Witness Intimidation*

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Abstract

Witness intimidation is a fundamental threat to the rule of law. It also involves significant strategic complexity and two-sided uncertainty: a criminal cannot know whether his threat will effectively deter a witness from testifying, and a witness cannot know whether the threat will in fact be carried out. We model this interaction and explore the manner in which equilibrium rates of intimidation, testimony, and conviction respond to changes in prosecutorial effectiveness, police-community relations, and witness protection programs. An increase in prosecutorial effectiveness raises the incentives for criminals to threaten witnesses but also makes these threats less credible. Sometimes the rise in threats will be large enough to drive down the rate of conviction, with the paradoxical outcome that better prosecutors may convict fewer criminals. Direct attempts to reduce witness tampering may also prove counterproductive. When the harm faced by a witness itself depends on whether or not the criminal is convicted, communities can be trapped in equilibria with collective silence: no witness testifies because none expects others to testify.

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1 Introduction

If you commit a crime, you will usually escape punishment if no one testifies against you. So you have an interest in keeping witnesses from testifying. If criminals often succeed in deterring testimony, however, the criminal justice system withers, and laws can be broken with impunity. Witness intimidation is a fundamental threat to the rule of law.

Empirical data on witness intimidation are hard to come by. When intimidation is successful, law enforcement officials seldom hear about it, and the police may not even learn about the underlying crime. A survey in the Bronx courts in 1988 found astonishing levels of intimidation: 36% of victims and witnesses said they had been threatened, 57% of those who had not been explicitly threatened feared reprisals, and 71% of witnesses said they would feel threatened if the defendants were released on bail (Finn and Healey, 1996). Since these respondents were in court, this survey provides a snapshot of *unsuccessful* intimidation; it tells us nothing about the extent of successful intimidation. A British survey (Maynard, 1994) found much smaller rates of (unsuccessful) intimidation in the general population, but considerably more activity in high-crime housing estates, where victims, offenders, and witnesses all tended to know each other and live in close proximity. Later British reports (Tarling *et al.*, 2000) relied on household surveys and so could detect some successful intimidation, but they found much smaller rates of occurrence than the Bronx survey did. Both British surveys are mainly about crimes like vandalism and car theft; little is known about murder and other more serious crimes.

While quantitative data are scarce, anecdotal evidence is plentiful. Police in many cities, including Baltimore, New Orleans, Boston, and Newark describe chronic difficulties with witnesses who refuse to step forward, and witnesses who change their testimony at the last minute. And certain spectacular instances of intimidation have occasionally been reported in the national press (Kocieniewski, 2007):

> A woman who was standing 10 feet away when a stray bullet from a gang fight struck 7-year-old Tajahnique Lee in the face told the police she had been too distracted by her young son to see who fired the shots. A man who was also in the courtyard when that .45-caliber round blew Tajahnique off her bicycle told detectives he had been engrossed in conversation with neighbors and ducked too quickly to notice what had happened. Indeed, at least 20 people were within sight of the gunfight among well-known members of the Sex Money Murder subset of the Bloods gang 15 months ago, but the case remains unsolved because not a single one will testify or even describe what they saw to investigators. The witnesses include Vera Lee, Tajahnique's grandmother,

> who declined to be interviewed for this article. People who have spoken to her about the shooting said she would not talk to the police for fear she would "have to move out of the country."

In some cases, witnesses fear a loss of reputation rather than physical harm. Hip-hop artist Lil' Kim served 10 months in prison for perjury after testifying before a federal grand jury that she had not seen her manager and bodyguard at the scene of a 2001 shootout in New York City. Prior to her incarceration, the artist was featured on a television reality show "Lil' Kim: Countdown to Lockdown", promoted with the slogan "She's going to prison with her mouth shut and her head held high" (Kennedy, 2006). Less prominent witnesses fear a different kind of reputation loss; even if there is no danger of injury, exclusion from social networks can be costly enough to deter cooperation with police. Acceptance in such networks can be a matter of survival, especially if the witness finds himself in prison on some other matter.

