high law-breaking at time t, then these agents will not whistle-blow on their future partners, and anticipating this, there will be high law-breaking at time $t+1$, and so on.

4.4 Social Norms and the Effectiveness of Laws

We now show that laws that are in strong conflict with the prevailing norms may backfire and significantly increase law-breaking, while more moderate laws that are not in discord with prevailing norms reduce behavior without causing as much lawlessness (because they change social norms in the process). Though the general insight concerning the interplay between social norms and laws holds for all parameter values, the analysis with changing laws and behaviors is quite complex, and this motivates our focus in the next proposition on a subset of the parameters for which the sharp contrast between abrupt and gradual tightenings of laws can be transparently demonstrated. In particular, since our emphasis is on how the best response of the current generation is shaped by the prevailing social norms determined by the behavior of past generations, we focus on the case in which $\lambda = 0$ so that things are backward looking.[25]

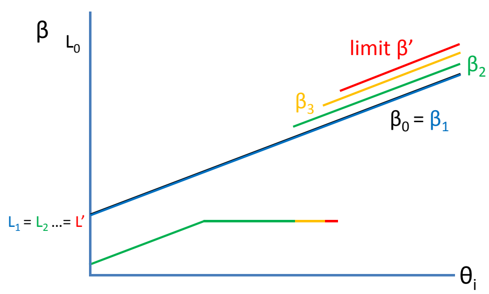
[25] In this case, the equilibrium is unique. It also then follows that any sequence of equilibria of nearby games for positive values of λ for which strategies converge to a limit (where convergence is defined in the weak* topology for all finite T) as λ gets small, must then converge to an equilibrium that satisfies the proposition for arbitrary T, and so upper hemicontinuity of the equilibrium correspondence (under such convergence) would imply that the result holds for small λ.

Proposition 8 *Fix F, $\phi > 0$ and $\zeta \geq 0$, and let $\lambda = 0$. There exists $\bar{\eta} > 0$, and for each $\eta \in (0, \bar{\eta})$ there exists $\bar{a} > 0$ such that for $a \in (0, \bar{a})$ the following holds. Suppose that there is an initial law, $L \geq (1-a)\mathbb{E}[\theta] + a$ (so non-binding), and a society starts at time $t = 0$ in the unique steady-state equilibrium corresponding to L. For any new law $L' < (1-a)\mathbb{E}[\theta] - a$ for which there is a less than full compliance steady-state equilibrium under L':*

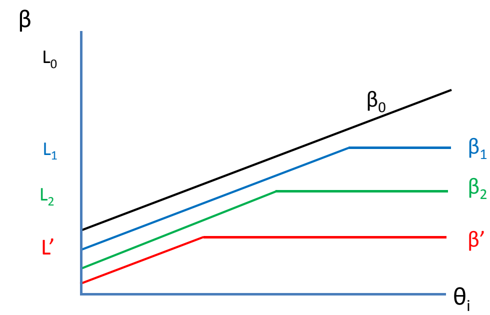
- *(*Abrupt tightening of law*) If there is an unanticipated and permanent change to L' in period 1, then all agents break the law in period 1, and some agents continue to break the law in subsequent period in any equilibrium, and behavior converges (weak*) to the lowest compliance equilibrium associated with L' over time.*
- *(*Graduate tightening of law*) However, for any such L' there exists a (finite) decreasing sequence of laws $\{L_t\}_{t=1}^{T}$ with $L_T = L'$ and then keeping the law at L' subsequently, such that following a switch to this sequence of laws, all agents comply with the law at their birth and play converges (weak*) to the full compliance steady-state equilibrium associated with L'.*

A significant tightening of the law creates a conflict between the prevailing norms and the law, leading to an immediate and significant increase in law-breaking. This then makes it impossible for society to achieve the full compliance steady-state equilibrium. For example, starting with the full compliance steady-state equilibrium for law L, a much tighter law L' will not be enforced. This is because agents in the previous generation, even though they are grandfathered, will force their partner down to L' if they whistle-blow, but L' is much lower than their current behavior, and thus forcing their partner down to L' would cause significant miscoordination. This implies that the initial (grandfathered) generation, though it can whistle-blow, will choose not to whistle-blow against the behavior that would have been chosen by the next generation absent of the law. But then knowing that there will be no whistle-blowing forthcoming from this initial generation, the next generation ignores the law, leading to pervasive law-breaking. This extent of law-breaking cannot last, because the very low types in the next generation will want to obey the law and whistle-blow on law-breakers. Nevertheless, significant law-breaking persists and society converges (from below, meaning from greater law-breaking behavior) to the lowest compliance steady-state equilibrium, with positive law-breaking.

In contrast, a series of gradual laws converging to L' can be much more effective in containing law-breaking and can achieve full compliance. In particular, each gradual tightening of the law will have a small impact on behavior, and the next generation will be willing to abide by the law, because this enables both coordination with the current generation and avoids the costs imposed by public law enforcement. This gradual sequence of tighter laws slowly changes the prevailing norms, and as norms change, these tighter laws become more and more powerful in restricting behavior. This ensures the convergence of the dynamic equilibrium without ever deviating from full compliance. Both parts of the proposition are illustrated in Figure 6.



(a) An abrupt tightening of the law leading to a switch from full compliance to the lowest compliance equilibrium



(b) A gradual tightening of the law while maintaining the full compliance equilibrium

Figure 6: Dynamics of the Effects of a Law

5 Extensions

In this section, we discuss several extensions. To facilitate the exposition, these are presented in the context of the baseline static model.

The first extension focuses on multiple types of behavior regulated by multiple laws, showing that badly-designed laws in one dimension make other dimensions of laws ineffective. Other extensions show how assortative matching between individuals depending on their behavior changes the results, and highlight the implications of relaxing some other assumptions in the model.

5.1 Multiple Laws

We first consider an extension of the model to multiple behaviors.

Each individual has a two-dimensional vector of types (θ_i^1, θ_i^2), and chooses two behaviors (b_i^1, b_i^2). Individual types are drawn from a joint type distribution G. To simplify the discussion in this extension and focus on the interaction in laws, we assume that G is such that $\theta_i^1 = \theta_i^2$ for all i (meaning that G puts probability 1 on the "diagonal" where each agent has the same type on both dimensions).

Each individual now matches (uniformly at random) with two others, corresponding to the two dimensions of behavior. We denote the partners of agent i in these two matches by $(m^1(i), m^2(i))$. There are two different laws applying to each dimension of behavior, denoted by (L^1, L^2). We take payoffs to be a direct generalization of (1),

$$u_i = \sum_{k=1,2} \left[-a \left(B_i^k - \theta_i^k \right)^2 - (1-a) \left(B_i^k - B_{m^k(i)}^k \right)^2 - \zeta^k \overline{B}_i^k - (\eta + (1-\eta)\, w_{m^k(i)}^k \mathbf{I}_{\{b_i^k > L^k\}}) \phi^k \right], \tag{5}$$

where

$$\overline{B}_i^k \equiv \frac{\sum_{j \neq i} B_j^k}{n-1}.$$

As (5) shows, there is no direct payoff linkage between the two dimensions of behavior. The key linkage results from the fact that an agent cannot whistle-blow on her partner on either dimension if she has broken any laws (e.g., a firm that whistle-blows on their business partner for their environmental transgressions will have her tax records also scrutinized). We also assume that an agent only observes the behavior of her partner in the specific dimension for which they are matched with her.

Equilibria can again be defined similarly and are in monotone strategies. However, the linkage between the two dimensions of behavior makes equilibrium more subtle. In particular, compared to a world in which there is only one type of behavior, an individual may be more willing to obey the law because by doing so, she has the option to whistle-blow on the other dimension. But also an individual will be less willing to obey the law because others who are breaking the law in the second dimension will not be able to whistle-blow on her in the first dimension. Though it is not possible in general to determine whether the first or the second effect dominates (and thus whether the linkage between the two dimensions of behavior makes law-breaking more or less likely), the next proposition characterizes some cases in which the law on one dimension encourages law-abiding behavior in the other and also some cases in which it encourages law-breaking in the other dimension.