Threats to witnesses and their families need not be explicit in order to be effective. Symbolic displays work as well as (or better than) verbal threats as long as they are understood by witnesses. Witness intimidators, for instance, can make phone calls in the middle of the night and hang up, puncture tires, or leave dead fish in the mail box. More diffusely, "acting like a gangster (or gangsta)" can be an implicit threat in a society where gangsters are known to harm witnesses. In this context, "acting like a gangster" can mean not only wearing gangster clothing, but also committing crimes as a gangster would commit them—brazenly, fearlessly, without subterfuge. Thus, ironically, a person who tries to shoot someone surreptitiously and flee quickly may end up with more witnesses testifying against him than someone who shoots his victim in broad daylight on a busy street and strides away unperturbed. The latter *modus operandi* is a non-verbal threat to bystanders. While such behavior is often associated with urban gangs today, it has a long history in the annals of organized crime (Adler, 2006):

> The behavior identified with the Black Hand, in short, obscured the motives of many Italian murderers and stymied police investigations, fueling the Black Hand mystique and encouraging killers to hide behind its shroud. This strategy succeeded. Between 1910 and 1920 Chicago policemen and prosecutors secured convictions for 21 percent of the city's homicides. Among homicides labeled Black Hand killings, only 4 percent of killers were convicted—providing another incentive for non-gangsters to kill in public (ideally near Death Corner), use sawed-off shotguns, and whisper about extortion letters, *omerta*, and the code of personal vengeance. Similarly, police made arrests in

> only 21 percent of Black Hand killings, compared with 71 percent for all of the city's homicides. During the trial in one of the few cases in which law enforcers made an arrest and secured an indictment, a stranger walked into the courtroom and waved a red handkerchief. Seeing this, the Italian immigrant on the witness stand instantly fell silent and "refused to answer any questions by the prosecutor"...
>
> Neither law enforcers nor newspaper reporters were able to distinguish Black Hand murders from murders merely committed in the Black Hand style. Thus, the Black Hand provided a kind of default explanation for Italian homicides. Italian killers eager to disguise their motives invoked the name and imagery of the secret society of assassins, but so, too did law enforcers unable to solve Italian crimes and journalists itching to write about shotgun-packing Sicilians.

As the example of the Back Hand illustrates, witnesses can never be entirely certain that the threatening signals they observe come from authentic sources or from less dangerous imitators. A witness therefore faces a complex inference problem in deciding how seriously to take a threat. Furthermore, the manner in which witnesses respond to threats will influence the extent to which criminals find it worthwhile to make threats in the first place. Hence the extent of intimidation, the credibility of threats, and the likelihood of witness testimony are all jointly determined, and depend in complex ways on such factors as the effectiveness with which the prosecutor's office can win convictions once a witness comes forward.

This paper is an attempt to explore the manner in which equilibrium rates of intimidation, testimony, and conviction respond to changes in prosecutorial effectiveness, witness protection policies, and police-community relations. We develop a strategic model of criminal and witness behavior which allows for uncertainty on the part of both groups: some witnesses testify despite being threatened, and some criminals make threats that they have no intention of carrying out. We focus on two key probabilities: the likelihood of witness testimony conditional on a threat, and the likelihood that a witness will be harmed conditional on testifying. Both of these are endogenously determined in equilibrium. Under empirically plausible conditions, an increase in prosecutorial effectiveness raises the incentives for criminals to threaten witnesses but also makes these threats less credible. The reason is that the marginal criminal (who is indifferent between threatening the witness and not doing so) is bluffing and has no intention of carrying out the threat. A shift in the margin which raises the incidence of threats also disproportionately raises the incidence of bluffing. Since witnesses cannot distinguish between genuine and empty threats, this makes the average threat less credible and raises the likelihood of witness testimony conditional on a threat. Despite this effect, the overall rate of witness testimony may decline, since more witnesses are threatened. In certain cases, even the conviction rate may decline: a prosecutor's office that is better able to obtain a conviction once a witness has come forward may end up with fewer convictions per unit of crime. Better prosecutors will sometimes convict fewer criminals because of witness intimidation.

Witness protection policies, which make it more costly to harm witness, have effects that are similar to increases in prosecutor effectiveness. Threats become less credible and witnesses are accordingly more likely to ignore them. If increases in prosecutor effectiveness raise the rate of testimony, then witness protection increases the rates of testimony and conviction. However, a narrowly tailored policy that simply makes threatening behavior more costly can have precisely the opposite effect. Fewer criminals threaten witnesses, but those that do are less likely to be bluffing. Threats therefore provide a stronger deterrent to witnesses, and the rates of testimony and conviction may therefore decline. On the other hand, improvements in the underlying willingness of witnesses to testify, which we call police-community relations, unambiguously raise rates of testimony and conviction.

We extend this basic model to allow for the possibility that a conviction makes it less likely that a threat will be carried out, and for multiple witnesses. When there are two witnesses, criminals must decide whether to threaten one, both or none of them. Since witnesses are unaware of whether or not other witnesses have been threatened, this can give rise to tipping phenomena and multiple equilibria. Some of these equilibria involve *collective silence*: witnesses fear that others have been threatened and will not come forward, which makes conviction less likely, and hence makes it more likely that they will be harmed if they testify. Communities can be caught in inferior equilibria where no witness testifies because each expects no one else to testify. Breaking this cycle of reticence is a critically important component of any crime reduction policy.

The analysis in this paper begins at the stage when a crime has already been committed in the presence of one or more witnesses. This restriction means we cannot deal with two important questions: what effects witness intimidation and attempts to combat it have on the volume of crime, and how they affect the probability that an innocent person will be convicted. The danger of convicting innocent people rules out one otherwise obvious solution to the problem of witness intimidation: prosecutors cannot pay witnesses who testify (at least overtly). Purchased testimony is not credible testimony. Authorities can and often do pay for tips rather than testimony, but tips are generally useful only if they result in supporting physical evidence or credible witness testimony.

We also rule out cases where the criminal kills the witness to keep her from testifying. Marvell and Moody (2001) show that 3-strikes laws increase the number of such murders, and numerous specific murders have been attributed to this motive. (For instance, a famous 2004 quadruple homicide in which the victims' bodies were dumped next to St. Thomas Aquinas Church in Newark was alleged to have been driven by this concern.) The strategic considerations in these circumstances are very different from the ones we consider here. Accordingly, we deal only with situations in which the criminal is either unwilling or unable to kill the witness preemptively.

Despite its prevalence and importance, witness intimidation has received little theoretical attention in the economics literature. A notable exception is Akerlof and Yellen (1994), who model the interactions between a community, a gang, and a government, and explore the determinants of the equilibrium level of crime and community cooperation. They allow for the possibility that a fear of reprisals by the gang can affect the community's willingness to cooperate with police. However, their model does not explain why the community believes it has to fear reprisals, or why the gang would carry them out, or what steps authorities could take to make the community less fearful. We concentrate on a small part of the world that Akerlof and Yellen discuss, but derive our results from first principles, and explore in detail the effects of public policy on the extent of witness intimidation.

2 The Model

2.1 Basics

Consider an individual who has already committed a crime but has yet to be convicted. The testimony of a single witness is crucial to the case against him (we consider the case of multiple witnesses below). If the witness testifies, the probability of conviction is $e \in (0, 1)$, where e reflects the effectiveness of the prosecutor, and depends on such factors as resource availability, motivation and competence.[1] If convicted, the criminal receives a punishment $\rho > 0$. If the witness does not testify, the probability of conviction is 0 and the payoff to the criminal in this case is also normalized to equal 0.[2]

Before the witness has the opportunity to testify, the criminal may send a costly signal, which we shall refer to as a *threat*. The signal itself does not harm the witness but (for reasons given below)

[1] To be precise, the variable e represents the effectivenss of the prosecutor with respect to the original crime, and not the secondary charges that could stem from witness intimidation. We examine policies that directly target witness intimidation separately below.

[2] Notice that in this formulation with only one point of testimony we are abstracting from the usual process of statements to police, grand jury testimony, and trial jury testimony. Intimidation can occur at any stage, and in general if it is successful at any stage the criminal will not be punished. Further work, especially empirical work, will have to distinguish among these stages, but a model with only one stage can capture most of the strategic considerations involved.

may deter him from testifying. If a witness chooses to testify despite having received a threat, the criminal may attack the witness. We assume that no criminal wishes to attack a witnesses who does *not* testify, since there is no revenge motive to outweigh the costs of doing so, and we have ruled out preemptive murder. If the criminal does attack he incurs a cost γ while the witness suffers damages $\delta > 0$. While δ is exogenously given and commonly known, γ is private information, known only to the criminal, and drawn from a distribution $F(\gamma)$ with support $\mathbf{R}$. Criminals with $\gamma < 0$ enjoy harming witnesses who testify against them, and this is precisely the set of criminals who will attack if testified against. Since γ is unobservable, witness behavior will depend on expectations of γ conditional on a threat, which in turn will depend on the equilibrium behavior of criminals.