Proposition **9** *Consider the model with multiple laws described above. Suppose that there is a non-trivial law in the first dimension ($L^1 < 1$) but no law in the second dimension ($L^2 = 1$), and an associated equilibrium, $\left(\beta^1(\theta), \beta^2(\theta)\right)$ with a law-breaking threshold $\theta^{1*} < 1$ on the first dimension. Then:*

- *There exist $\bar{\delta}$ and $\underline{\delta}$ such that if a law $\tilde{L}^2 \in (L^1 - \underline{\delta}, L^1 + \bar{\delta})$ is imposed on the second dimension, then there is a new equilibrium $\left(\tilde{\beta}^1(\theta), \tilde{\beta}^2(\theta)\right)$ that involves a law-breaking threshold $\tilde{\theta}^{1*} > \theta^{1*}$ (i.e., there is less law-breaking on the first dimension).*
- *There exists $\underline{L} > 0$ such that if a law $\tilde{L}^2 < \underline{L}$ is imposed on the second dimension, then the new equilibrium $\left(\tilde{\beta}^1(\theta), \tilde{\beta}^2(\theta)\right)$ involves a law-breaking threshold $\tilde{\theta}^{1*} < \theta^{1*}$ (i.e., there will be more law-breaking on the first dimension).*

This proposition thus shows that the imposition of law sufficiently similar to prevailing laws on the second dimension increases law-abiding behavior in the first dimension, while a very strict law in the second dimension encourages law-breaking in the first. The latter result here is particularly important because it suggests that a "badly-designed" law in the second dimension destroys the power of the first law. This is because a too strict (or badly-designed) law naturally leads to extensive law-breaking in the second dimension. But then these agents will cease to be able to whistle-blow on the first dimension, the anticipation of which discourages law-abiding behavior in the first dimension. This reasoning may explain why laws that are viewed as unfair or unjust lead to the erosion of respect for other laws and regulations in society as discussed in the Introduction.

In light of this extension, we can return to our discussion of the broken windows theory of Kelling and Wilson (1982) in the Introduction. Consistent with the broken windows theory, pervasive law-breaking in the second dimension encourages law-breaking in the first dimension (which may be more costly for society, e.g., if ζ^1 is very high). Then, one might conclude that greater resources have to be devoted to prevent law-breaking behavior in the second dimension. Though this would not be entirely incorrect in our model, the real problem is not that there is high behavior in the second dimension, but that the law in the second dimension is too strict (badly-designed). Decriminalizing moderate behaviors in the second dimension would be much more effective in preventing the "culture of law-breaking," and for reducing law-breaking in the first dimension.

5.2 Assortative Matching and the Power of Laws

We have so far assumed uniform random matching. In many situations, those engaged in illegal activities may be able to partner with others also doing so. A simple way of flexibly allowing for this possibility is to introduce some degree of assortative matching. To analyze this possibility, let us modify the model in one other dimension, by assuming that there is a continuum of agents.[26] Then, suppose that with probability q, an individual matches with another agent with exactly the same type as herself, and with probability $1-q$, she matches with somebody else uniformly at random. As $q \to 0$, we converge to our baseline model. As $q \to 1$, we converge to fully assortative matching. Equilibria are again similar to the baseline, but both the threshold for law-breaking, θ^*, and the strategies of law-abiding and law-breaking agents are now modified as outlined in the next proposition.

PROPOSITION **10** *Suppose that in the baseline static model we have probability $q \in [0,1]$ of assortative matching. Then Propositions 1 and 3 apply, and Proposition 4 is modified such that*

$$\beta(\theta_i) = \min[(a + (1-a)q)\theta_i + (1-a)(1-q)x, L] \quad \text{if} \quad \theta_i < \theta^*$$

and

$$\beta(\theta_i) = (a + (1-a)q)\theta_i + (1-a)(1-q)\mathbb{E}[\theta|\theta > \theta^*] \quad \text{if} \quad \theta_i > \theta^*,$$

where x is the unique point satisfying $x = \mathbb{E}\left[\min[(a + (1-a)q)\theta + (1-a)(1-q)x, L]\right]$. In addition, θ^* is decreasing in q.

[26] Though this requires some care in the definition of a matching, we omit these details.

The intuition for the change in the law-abiding and law-breaking strategies is straightforward (as they both reflect the increased likelihood of a match with somebody very close to one's own type and thus reduced mismatch). Though both law-abiding and law-breaking agents benefit from a higher probability of assortative matching, the gain is greater for law-breakers, since it enables them to avoid facing whistle-blowing and punishment. Hence, higher q encourages greater law-breaking. As a consequence, enforcing laws is more difficult in activities where law-breakers can more easily find and operate with other law-breakers, thus insulating them from whistle-blowing. This suggests that laws relying on private enforcement (whistle-blowing) can be more effective in certain activities, such as tax evasion, where the degree of assortative matching is likely to be more limited, than others such as smuggling.

5.3 Costly Whistle-Blowing

In this subsection, we introduce a cost of whistle-blowing, ε, and to simplify the discussion we set the probability of public enforcement to zero, i.e., $\eta = 0$. Now agent i's payoff is

$$u_i = -a\left(B_i - \theta_i\right)^2 - (1-a)\left(B_i - B_{m(i)}\right)^2 - \zeta \overline{B}_i - w_{m(i)}\mathbf{I}_{\{b_i > L\}}\phi - w_i \mathbf{I}_{\{b_{m(i)} > L\}}\varepsilon. \tag{6}$$

Let us start by considering the decision to whistle-blow (since it is no longer optimal to whistle-below on all law-breakers). Since whistle-blowing reduces the action of one's partner to L, the gain to doing so for an agent who has chosen behavior B_i is

$$(1-a)[\left(B_i - B_{m(i)}\right)^2 - (B_i - L)^2] = (1-a)[B_{m(i)}^2 - L^2 + 2LB_i - 2B_{m(i)}B_i],$$

and whistle-blowing is a strict best response when this quantity exceeds ε. It is straightforward to verify that it will do so when $B_{m(i)} > W_\varepsilon(b_i)$ (where the switch from B_i to b_i reflects the fact that agent i is law-abiding and hence $B_i = b_i$). Incorporating this behavior, we can again reduce our multistage game to a static one in which each agent chooses $\beta(\theta_i)$, and define an equilibrium as a pure-strategy Bayesian equilibrium. Then the next proposition follows straightforwardly using the same arguments as Proposition 1.

Proposition **11** *An equilibrium exists, and all equilibria are in monotone strategies.*

Proposition 11 also enables us to simplify the whistle blowing strategy by writing W_ε as a function of θ_i rather than b_i (by simply substituting for $b_i = \beta(\theta_i)$), so that whistle-blowing happens when the behavior of one's partner is above a threshold $\bar{W}_\varepsilon(\theta_i)$. It is also straightforward to see that every equilibrium is characterized by a threshold θ^* such that types above this threshold break the law. Though the exact characterization in Proposition 4 no longer applies, it can be shown that any equilibrium with costly whistle-blowing converges to an equilibrium of the form given in Proposition 4 as $\varepsilon \to 0$.

Proposition **12** *As $\varepsilon \to 0$, the equilibrium with costly whistle-blowing converges (weak*) to an equilibrium of the baseline model with a zero cost of whistle-blowing.*

An interesting implication of costly whistle-blowing (with $\eta = 0$) is the possibility of a distinction between "laws on the book" and laws that are actually enforced. In particular, for any positive cost of whistle-blowing, ε, there exists a range of behaviors on which nobody will blow the whistle. So even though these are banned behaviors (i.e., they are above L), everybody understands that they will be tolerated by society. There then exists another threshold above L, say $\hat{L}$, beyond which whistle-blowing begins (but not all behaviors above $\hat{L}$ will be whistle-blown upon as this will depend on the behavior of the partner).

Another result that follows immediately from the analysis of costly whistle-blowing is that the government can also increase the enforcement of laws by rewarding whistle-blowing. This can offset the reduction in whistle-blowing due to the cost, and in fact, it can induce whistle-blowing in situations (such as those highlighted in Proposition 8) where the unwillingness of agents to whistle-blow makes laws ineffective.

5.4 Whistle-Blowing by Law-Breakers

In the baseline model, we assumed that only law-abiding agents can whistle-blow. The analysis is similar when this assumption is relaxed. It can be verified that if the fine for whistle-blowing, ϕ, is sufficiently large (though less than the threshold $\bar{\phi}$ defined in Proposition 3, above which the unique equilibrium involves all agents obeying the law), then no agent who has herself broken the law will whistle-blow. But when ϕ is sufficiently small, an agent who has broken the law by a small amount may prefer to whistle-blow when matched against somebody who breaks the law by a very large amount, because this will get both of them to coordinate at L (and thus avoid the disutility resulting from a significant mismatch). Nevertheless, we can utilize the same strategy as in the previous subsection, where we first solve for whistle-blowing, and then substituting for this, we look for an equilibrium in terms of $\beta(\theta_i)$'s for each agent. An equilibrium can then be defined in the same fashion and is once again characterized by a threshold θ^*.

This extension also enables us to discuss how amnesty laws, which partially wave sanctions against law-breakers who turn whistle-blower, affect law-breaking. In our model, when law-breakers can whistle-blow and avoid punishment because of an amnesty, whistle-blowing greatly increases.

6 Welfare

We conclude our formal analysis with a brief discussion of welfare properties. We should first note that the (simple) laws we have examined in this paper are not fully optimal. If a social planner could influence ex post behavior, then she would do so in a pair-dependent manner, since there is a mismatch (miscoordination) externality within a pair. We believe that the laws we have studied in this paper are nevertheless relevant because they are much simpler to implement than fully pair-dependent taxes or subsidies conditional on the exact behavior of each agent.

Here we would like to note that it is not generally optimal to choose laws and fines that force full compliance. In particular, note that for any law $L > 0$, there exists some level of fine, defined as $\bar{\phi}$ in Proposition 3, which will ensure full compliance. The next proposition shows that provided that the externality on others is not too large, full compliance is not optimal. To establish this result, we focus on the choice of a utilitarian social planner (and treat fines paid in equilibrium as pure transfers).

PROPOSITION **13** *Fix a distribution of types F and law $L \in (0, 1)$. Then for any partial compliance equilibrium (associated with some fine $\phi < \bar{\phi}$), there exists $\bar{\zeta}$ such that for any $\zeta < \bar{\zeta}$, utilitarian social welfare is greater under this partial compliance equilibrium than under full compliance. Moreover, there exist distributions and levels of externality for which the total expected utility maximizing law and fine involve partial compliance.*

This proposition implies that for sufficiently small externalities, any partial compliance is better than full compliance — and thus, the utilitarian social planner would not like to choose a very high fine $\phi > \bar{\phi}$. Naturally, this result may not be true if externalities are very large, but still points out that there are natural reasons for allowing some law-breaking in society.

The intuition for this proposition is instructive. Partial compliance leads to law-breaking only by high types. When a high type matches with a low type, the latter can whistle-blow and reduce the behavior of her partner back down to L. This insulates low types from the mismatch consequences of law-breaking by high types, and thus low-types (those below the law-breaking threshold θ^*) are only worse off in a partial compliance equilibrium relative to full compliance because of the negative externalities from high behavior. This reasoning also implies that under partial compliance, there will only be behavior above L when two high types (two types above θ^*) match. But it is costly for a utilitarian social planner to force two high-type agents down to L. In fact, by revealed preference, these high types strictly prefer partial compliance to full compliance (as they could have chosen law-abiding behavior even under $\phi < \bar{\phi}$). Consequently, if the externality that law-breakers impose on society is not too large (i.e., provided that $\zeta < \bar{\zeta}$), it is optimal to permit high-type agents to break the law when they are matched to each other. Notably, this conclusion holds for any $\phi < \bar{\phi}$, and thus for any partial compliance equilibrium (though of course the relevant threshold $\bar{\zeta}$ for the size of externalities does vary across partial compliance equilibria).

7 Conclusion

This paper has examined the interplay between social norms and the enforcement of laws. The main motivation for our approach comes from the fact that many laws are ineffective, in part because they conflict with prevailing social norms, making private agents unwilling to cooperate with law enforcement (for example, by whistle-blowing).

In our model, agents choose a behavior (e.g., tax evasion, production of low-quality products, corruption, substance abuse, etc.), and then are matched uniformly with another agent. Utility depends negatively on the average behavior of other agents and on the mismatch between the behaviors of the two partners. A law is a cap (upper bound), L, on behavior and a law-breaker, when detected, pays a fine and has her behavior forced down to L. Incentives to break the law depend on social norms because detection has to rely, at least in part, on private cooperation and whistle-blowing. Law-abiding agents have an incentive to whistle-blow because this will reduce their partner's behavior, ameliorating the mismatch.

When laws are in conflict with norms so that many others are breaking the law, anticipating little whistle-blowing, each agent has further incentives to also break the law. We show that all equilibria are characterized in terms of a threshold for law-breaking, and a range of comparative statics of the lowest compliance equilibrium are presented. For example, greater fines for law-breaking reduce law-breaking and behavior among law-abiding agents, but also increase behavior among law-breakers (because law-breakers choose their behavior in the hope of matching with other law-breakers, and in this case, the composition of law-breakers has shifted towards higher type agents). A tighter law (banning more behaviors) leads to greater law-breaking, but also reduces behavior among law-breakers.

We further show that laws that are in strong conflict with prevailing social norms may backfire and lead to a significant decline in law-abiding behavior in society. In contrast, gradual imposition of moderately tight laws can be effective in changing social norms and can thus alter behavior without leading to pervasive lawlessness. We also show that excessively strict (or badly-designed) laws concerning some dimensions of behavior encourage broader law-breaking in society.

We view our paper as a first step towards a systematic analysis of the interaction between laws and norms. Important next steps in this research program would include, among others, an investigation of the interaction between internal norms and laws; the interplay between collective choices of society (as a function of behavior), laws and norms; the impact of laws on the inference that agents may draw on the type and intentions of law-breaking and law-abiding agents in society; and a systematic investigation of substitutability and complementarity between private and public law enforcement. Empirical investigation of these interactions, and the role of history and prevailing social norms on law-breaking behavior and law enforcement, are also obvious fruitful area for future research.

Appendix

The following lemma establishes the monotonicity and structure of best replies to (symmetric) strategies of the other players.

LEMMA 1 *Let $\beta(\cdot)$ be a best response for some agent i to any strategy $\beta'(\cdot)$ played by the other players. Then $\beta(\theta_i) \geq \beta(\theta_i')$ whenever $\theta_i > \theta_i'$. Furthermore, either $\beta(\theta_i) \leq L$ in which* *case*

$$\beta(\theta_i) = \min\left[L, a\theta_i + (1-a)\mathbb{E}[\min[L, \beta'(\theta_{m(i)})]]\right];$$

or $\beta(\theta_i) > L$ *and then*

$$\beta(\theta_i) = a\theta_i + (1-a)\mathbb{E}[\beta'(\theta_{m(i)})|\beta'(\theta_{m(i)}) > L].$$

Proof of Lemma 1: Consider any measurable $\beta'(\cdot)$ used by the other agents.

Following (1) we can write agent i's expected payoff, including only the external effects that i's behavior affects, as:

$$\begin{aligned} \mathbb{E}u_i(b_i,\theta_i,\beta') &= -\frac{\zeta}{n-1}\mathbb{E}[\min(\beta'(\theta_{m(i)}),L)] && \text{if } b_i \le L; \quad \text{(A1)} \\ &\quad -a\left(b_i-\theta_i\right)^2-(1-a)\mathbb{E}\left[\left(b_i-\min[\beta'(\theta_{m(i)}),L]\right)^2\right] \end{aligned}$$

and

$$\begin{aligned} \mathbb{E}u_i(b_i,\theta_i,\beta') &= -\frac{\zeta}{n-1}\left(\eta\mathbb{E}[\min(\beta'(\theta_{m(i)}),L)]+(1-\eta)\mathbb{E}[\beta'(\theta_{m(i)})]\right) && \text{if } b_i > L; \quad \text{(A2)} \\ &\quad -\Pr(\beta'(\theta_{m(i)}) \le L)(a(L-\theta)^2+(1-a)\mathbb{E}\left[(L-\beta'(\theta_{m(i)}))^2|\beta'(\theta_{m(i)}) \le L\right]+\phi) \\ &\quad -\eta\Pr(\beta'(\theta_{m(i)}) > L)(a(L-\theta)^2+(1-a)\times 0+\phi). \\ &\quad -(1-\eta)\Pr(\beta'(\theta_{m(i)}) > L)\left(a(b-\theta)^2+(1-a)\mathbb{E}\left[(b-\beta'(\theta_{m(i)}))^2|\beta'(\theta_{m(i)}) > L\right]\right). \end{aligned}$$

To understand (A1), note that the first line is simply the expected externality from her match. The second line comes from the utility of the distance between action and own type and match's behavior; noting that the agent's match's behavior is always at most L, either due whistle-blowing or enforcement if it starts above L. To understand (A2), note that the first line is simply the expected externality from her match. The second line comes from noting that with probability $\Pr(\beta'(\theta_{m(i)}) \le L)$ the agent will meet a law-abiding agent, who will whistle-blow on her. In this case, her behavior will be reduced down to L and she will incur the fine ϕ. The third line comes from noting that with probability with probability $\eta\Pr(\beta'(\theta_{m(i)}) > L)$, she will meet a fellow law-breaker but there will be public enforcement, and in this case she will again be subject to the fine, and her behavior will be reduced to L (but so will the behavior of her partner accounting for the 0 term).must look Finally, with probability $(1-\eta)\Pr(\beta'(\theta_{m(i)}) > L)$ the agent will meet another law-breaker and will not be subject to public enforcement. In this case, her utility is given by the convex combination of the distances between her behavior and her type, and her behavior and the behavior of the fellow law-breaker ($\beta'(\theta_{m(i)})$), and this gives the last line.