A key assumption is that the cost of threatening the witness is correlated with the cost of subsequently harming the witness. Specifically, we assume that the cost of making a threat is a strictly increasing function $h(\gamma)$ satisfying $h(0) = 0$. Hence a criminal who takes pleasure in harming a witness who testifies also takes pleasure in threatening the witness to begin with. We show below that such individuals will always make threats in equilibrium, although some individuals with $\gamma > 0$ will also make threats.

If the witness does not testify his payoff is 0 (regardless of whether or not he was threatened). If he does testify, he obtains a payoff β which is private information and drawn from a distribution $G(\beta)$ with support $\mathbf{R}$. This should be interpreted as the subjective benefit of doing one's duty as a citizen, or the satisfaction of contributing to the conviction of an offender, net of the private costs of doing so. Witnesses with $\beta < 0$ are recalcitrant: they are unwilling to testify even if there is no likelihood of being attacked for doing so. Some witnesses with $\beta > 0$ will also be unwilling to testify, provided that the expected damages from being attacked for doing so are strictly positive.

2.2 Equilibrium

Let q denote the likelihood that a witness will testify conditional on being threatened, and p the likelihood that a witness will be attacked conditional on testifying after being threatened. Similarly, let $\hat{q}$ denote the likelihood that a witness will testify when left unthreatened, and $\hat{p}$ the likelihood that such a witness will be attacked conditional on testifying. As noted above, a witness who does not testify is never attacked.

Let π_0^c denote the expected payoff to the criminal from *not* threatening the witness, and π_1^c the criminal's payoff conditional on making the threat. Note that regardless of whether not a threat has been made, a criminal will harm a witness who testifies if and only if $\gamma < 0$. Hence we have

$$\pi_0^c = -\hat{q}\left(e\rho + \min\{0, \gamma\}\right), \tag{1}$$

$$\pi_1^c = -q\left(e\rho + \min\{0, \gamma\}\right) - h(\gamma). \tag{2}$$

The following result establishes that in equilibrium only witnesses who are threatened have a positive probability of being attacked, and threats therefore reduce the likelihood of witness testimony (see the appendix for all proofs):

Proposition 1. *In equilibrium* $\hat{p} = 0$ *and* $q < \hat{q} = 1 - G(0)$.

The payoffs (1-2) for any criminal with $\gamma > 0$ may be written:

$$
\begin{aligned}
\pi_0^c &= -\hat{q}e\rho, \\
\pi_1^c &= -qe\rho - h(\gamma).
\end{aligned}
$$

Such a criminal will be indifferent between threatening a witness and not doing so if

$$h(\gamma) = e\rho\left(\hat{q} - q\right).$$

Hence for any given q there exists a unique threshold $\tilde{\gamma}(q) \geq 0$ such that $\pi_0^c = \pi_1^c$ if $\gamma = \tilde{\gamma}(q)$. If γ lies below this threshold, then $\pi_0^c < \pi_1^c$ so the criminal will threaten the witness, and if γ lies above the threshold then $\pi_0^c > \pi_1^c$ so the witness will remain unthreatened. The threshold $\tilde{\gamma}(q)$ is itself strictly decreasing in q: the greater the proportion of witnesses who testify despite being threatened, the smaller the proportion of criminals who make threats.

Given any value of $q \in [0, 1]$, the best response by the criminal induces a unique value of p given by

$$p = \frac{F(0)}{F(\tilde{\gamma}(q))}. \tag{3}$$

This is because a proportion $F(\tilde{\gamma}(q))$ of criminals threaten, and a proportion $F(0)$ of criminals both threaten and attack a witness who testifies. We refer to the (p, q) locus defined by (3) as the *criminal reaction curve*. Note that since $\tilde{\gamma}(q)$ is decreasing, this curve is upward sloping. This makes sense: higher values of q mean that threats are less effective as a deterrence measure, and hence fewer criminals with $\gamma > 0$ bother to make them. The pool of criminals who continue to threaten is therefore composed of a greater share of those with $\gamma < 0$, and hence the likelihood of attack conditional on testimony is higher.

Now consider the witness payoffs. Let π_0^w denote the expected payoff to the witness from *not* testifying if threatened and π_1^w the witness's payoff conditional on testifying after being threatened. Then

$$
\begin{aligned}
\pi_0^w &= 0, \\
\pi_1^w &= \beta - p\delta.
\end{aligned}
$$

For any given p, a witness with β above $p\delta$ will testify and one with β below this threshold will not. The threshold itself is increasing in p: if the threat is a more credible signal of a future attack it will deter a larger proportion of witnesses from testifying. Given any value of p, the best response by the witness induces a unique value of q given by

$$q = 1 - G(p\delta). \tag{4}$$

This is the proportion of witnesses who testify despite being threatened. The (p, q) locus defined by (4) is the *witness reaction curve*. This curve must be downward sloping: higher values of p mean that testifying is riskier, which induces a smaller proportion of witnesses to come forward.