It then follows from the first-order necessary conditions that a best response must satisfy: either $\beta(\theta_i) \le L$ and

$$\beta(\theta_i) = \min\left[L, a\theta_i + (1-a)\mathbb{E}[\min[L, \beta'(\theta_{m(i)})]]\right]; \quad \text{(A3)}$$

or $\beta(\theta_i) > L$ and

$$\beta(\theta_i) = a\theta_i + (1-a)\mathbb{E}[\beta'(\theta_{m(i)})|\beta'(\theta_{m(i)}) > L]. \tag{A4}$$

Both of these functions are nondecreasing in θ_i, and (A4) is always greater than (A3). So, the only possible violation of the nondecreasing property would have to be a setting where the best response at θ_i is smaller than (or equal to) L, while at $\theta_i' < \theta_i$ the best responses greater than than L.

Consider any $\underline{b}_i$ and $\bar{b}_i$ such that $\underline{b}_i \leq L$ and $\bar{b}_i > L$ and let us evaluate

$$\mathbb{E}u_i(\bar{b}_i, \theta_i, \beta') - \mathbb{E}u_i(\underline{b}_i, \theta_i, \beta').$$

To rule out this last situation where the best reply at θ_i is no higher than L, while at $\theta_i' < \theta_i$ the best reply is higher than L, it is enough to show that $\mathbb{E}u_i(\bar{b}_i, \theta_i, \beta') - \mathbb{E}u_i(\underline{b}_i, \theta_i, \beta')$ is increasing in θ_i. From (A1) and (A2), it follows that

$$\mathbb{E}u_i(\bar{b}_i, \theta_i, \beta') - \mathbb{E}u_i(\underline{b}_i, \theta_i, \beta') = (1-(1-\eta)\Pr[\beta'(\theta_{m(i)}) > L])a\left[(\underline{b}_i - \theta_i)^2 - (L-\theta_i)^2\right]$$

$$+(1-\eta)\Pr[\beta'(\theta_{m(i)}) > L]a\left[(\underline{b}_i - \theta_i)^2 - \left(\bar{b}_i - \theta_i\right)^2\right] + X$$

where X is a term that is independent of θ_i. We simplify to get

$$\mathbb{E}u_i(\bar{b}_i, \theta_i, \beta') - \mathbb{E}u_i(\underline{b}_i, \theta_i, \beta')$$

$$= (1-(1-\eta)\Pr[\beta'(\theta_{m(i)}) > L])2a(L-\underline{b}_i)\theta_i + (1-\eta)\Pr[\beta'(\theta_{m(i)}) > L]2a(\bar{b}_i - \underline{b}_i)\theta_i + Y$$

where Y is a term that is independent of θ_i. This expression is increasing in θ_i whenever $\Pr[\beta'(\theta_{m(i)}) > L] > 0$. In the case in which $\Pr[\beta'(\theta_{m(i)}) > L] = 0$, a strategy of L offers a strictly higher payoff than any strategy above L, and so the best reply at $\theta_i' < \theta_i$ could not be higher than L. This concludes the proof. ▮

Proof of Propositions 1 and 4: The monotonicity follows from Lemma 1, and then the existence of a cutoff type describing any agent's best reply follows directly. Thus, by the lemma, any symmetric pure strategy equilibrium must be such that there is a threshold θ^* such that agents above this threshold break the law and those below do not (with full compliance corresponding to $\theta^* = 1$ and full law-breaking to $\theta^* = 0$). Moreover, from the characterization of strategies in the lemma it also then follows that such an equilibrium $\beta(\cdot)$ must satisfy the following when $\theta_i > \theta^*$

$$\beta(\theta_i) = a\theta_i + (1-a)\mathbb{E}\left[\beta(\theta)|\theta > \theta^*\right].$$

Taking expectations conditional upon $\theta > \theta^*$ on both sides leads to

$$\mathbb{E}\left[\beta(\theta)|\theta > \theta^*\right] = \mathbb{E}\left[\theta|\theta > \theta^*\right],$$

and thus

$$\beta(\theta_i) = a\theta_i + (1-a)\mathbb{E}\left[\theta|\theta > \theta^*\right]. \tag{A5}$$

When $\theta_i < \theta^*$, the Lemma 1 implies that

$$\beta(\theta_i) = \min\left[L, a\theta_i + (1-a)\mathbb{E}\left[\min(\beta(\theta), L)\right]\right].$$

Thus,

$$\beta(\theta_i) = \min(L, a\theta_i + (1-a)x), \tag{A6}$$

where $x \equiv \mathbb{E}\left[\min(\beta(\theta), L)\right]$.

Next, we show that for any θ^*, x is uniquely defined, as claimed.

We expand $x = \mathbb{E}\left[\min(\beta(\theta), L)\right]$ as

$$x = \Pr(\theta < \theta^*)\mathbb{E}\left[\min(\min(L, a\theta + (1-a)x), L)|\theta < \theta^*\right] + \Pr(\theta > \theta^*)L,$$

or

$$x = \Pr(\theta < \theta^*)\mathbb{E}\left[\min(L, a\theta + (1-a)x)|\theta < \theta^*\right] + \Pr(\theta > \theta^*)L. \tag{A7}$$

The right-hand side of this equation is a contraction (it is nondecreasing in x but always less than one-for-one as $1-a<1$). Thus, by the contraction mapping principle (A7) has a solution and it is unique.

We have therefore established Proposition 4, subject to proving existence, which then completes the proof of Proposition 1.

Existence of an equilibrium follows straightforwardly as $\theta^* = 1$ is always an equilibrium: if all other agents abide by the law, then any action $b_i > L$ is dominated by $b_i = L$, and so then best replies must all be abiding by the law. In that case, by the arguments above $\theta^* = 1$, and then $\beta(\theta_i) = \min[a\theta_i + (1-a)x, L]$ is a best reply to itself, providing an equilibrium. ∎

Proof of Proposition 2: Applying Lemma 1 to the case in which $L = 1$, it follows that the unique best response of any agent i to the strategies of other agents is to set

$$\beta(\theta_i) = a\theta_i + (1-a)\mathbb{E}[b_{m(i)}].$$

Writing $\mathbb{E}[b]$ for the expected strategy of a randomly selected agent, the above expression implies that

$$\mathbb{E}[b] = \mathbb{E}\left[a\theta + (1-a)\mathbb{E}[b]\right],$$

which given $0 < a < 1$ has a unique solution of

$$\mathbb{E}[b] = \mathbb{E}[\theta].$$

Thus, the unique equilibrium without laws involves

$$\beta(\theta_i) = a\theta_i + (1-a)\mathbb{E}[\theta],$$

as claimed. ∎

Proof of Proposition 3: We have already shown that in any equilibrium, (2) and (3) have to hold given the law-breaking threshold θ^*. Clearly, the relevant thresholds are fixed points: if all other agents use threshold θ^*, then it is a best response for each to also use threshold θ^*. Given the monotonicity of best responses already established in Lemma 1, it is sufficient to look at the payoffs from law-breaking and law-abiding for the agent of type θ^*.

We first note that there is always an equilibrium with $\theta^* = 1$ given that $\phi > 0$. This follows since, if all other agents abide by the law, then by breaking the law an agent's action will reduced down to L with certainty and the agent will pay the fine ϕ. The agent would have a strictly higher payoff from choosing L directly. Thus, it is a best response to obey the law when all other agents do, and so having $\theta^* = 1$ and actions as in (2) is an equilibrium. We next consider characterize equilibria for which $\theta^* < 1$.

Suppose that type θ^* decides to take a law-breaking action. Then, from (A5) in the proof of Lemma 1, the optimal law-breaking action will be $a\theta^* + (1-a)y$ (with $y \equiv \mathbb{E}[\theta|\theta > \theta^*]$), and since $\theta^* \geq L$ this behavior is above L. Her payoff can then be written based on (A2) as

$$\begin{aligned}
-\Pr(\theta &< \theta^*)(a(L-\theta^*)^2 + (1-a)\mathbb{E}\left[(L - a\theta - (1-a)x)^2|\theta < \theta^*\right] + \phi) \\
-\eta\Pr(\theta &> \theta^*)(a(L-\theta^*)^2 + \phi) \\
-(1-\eta)\Pr(\theta &> \theta^*)\left(a(a\theta^* + (1-a)y - \theta^*)^2\right. \\
&\qquad\qquad \left. +(1-a)\mathbb{E}\left[(a\theta^* + (1-a)y - a\theta - (1-a)y)^2|\theta > \theta^*\right]\right) \\
&\qquad -\frac{\zeta}{n-1}\left(\eta\mathbb{E}[\min(\beta(\theta), L)] + (1-\eta)\mathbb{E}[\beta(\theta)]\right). \qquad \text{(A8)}
\end{aligned}$$

Suppose, instead, that type θ^* chooses to abide by the law, in which case she will set her behavior to $b = \min[L, a\theta^* + (1-a)x]$ and from (A1) receive expected payoff

$$\begin{aligned}
-\Pr(\theta &> \theta^*)\left(a(b-\theta^*)^2 + (1-a)(b-L)^2\right) \qquad \text{(A9)} \\
-\Pr(\theta &< \theta^*)\left(a(b-\theta^*)^2 + (1-a)\mathbb{E}\left[(b - a\theta - (1-a)x)^2|\theta < \theta^*\right]\right) \\
&\quad -\frac{\zeta}{n-1}\mathbb{E}[\min(\beta(\theta), L)].
\end{aligned}$$

The threshold type θ^* is given by setting (A8) equal to (A9). We the former on the left-hand side and the latter on the right-hand side and equal to each other. To help with the comparative statics analysis, we then transfer all terms involving ϕ and ζ to the right-hand side, and all other terms to the left-hand side; noting that that $\Pr(\theta > \theta^*) = 1 - \Pr(\theta < \theta^*)$; and dividing both sides by $(1-\eta)\Pr(\theta > \theta^*)$ (which is strictly positive in view of the fact that $\eta < 1$ and $\theta^* < 1$ as we see below), we obtain:

$$\begin{aligned}
&-a(1-a)^2(\theta^* - y)^2 - (1-a)a^2\mathbb{E}\left[(\theta - \theta^*)^2|\theta > \theta^*\right] - \left(\frac{1-(1-\eta)\Pr(\theta > \theta^*)}{(1-\eta)\Pr(\theta > \theta^*)}\right)a(L-\theta^*)^2 \\
&+\left(\frac{1}{(1-\eta)\Pr(\theta > \theta^*)}\right)\left[\Pr(\theta > \theta^*)(1-a)(b-L)^2 + a(b-\theta^*)^2\right] \\
&+\left(\frac{\Pr(\theta < \theta^*)}{(1-\eta)\Pr(\theta > \theta^*)}\right)(1-a)\left(\mathbb{E}\left[(b - a\theta - (1-a)x)^2|\theta < \theta^*\right] - \mathbb{E}\left[(L - a\theta - (1-a)x)^2|\theta < \theta^*\right]\right) \\
= &\left(\frac{1-(1-\eta)\Pr(\theta > \theta^*)}{(1-\eta)\Pr(\theta > \theta^*)}\right)\phi + \frac{\zeta}{n-1}\frac{(\mathbb{E}[\beta(\theta)] - \mathbb{E}[\min(\beta(\theta), L)])}{\Pr(\theta > \theta^*)}.
\end{aligned}$$

Noting that

$$\mathbb{E}[\beta(\theta)] - \mathbb{E}[\min(\beta(\theta), L)] = \Pr(\theta > \theta^*)\mathbb{E}[\theta - L|\theta > \theta^*],$$

this simplifies to

$$\begin{aligned}
&-a(1-a)^2(\theta^*-y)^2 - (1-a)a^2\mathbb{E}\left[(\theta-\theta^*)^2|\theta>\theta^*\right] - \left(\frac{1-(1-\eta)\Pr(\theta>\theta^*)}{(1-\eta)\Pr(\theta>\theta^*)}\right)a(L-\theta^*)^2 \\
&+\left(\frac{1}{(1-\eta)\Pr(\theta>\theta^*)}\right)\left[\Pr(\theta>\theta^*)(1-a)(b-L)^2 + a(b-\theta^*)^2\right] \\
&+\left(\frac{\Pr(\theta<\theta^*)}{(1-\eta)\Pr(\theta>\theta^*)}\right)(1-a)\left(\mathbb{E}\left[(b-a\theta-(1-a)x)^2|\theta<\theta^*\right] - \mathbb{E}\left[(L-a\theta-(1-a)x)^2|\theta<\theta^*\right]\right) \\
= &\left(\frac{1-(1-\eta)\Pr(\theta>\theta^*)}{(1-\eta)\Pr(\theta>\theta^*)}\right)\phi + \frac{\zeta}{n-1}\mathbb{E}[\theta-L|\theta>\theta^*].
\end{aligned} \tag{A10}$$

Note that since all of the transformations used to obtain (A10) involve adding and subtracting numbers and dividing by the positive number, the left-hand side of (A10) is greater than the right-hand side if and only if (A8) is greater than (A9).

We now consider the set of θ^* that satisfy (A10).

First, note that $\theta^* \geq L$, since for type L choosing behavior L strictly dominates anything above it: L does strictly better against law-abiders, and gets maximal utility against law-breakers since all of their behaviors are reduced to exactly L, the most preferred point of an L type. So, let us consider the set of $\theta^* \in [L, 1)$ that satisfy (A10). The fact that for $\theta^* = L$, choosing behavior L strictly dominates anything above it implies that the expression in (A8) is strictly less than the expression in (A9) when $\theta^* = L$. This implies that the left-hand side of (A10) is greater than its right-hand side at $\theta^* = L$.

Second, as shown above, if others are all abiding by the law, then it is a strict best response to abide by the law for an agent. Put differently, when $\theta^* = 1$ (A8) is strictly less than the expression in (A9). This implies that the left-hand side of (A10) is strictly greater than its right-hand side as $\theta^* \to 1$ (where this statement is for the limit $\theta^* \to 1$, since the expressions in (A10) diverge at $\theta^* = 1$ due to the fact that they are both divided by $(1-\eta)\Pr(\theta > \theta^*)$, though of course this does not affect their relative ranking as $\theta^* \to 1$).

Next, note that the right-hand side is continuous and increasing in θ^* and is always positive, and as just argued the right-hand side starts out and ends up strictly above the left-hand side. Note that the left-hand side is also continuous in θ^*. Thus, if there is an intersection and an interior equilibrium (rather than tangency which we discuss in the next paragraph), then the smallest intersection must involve the left-hand side cutting the right-hand side from below, and the greatest intersection must involve the reverse. This pictured in Figure 7, with the blue line corresponding to the left-hand side and the red curve to the right-hand side.[27] As Figure 7 makes it clear, when there is an intersection between the two

[27]The figures are drawn for the case in which $b = L$, in which case the left hand side stays bounded while the right-hand side asymptotes to infinity as $\theta^* \to 1$ (since then $\Pr(\theta > \theta^*) \to 0$, but qualitatively similar pictures hold for the other case, but the left hand side may be unbounded.

curves, there must be at least two of them and thus two equilibrium thresholds (all in the range $\theta^* \in [L, 1)$).

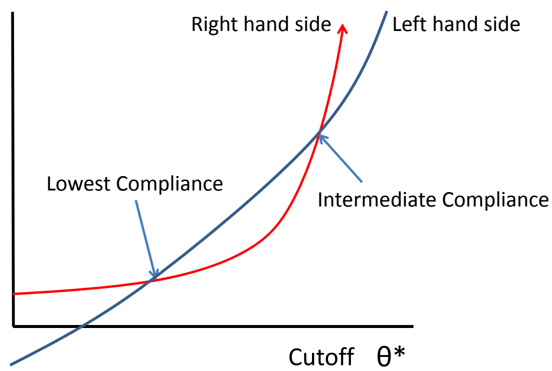


Figure 7: Multiplicity of Partial Compliance Equilibria.