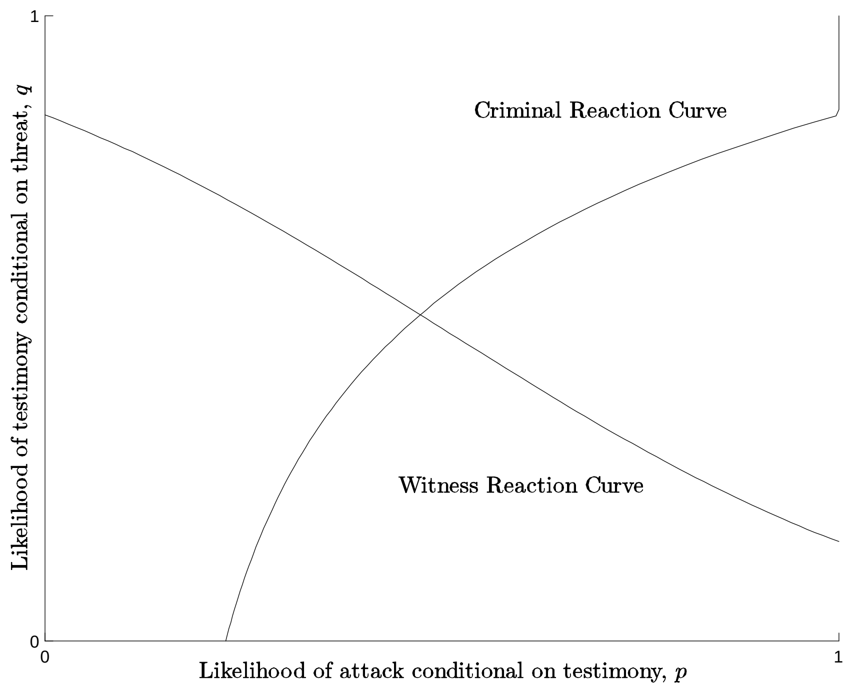

Figure 1. Equilibrium threat and conditional attack probabilities.

A pair (p, q) is an equilibrium if and only if it is a solution to (3–4). Figure 1 shows the reaction curves and the corresponding equilibrium for a particular numerical specification of the model. In this example there exists a unique, interior equilibrium, a property that can be shown to hold in general:

Proposition 2. *There exists a unique equilibrium* $(p, q) \in (0, 1)^2$.

We have implicitly assumed that criminals have only one tool to keep witnesses from testifying: they can threaten them with harm for testifying, but cannot entice them with rewards for not testifying. What if criminals were endowed with carrots as well as sticks? The problem with carrots is credibility. An equilibrium with witness intimidation can be maintained only if some positive fraction $F(0)$ of criminals are actually better off inflicting harm *ex post* on those who testify. If $F(0) = 0$, witnesses can never be intimidated because no criminals will ever actually punish them after they have testified. Criminals who promise rewards rather than punishment would be believed only if some criminals would actually be better off paying silent witnesses after the fact than not paying them. Absent very large considerations of reputation, this is unlikely. Indeed, most anecdotes about payments to witnesses rather than threats are about large, long-lived, and extremely visible organizations like major corporations, political parties, and some traditional organized crime families. These are organizations with highly valued reputations.

We next explore how equilibrium rates of intimidation, testimony, and conviction respond to changes in prosecutor effectiveness, witness protection programs, and police-community relations.

3 Prosecutor Effectiveness

Let t denote probability that the witness will receive a threat:

$$t = F(\tilde{\gamma}(q)). \tag{5}$$

We shall refer to this as the *rate of witness intimidation*. Note from (3) that t and p are inversely related: the greater the proportion of criminals who threaten witnesses, the smaller the likelihood that a threatened witness who testifies will subsequently be attacked. This is because of a pool composition effect: the increase in t comes about through a greater willingness to threaten on the part of those criminals with $\gamma > 0$, who would not subsequently attack a testifying witness.[3]

Since all unthreatened witnesses testify and threatened witness testify with probability q, the unconditional probability that the witness will testify is

$$s = 1 - t + tq. \tag{6}$$

We shall refer to s as the (unconditional) *rate of witness testimony*. Hence the likelihood that the criminal will be convicted, which we call the *conviction rate* r, is simply

$$r = es. \tag{7}$$

[3] This is precisely the kind of effect identified in O'Flaherty and Sethi (2007) to explain why robberies have become less frequent but more violent.