Now consider the case in which ϕ is large. In that case the right-hand side still starts out at a higher intercept on the vertical axis, and for large enough ϕ will have no intersection with the left-hand side. The threshold value for there to be a tangency between the two curves is defined as $\bar{\phi}$ (and when there are intersections for all values of ϕ, we set this as $\bar{\phi} = 0$). So when $\phi > \bar{\phi}$, there are no interior equilibria and the unique equilibrium is full compliance. When $\bar{\phi} > 0$ and $\phi < \bar{\phi}$, there are at least two interceptions as drawn in Figure 7, and the full compliance equilibrium always continues to exist. This completes the proofs of Propositions 3 and 4. ∎

Proof of Proposition 5: Recall that the lowest compliance equilibrium threshold for law-breaking, θ^*, is given by the smallest intersection of (A8) and (A9), or equivalently, by the left-hand side of (A10) intersecting the right-hand side from below as shown in Figure 7.

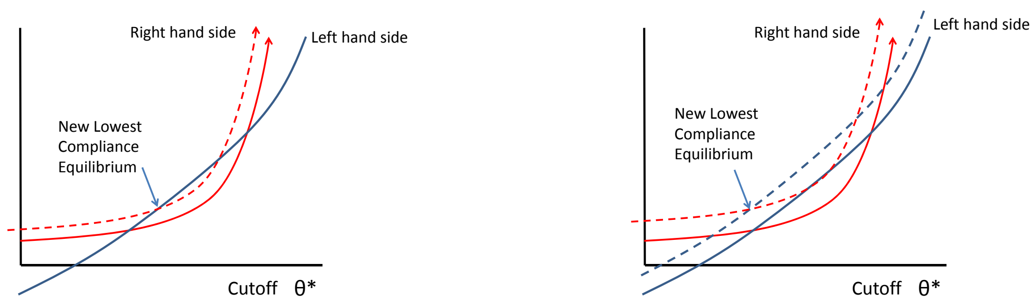
First note that the definition of "small" changes from footnote 17 is satisfied in Figure 7 since the lowest compliance equilibrium is given by the intersection of the two curves (rather than a tangency point). Now all of the comparative statics follow by noting how the parameters in question shift the right-hand and left-hand sides of (A10). In particular, the right-hand side shifts up and the left hand side is unchanged when ϕ, η or ζ increases, as pictured in Figure 8a.

When L decreases (and laws become more strict), both sides of equation (A10) shift as pictured in Figure 8b. The right-hand side shifts up, while the left-hand side's shift depends on parameters, and so which effect dominates depends on the level of the parameters. In particular, there is a critical ζ, $\overline{\zeta}$ (as a function of the other parameters), above which the equilibrium threshold increases, and below which it decreases (since ζ affects the magnitude of the change of the right-hand side equation).

Specifically, the derivative of the right hand side is $-\zeta/(n-1)$. The derivative of the left-hand side with respect to L depends on whether $b = L$ or differs from it. Let us first treat the case in which when L declines, $b = L$ in some small neighborhood. In that case, the derivative of the left-hand side is $-2a(\theta^* - L)$, and so the critical $\overline{\zeta}$ for which the two effects balance is

$$\overline{\zeta} = 2a(n-1)(\theta^* - L).$$

Above this, the increase in the right-hand side is larger from a decrease in L (leading to an increase in θ^*), while below it, the shift in the left-hand side is greater from a decrease in L (leading to a decrease in θ^*).



(a) Comparative Statics of the Equilibrium Thresholds due to an increase in fine, public enforcement, or externality.

(b) Comparative Statics of the Equilibrium Thresholds due to a Tighter Law.

Figure 8: Comparative statics in the lowest compliance equilibrium.

Next, let us suppose that $b < L$ when L declines slightly from its starting level. In that case, the derivative of the left-hand side is

$$\begin{aligned}
&-2a\left(\theta^* - L\right) \\
&+\left(\frac{1}{(1-\eta)\Pr(\theta > \theta^*)}\right)\left(2\Pr(\theta > \theta^*)(1-a)(L-b) + 2\Pr(\theta < \theta^*)a(\theta^* - L)\right. \\
&\left.- 2\Pr(\theta < \theta^*)(1-a)\mathbb{E}\left[(L - a\theta - (1-a)x)|\theta < \theta^*\right]\right)
\end{aligned}$$

and so

$$\begin{aligned}
\overline{\zeta} \;=\;& 2a(n-1)\left(\theta^* - L\right) \\
&-\left(\frac{n-1}{(1-\eta)\Pr(\theta > \theta^*)}\right)\left(2\Pr(\theta > \theta^*)(1-a)(L-b) + 2\Pr(\theta < \theta^*)a(\theta^* - L)\right. \\
&\left.- 2\Pr(\theta < \theta^*)(1-a)\mathbb{E}\left[(L - a\theta - (1-a)x)|\theta < \theta^*\right]\right).
\end{aligned}$$

This latter expression could be 0 or less, in which case the change is then unambiguous.

The rest of the results in parts 1 and 3 of the proposition follow directly from the inspection of equations (2) and (3). Finally, part 2 follows by considering large changes defined as changes that shift one of the two curves so much that the interior equilibria disappear. This case clearly leads to full compliance as the unique equilibrium and reduces overall average behavior. ∎

Proof of Propositions 6 and 7: Both of these results follow immediately by observing that in steady state, the maximization problem of agents is identical to that in the static model.The characterization of equilibrium proceeds in a similar fashion to the proof of Proposition 4, except that the distribution of behavior in the previous and the next generations needs to be treated separately. This leads to an immediate generalization of equations (2) and (3). The characterization of the threshold θ^* proceeds in exactly the same fashion as in the proof of Proposition 4 and is omitted. ∎

Proof of Proposition 8.

First let us note that generation 0's behavior is described by

$$\beta_0(\theta_i) = \beta^{\text{no law}}(\theta_i) = a\theta_i + (1-a)\mathbb{E}[\theta]. \tag{A11}$$

Consider an unanticipated tightening of the law to $L' < (1-a)\mathbb{E}[\theta] - a$. Let us start by analyzing the whistle-blowing behavior of type $\theta = 0$ of generation $t = 0$. Because society was previously in a full compliance steady-state equilibrium, all agents from generation $t = 0$, and in particular type $\theta = 0$, are law-abiding according to L and are hence grandfathered after the law change, and can whistle-blow. By whistle-blowing, type $\theta = 0$ can bring her partner with behavior $b > L'$ down to L' (this period's law). From (4), the gain of doing so is

$$\begin{aligned}(b-\beta_0(0))^2 - (L'-\beta_0(0))^2 &= (b-(1-a)E[\theta])^2 - (L'-(1-a)E[\theta]))^2 \\ &< (b-(1-a)\mathbb{E}[\theta])^2 - a^2\end{aligned}$$

where the equality uses the fact that, from (A11), $\beta_0(\theta = 0) = (1-a)\mathbb{E}[\theta]$, and the inequality exploits the fact that $L' < (1-a)\mathbb{E}[\theta] - a$. Then for any behavior $L' < b \leq a + (1-a)\mathbb{E}[\theta]$, the best response for type $\theta = 0$ is not to whistle-below. Thus, it is, a fortiori, the unique best response for any type to not whistle-blow against such behavior.

Next, consider behavior of generation $t = 1$. Now note that (i) this generation cannot whistle-blow on the previous generation (that was law-abiding according to L); (ii) there will not be whistle-blowing from the previous generation provided that $b \leq a + (1-a)\mathbb{E}[\theta]$; (iii) behavior in the next period does not matter for their utility given $\lambda = 0$. Then, for η sufficiently small (i.e., $\eta < \bar{\eta}$ with $\bar{\eta} > 0$ suitably defined) this generation will have a unique best response of $\beta^{\text{no law}}(\theta)$ as specified in (A11).

Next, consider the lowest compliance equilibrium β' and associated threshold $\theta^{*\prime}$ associated with L'. Note that $\mathbb{E}[\beta_1(\theta)] = \mathbb{E}[\theta] < \mathbb{E}[\beta'(\theta)|\theta > \theta^{*\prime}]$. Thus, the best response β_2 to

β_1 has a lower cutoff $\theta_2^* \leq \theta^{*\prime}$ and also, with the same reasoning as in the proof of Lemma 1, results in a strategy such that $\mathbb{E}[\beta_2(\theta)|\theta > \theta_2^*] \leq \mathbb{E}[\beta'(\theta)|\theta > \theta^{*\prime}]$. Iterating, the cutoff for law breaking of generation t, $\theta_t^* \leq \theta'$, and $\mathbb{E}[\beta_t(\theta)|\theta > \theta_t^*] \leq \mathbb{E}[\beta'(\theta)|\theta > \theta^{*\prime}]$ holds for every t, with an increasing sequence of cutoffs θ_t^*.

Note also, that in period 2 onwards, types with $\theta \leq L'$ will wish to abide by the law, since they can force any partners' behavior to be at most L', as their partners are not grandfathered under the original law, but must obey L'. Thus, although $\theta_1^* = 0$, thereafter $\theta_t^* > L'$. Since $\{\theta_t^*\}$ is an increasing sequence and bounded above by $\theta^{*\prime}$, it converges. Its limit point must then be the threshold for the lowest compliance steady-state equilibrium, and hence $\theta^{*\prime}$. Weak* convergence of the equilibrium actions to the steady-state then follows from the (uniquely-defined) form of the best responses described in the proof of Lemma 1.

Finally, note that the equilibrium is unique as each generation's behavior is completely determined by the previous generation's.

(*Gradual tightening of law*) Next consider a sequence of gradual tightenings defined by

$$L_1 = \beta_0(1) - \varepsilon = a + (1-a)\mathbb{E}[\theta] - \varepsilon,$$

and

$$L_t = \max[L', L_{t-1} - \varepsilon],$$

with ε defined below.

We next show inductively that each generation follows the current law given that all previous generations have. As the induction step, suppose that for all previous generations $t' < t$, $\beta_{t'}$ conforms to the law $L_{t'}$ and is a best response to the previous generation's strategy. We will then show that this is true for t.

We first show that for any type, choosing L_t is preferable to any behavior above L_t. The loss in utility from such conformity is bounded above by $a + (1-a)\varepsilon^2$ (where the first term is the loss in not matching own type, and the latter is the furthest change between any match from the previous generation from abiding compared to playing any higher strategy). Breaking the law, on the other hand, leads to a loss of at least $\eta\phi$ due to public enforcement. Thus, for $a + (1-a)\varepsilon^2 < \eta\phi$ the agents are better off abiding by the law than breaking it. Picking any $\bar{a} < \eta\phi$ and then setting $\varepsilon < \sqrt{(\eta\phi - a)/(1-a)}$ suffices to establish the result.

Once $L_t = L'$ after a finite number of steps, all future generations will obey the law L', and thereafter the argument in Lemma 1 implies that the behavior of all types is nonincreasing in time (and decreasing when it is above their steady-state behavior), and again the equilibrium strategy profile converges (weak*) to the full compliance steady-state equilibrium profile, as the limit point must be an equilibrium and it involves full compliance. ■

Proof of Proposition 9: To prove the first part, and note that with $L^2 = 1$ (i.e., no law on the second dimension), the equilibrium threshold θ^* is given by exactly the same characterization as in Proposition 4, and in particular, by the intersection of the left- and right-hand sides of equation (A10) above. Next consider the imposition of a law $\tilde{L}^2 = L^1$. Then, in the lowest compliance equilibrium, all law-abiding agents (those with types less than θ^{1*}) in the first dimension would also abide by the law in the second dimension (since the two dimensions are symmetric). But then types just above θ^{1*} now have an additional reason to abide by the law (on both dimensions), since this will give them an option to whistle-blow on very high behaviors on the other dimension. This shifts up the benefit to law-abiding behavior and thus the right-hand side of (A10), increasing θ^{1*} and reducing law-breaking. By continuity, the same argument applies to $\tilde{L}^2$ not too far from L^1, thus establishing that there exist $\bar{\delta}$ and $\underline{\delta}$ such that any $\tilde{L}^2 \in (L^1 - \underline{\delta}, L^1 + \bar{\delta})$ induces more law-abiding behavior on the first dimension.

To prove the second part, consider $\tilde{L}^2 > 0$ but small. This implies that only types very close to zero will abide by the law on the second dimension and thus there will be very little whistle-blowing on the first dimension, reducing θ^{1*} and thus encouraging law-breaking on the first dimension. ∎

Proof of Proposition 10: This proposition follows immediately from writing out the best responses of law-abiding and law-breaking agents as in the proofs of Proposition 3 and 4 with the assortative matching technology, and thus the details are omitted to save space. ∎

Proof of Proposition 11: The proof of this proposition closely follows the proof of Proposition 1 and is omitted. ∎

Proof of Proposition 12: To prove this result, note that the threshold for whistle-blowing $\bar{W}_\varepsilon(\theta_i)$ defined in the text as a function of the cost of whistle-blowing, ε, converges to L (for all $\theta_i \leq \theta^*$) as ε converges to zero. This ensures that any sequence of equilibria with costly whistle-blowing converges to an equilibrium of the baseline model (weak*) using standard upper hemicontinuity arguments (e.g., Theorem 2 of Jackson, Simon, Swinkels and Zame, 2002). ∎

Proof of Proposition 13: Let us first suppose that $\zeta = 0$, so that there are no externalities. Then, for a given law L and distribution of types F, consider first the level of fine $\phi_1 > \bar{\phi}$ so that there is full compliance (from Proposition 3). We will now compare utilitarian welfare in this full compliance equilibrium to that under the level of fine $\phi_2 < \bar{\phi}$ leading to partial compliance. Under partial compliance there exists a law-breaking threshold $\theta^* < 1$ such that below this threshold, there is law-abiding behavior, and above this threshold, there is law-breaking (and thus law-breaking for a positive measure of agents).

First, note that for all $\theta' \leq \theta^*$, behavior under both scenarios (where the fine is ϕ_1 and ϕ_2) is given by

$$\beta(\theta') = \min[a\theta' + (1-a)x, L],$$

where x is the unique fixed point of $x = \mathbb{E}[\min[a\theta + (1-a)x, L]]$. This follows because law-abiding agents can whistle-blow on law-breakers when they match and reduce their behavior to L. Since there are no externalities, this implies that these agents have exactly the same expected utility under both scenarios, i.e.,

$$U_2(\theta') = U_1(\theta') \text{ for all } \theta' \leq \theta^*,$$

where $U_k(\theta')$ denotes the expected utility of type θ' under scenario $k = 1, 2$.

Second, observe that all agents above $\theta' > \theta^*$ can still choose law-abiding behavior when the fine is $\phi_2 < \bar{\phi}$, which will give them exactly the same expected utility $U_1(\theta')$ as in the equilibrium with fine $\phi_1 < \bar{\phi}$. Since they choose to break the law, by revealed preference we have that $U_2(\theta') \geq U_1(\theta')$. But in fact we also know that only type θ^* is indifferent between law-breaking and law-abiding behavior, and thus we have

$$U_2(\theta') > U_1(\theta') \text{ for all } \theta' > \theta^*.$$

This implies that utilitarian social welfare is always strictly greater with partial compliance than full compliance when there are no negative externalities (i.e., $\zeta = 0$). But given this strict ordering, it also follows that for any level of fine $\phi_2 < \bar{\phi}$ (and thus for any partial compliance equilibrium), there exists $\bar{\zeta} > 0$ such that for $\zeta < \bar{\zeta}$, utilitarian social welfare is greater under the (nearby)[28] partial compliance equilibrium than under full compliance.

We prove the last claim in the proposition for an extreme distribution with equal weight on just two types, as this is easily extended to a continuous distribution that approximates this distribution. Consider a distribution with equal weight on two types, $1 > \theta_2 > \theta_1 > 0$, and let $\overline{\theta} = \frac{1}{2}(\theta_1 + \theta_2)$.

Consider any law L that is strict enough to have partial compliance, in particular such that

$$\overline{\theta} + \frac{a}{2}(\theta_2 - \theta_1) > L > \theta_1,$$

and a low enough ϕ so that there exists a partial/low compliance equilibrium (so that θ_1s comply and θ_2s do not). Then, the low compliance equilibrium is such that $\beta(\theta_2) = \theta_2$ and

$$\beta(\theta_1) = \frac{2a\theta_1 + (1-a)L}{1+a}.$$

The full compliance equilibrium has the same action for type θ_1, but $\theta_2 = L$ for type θ_2.