The following result identifies the effects of changes in prosecutor effectiveness e on equilibrium levels of p, q, r, s, and t.

Proposition 3. *An increase in prosecutor effectiveness lowers the likelihood of attack conditional on testimony, raises the likelihood of testimony conditional on a threat, raises the rate of witness intimidation, and has ambiguous effects on the rates of witness testimony and conviction.*

The effects of a rise in prosecutor effectiveness are illustrated in Figure 2. A rise in e leaves the witness reaction curve unaffected, but shifts the criminal reaction curve to the left. This lowers p and raises q: threats become less credible and witnesses are more likely to ignore them. The result is a rise in $\tilde{\gamma}(q)$, the cost threshold at which a criminal is indifferent between making a threat and not doing so. Hence more criminals engage in threatening behavior. Since the marginal criminal is bluffing, the credibility of threats declines.

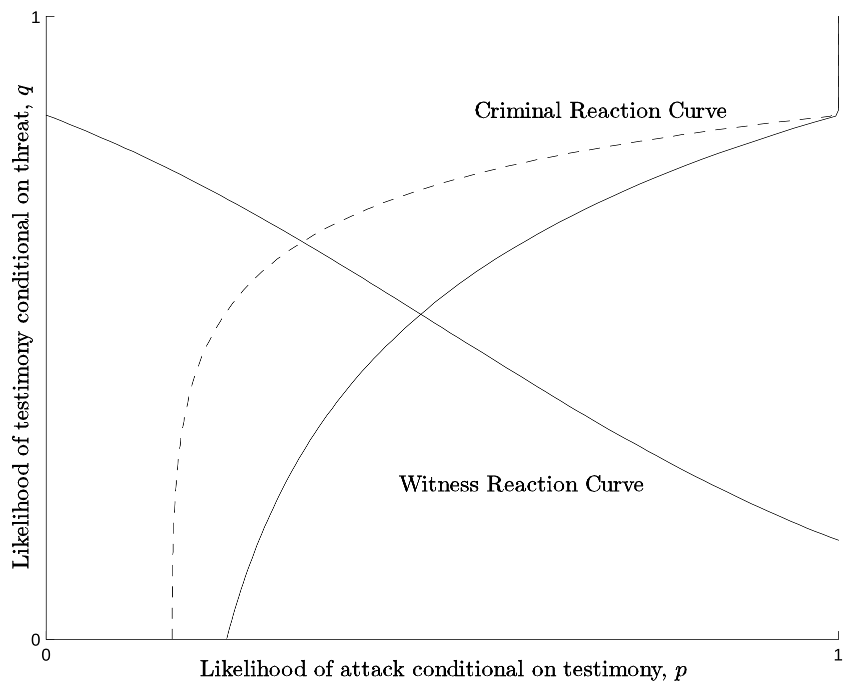

Figure 2. Effects of a change in prosecutor effectiveness.

Although greater prosecutor effectiveness raises the likelihood that a *threatened* witness will testify, it may lead to a decline in the overall rate of witness testimony since the proportion of witnesses who are threatened also rises. Since a rise in prosecutor effectiveness results in the movement along the witness reaction curve, it is the shape of this function that determines the effect of e on s. The shape of the witness reaction function, in turn, depends on the properties of the distribution function $G(\beta)$ and the corresponding density $g(\beta)$.

For the special case in which $g(\beta)$ is nondecreasing, we can show that an increase in prosecutor effectiveness e must result in a *decline* in the rate of testimony s. To see this, note from (6), (5) and (3) that

$$s = 1 - \left(\frac{1-q}{p}\right) F(0).$$

So testimony is constant along any (p, q) locus along which $(1-q)/p$ is constant. This defines a set of *isotestimony lines* all of which pass through the point $(p, q) = (0, 1)$, as illustrated in Figure 3. Steeper lines correspond to smaller rates of witness testimony.

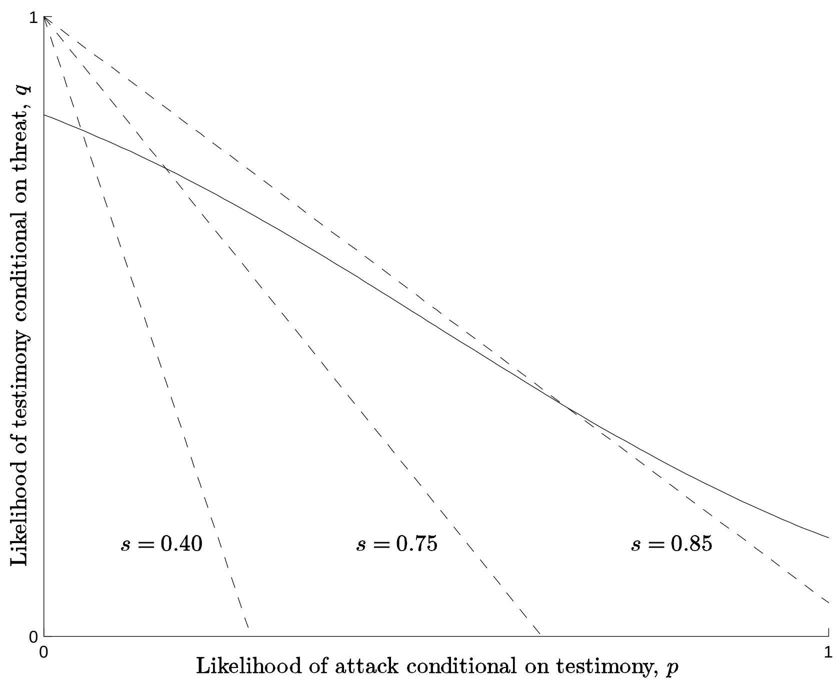

Figure 3. Isotestimony lines and the witness reaction curve

Any increase in prosecutor effectiveness corresponds to an upward shift in the criminal reaction curve and hence a movement left along the witness reaction curve (as shown in Figure 2). The effect of such a change on the rate of testimony depends on whether the new equilibrium lies on a higher or lower isotestimony curve. In the example depicted in Figure 3, a rise in e results in a decline in s. In fact, since the vertical intercept $1 - G(0)$ of the witness reaction curve is strictly less than 1, a rise in e *must* result in a decline in s whenever the witness reaction curve is convex. Furthermore, from (4), the witness reaction curve is convex if and only if the density function $g(\cdot)$

is nondecreasing. In particular, if β is uniformly distributed, greater prosecutor effectiveness results in a lower rate of witness testimony.

What if $g(\cdot)$ is decreasing on some part of its domain? Then the witness reaction curve will not be convex and the effect of e on s is theoretically indeterminate. As can be seen from figure 3, however, even in this case a rise in prosecutor effectiveness *could* result in a decline in the rate of witness testimony although it may do so only over some range of values of e. In particular, if β is normally distributed, then small increases in e will decrease s when either almost all witnesses testify or almost no witnesses testify. In either tail of the normal distribution, the witness reaction curve is almost flat. When β is normally distributed, it is only when around half of witnesses testify that small increases in prosecutor effectiveness are likely to raise the rate of testimony.

Recall that greater prosecutor effectiveness causes threatened witnesses to testify at higher rates (since the threats themselves are less credible). Furthermore, the criminal is more likely to be convicted conditional on the witness testifying when the prosecutor is more effective. Nevertheless, if the likelihood of witness testimony declines appreciably, then *greater prosecutor effectiveness may result in a lower conviction rate for offenders.* This is illustrated for a particular numerical specification of the model in Figure 4, which shows how the conviction rate varies with prosecutor effectiveness.