Let us thus check that there is a law $L < \overline{\theta} + \frac{a}{2}(\theta_2 - \theta_1)$ that leads to higher expected total utility than any $L \geq \overline{\theta} + \frac{a}{2}(\theta_2 - \theta_1)$. Given that the types θ_2 and θ_1 are both better off when meeting their own type under a partial compliance equilibrium than under no law, then taking externalities are sufficiently small, it is enough to show that the total utility of a type θ_1 meeting a θ_2 is better for at least some $L < \overline{\theta} + \frac{a}{2}(\theta_2 - \theta_1)$ than a law above

[28] Noting that the equilibrium changes continuously in a neighborhood if the equilibrium was not a tangency point, and that corresponding utilities vary continuously.

that threshold. The total utility just accounting for the cross-type matching and the portion affected by the law (when the externality is 0) is

$$-a(\frac{2a\theta_1 + (1-a)L}{1+a} - \theta_1)^2 - a(L-\theta_2)^2 - 2(1-a)(\frac{2a\theta_1 + (1-a)L}{1+a} - L)^2.$$

The derivative of this with respect to L is

$$-2a\left(\frac{(1-a)}{1+a}\right)^2 (L-\theta_1) - 2a(L-\theta_2) - 4(1-a)\left(\frac{2a}{1+a}\right)^2 (L-\theta_1).$$

When $L = \overline{\theta} + \frac{a}{2}(\theta_2 - \theta_1)$, this becomes

$$\begin{aligned} & -a\frac{(1-a)^2}{1+a}(\theta_2-\theta_1) + a^2(1-a)(\theta_2-\theta_1) - (1-a)\frac{8a^2}{1+a}(\theta_2-\theta_1), \\ & = a(1-a)(\theta_2-\theta_1)\left[\frac{-1+a+a+a^2-8a}{1+a}\right], \end{aligned}$$

which is negative, implying that the total utility is increased as L is decreased below $L = \overline{\theta} + \frac{a}{2}(\theta_2 - \theta_1)$ and there is partial compliance. ∎

References

Acemoglu, Daron (1995) "Reward Structures and the Allocation of Talent," *European Economic Review*, 39(1), 17-33.

Acemoglu, Daron, Davide Cantoni, Simon Johnson and James A. Robinson (2013) "The Consequences of Radical Reform: The French Revolution," *American Economic Review*, 101(7), 3286–3307.

Acemoglu, Daron, and Matthew O. Jackson (2013) "History, Expectations, and Leadership in the Evolution of Social Norms," MIT and Stanford, SSRN DP 1839768.

Akerlof, George, and Janet L. Yellen (1994) *Gang Behavior, Law Enforcement, and Community Values,* Canadian Institute for Advanced Research.

Aldashev, Gani, Imane Chaara, Jean-Philippe Platteau, and Zaki Wahhaj (2012) "Formal Law as a Magnet to Reform Custom," *Economic Development and Cultural Change,* 60(4): 795–828.

Barfield, Thomas (2010) *Afghanistan: A Cultural and Political History.* Princeton University Press, Princeton New Jersey.

Becker, Gary S. (1968) "Crime and Punishment: an Economic Approach," *Journal of Political Economy* 76(2): 169–217.

Becker, Gary S. and George J. Stigler (1974) "Law Enforcement, Malfeasance, and Compensation of Enforcers," *The Journal of Legal Studies* 3(1): 1–18.

Benabou, Roland, and Jean Tirole (2011) "Laws and Norms," NBER Working Paper 15579.

Berkowitz, Daniel, Katharina Pistor, and Jean-Francois Richard (2003) "Economic Development, Legality, and the Transplant Effect," *European Economic Review* 47(1): 165–195.

Bernstein, Lisa (1992) "Opting Out of the Legal System: Extralegal Contractual Relations in the Diamond Industry," *Journal of Legal Stud,* 21: 115.

Bierstedt, Robert (1963) *The Social Order* (Second Edition), McGraw-Hill, NY.

Bisin, Alberto, and Thierry Verdier (2001) "The Economics of Cultural Transmission and the Dynamics of Preferences," *Journal of Economic Theory*, 97: 298–319.

Calvó-Armengol, A. and Yves Zenou (2004) "Social Networks And Crime Decisions: The Role of Social Structure In Facilitating Delinquent Behavior," *International Economic Review,* 45(3): 939–958.

Cooter, Robert (1998) "Expressive Law and Economics," *Journal of Legal Studies*, 27.

Doepke, Matthias, and Fabrizio Zilibotti (2008) "Occupational Choice and the Spirit of Capitalism," *The Quarterly Journal of Economics*, 123(2): 747–793.

Ellickson, Robert (1991) *Order Without Law.* Harvard University Press, Cambridge.

Ferrer, Rosa (2010) "Breaking the Law when Others Do: A Model of Law Enforcement with Neighborhood Externalities," *European Economic Review* 54(2): 163–180.

Galor, Oded (2011) *Unified Growth Theory*, Cambridge, MA: MIT Press.

Giavazzi, Francesco, Ivan Petkov and Fabio Schiantarelli (2014) "Culture: Persistence and Evolution" NBER Working Paper.

Gibbs, Jack P. (1965) "Norms: The Problem of Definition and Classification," *American Journal of Sociology,* 70(5): 586-594.

Glaeser, Edward L., Bruce Sacerdote, and Jose A. Scheinkman (1996) "Crime and social interactions," *Quarterly Journal of Economics* 111(2): 507–548.

Hay, Jonathan R., Andrei Shleifer, and Robert W. Vishny (1996) "Toward a Theory of Legal Reform," *European Economic Review,* 40(3): 559–567.

Hay, Jonathan R., and Andrei Shleifer (1998) "Private Enforcement of Public Laws: A Theory of Legal Reform," *American Economic Review,* 88(2): 398–403.

Helliwell, John, Shun Wang, and Jinwen Xu (2014) "In How Durable are Social Norms? Immigrant Trust and Generosity" NBER Working Paper.

Hoffman, Martin L. (1977) "Moral Internalization: Current Theory and Research" in *Advances in Experimental Social Psychology*, Volume 10, New York: Academic Press.

Jackson, Matthew O., Simon, Leo K., Swinkels, Jeroen M., and William R. Zame (2002) "Communication and Equilibrium in Discontinuous Games of Incomplete Information," *Econometrica*, 70(5): 1711–1740.

Lynn, John A. (1997) *The Giant of the Grand Siecle: French Armies, 1600-1715,* Cambridge UK: Cambridge University Press.

Mailath, George J. and Larry Samuelson (2006) *Repeated Games and Reputations.* New York, Oxford University Press.

Morris, Richard T. (1956) "A Typology of Norms," *American Sociological Review*, 21(5): 610-613.

Nisbett, Richard, and Dov Cohen, (1996) *Culture of Honor: The Psychology of Violence in the South.* Westview Press.

Parsons, Timothy (2010) *The Rule of Empires: Those Who Built Them, Those Who Endured Them, and Why They Always Fall.* Oxford University Press.

Pinker, Steven (2011) *The Better Angels of Our Nature: Why Violence Has Declined.* New York: Viking.

Pistor, Katharina (1996) "Supply and Demand for Contract Enforcement in Russia: Courts, Arbitration, and Private Enforcement," *Review of Central and East European Law,* 22: 55–87.

Posner, Eric (2002) *Laws and Social Norms.* Cambridge: Harvard University Press.

Posner, Richard (1997), "Social Norms and the Law: An Economic Approach" *The American Economic Review*, 87:2, 365-369.

Rasmusen, Eric Bennett (1996) "Stigma and Self-Fulfilling Expectations of Criminality." *Journal of Law and Economics*39: 519–544.

Sah, Raaj K. (1991) "Social Osmosis and Patterns of Crime," *Journal of Political Economy,* 1272–1295.

Shavell, Steven M. (2004) *Foundations of Economic Analysis of Law.* Belknap Press of Harvard University Press, Cambridge MA.

Simmel, Georg (1903) *The Metropolis and Mental Life*, Dresden: Petermann.

Simmel, Georg (1908) *Sociology: Investigations on the Forms of Sociation*, Leipzig: Duncker and Humblot.

Sorokin, Pitirim A. (1947) *Society, Culture, and Personality*, Harper and Brothers, New York, NY.

Tabellini, Guido (2008) "The Scope of Cooperation: Values and Incentives," *Quarterly Journal of Economics*, 123(3): 905–950.

Tyler, Tom R. (1990) *Why Do People Obey the Law.* Yale University Press, New Haven, Connecticut.

Williams, Robin M. (1960) *American Society: A Sociological Interpretation*, Alfred A Knopf, New York NY.

Wilson, James Q and George Kelling (1982) "Broken Windows: The Police and Neighborhood Safety," *The Atlantic.*

Woodward, Comer V. (1955) *The Strange Career of Jim Crow.* Oxford University Press, New York.

Wright, Gavin (2013) *Sharing the Prize: The Economics of the Civil Rights Revolution in the American South.*

Wyatt-Brown, Bertram (1982) *Southern Honor: Ethics and Behavior in the Old South.*Oxford University Press, New York.

Young, Peyton H. (1998) *Individual Strategy and Social Structure: An Evolutionary Theory of Institutions.* Princeton University Press, Princeton New Jersey.