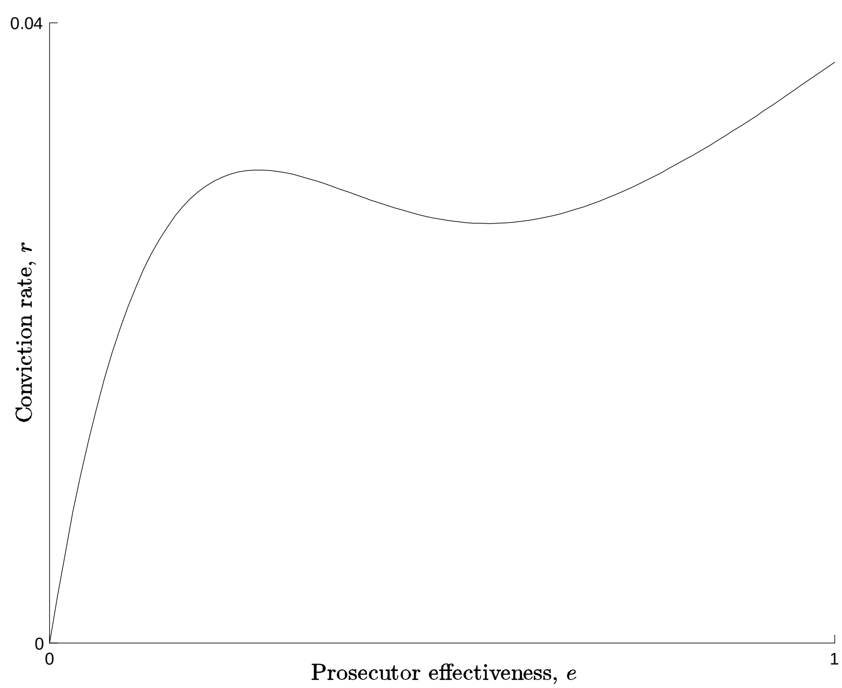

Figure 4. Conviction rate as a function of prosecutor effectiveness.

To understand why greater prosecutor effectiveness can lower the conviction rate, consider an initial equilibrium state (p, q) such that the distribution function $F(\gamma)$ is very steep at the threshold cost $\tilde{\gamma}(q)$. In this case a small increase in e will result in a large increase in the proportion of criminals who threaten witnesses and hence a large increase in t. As long as the resulting effect on q is modest, the rise in witness intimidation can outweigh both the greater likelihood of conviction contingent on witness testimony, as well as the increased propensity for threatened witnesses to testify. Hence the proportion of crimes that result in a conviction may not a reliable indicator of the effectiveness of a prosecutor.

4 Witness Protection

As noted above, the probability of conviction e refers to the original crime and not the likelihood of conviction on charges related to witness intimidation. However, law enforcement officials can also use resources to make intimidation more costly, by prosecuting threats to witnesses or attacks on them, or by protecting witnesses from threatening or harmful behavior.

Most discussion in the criminal justice literature about witness intimidation is about raising the cost of making or carrying out threats (see, for instance, Finn and Healey, 1996). Thus police and prosecutors strive to keep witnesses and defendants apart in precincts and court houses, hide the identity of witnesses from defendants as much as the law will permit, separate incarcerated witnesses from the general population, seek quick trials so that intimidation schemes have less opportunity to work, request high bail so that defendants have to stay in jail, relocate witnesses temporarily or permanently, and prosecute offenders under a panoply of different laws about witness tampering, accomplices after the fact, and obstruction of justice.[4]

From the perspective of the model, such efforts shift the cost distribution $F(\gamma)$ to the right, raising the costs of intimidation for criminals of every type. Holding constant the function $h(\gamma)$, this also implies a higher cost of making threats. Specifically, let F and F' be two distributions of γ, and suppose that F' stochastically dominates F and the monotone likelihood ratio property holds. That is, the ratio of the density functions $f'(x)/f(x)$ is increasing in x for all x. Then we say that the change from F to F', everything else being equal, is a *witness protection policy.* The following result establishes conditions under which a witness protection policy increases the rates of testimony and conviction.

[4] "Vertical prosecution" might also be viewed as a tool for reducing witness tampering. In vertical prosecution, a large proportion of a gang's hierarchy is indicted simultaneously and held on high bail, so that few members are left on the street to intimidate witnesses.

Proposition 4. *A witness protection policy lowers the likelihood of attack conditional on testimony, and raises the likelihood of testimony conditional on a threat. If increases in prosecutor effectiveness increase the rate of testimony, then witness protection policies increase the rates of testimony and conviction.*

The intuition underlying this result is as follows. For any given value of q, stochastic dominance and the monotone likelihood ratio property imply that when witness intimidation becomes more costly, the distribution of γ shifts to the right in such a fashion that $F(0)/F(\tilde{\gamma})$ falls. Holding q constant, p falls: threats are less credible because relatively fewer criminals will carry them out. This shifts the criminal reaction curve to the left, just as in Figure 2. Because threats are less credible, the new equilibrium has lower p and higher q. In this sense, witness protection is just like increases in prosecutor effectiveness: whether the shifts in p and q increase the rate of testimony depends on the properties of the witness response curve. If the witness response curve is such that increases in prosecutor effectiveness raise the rate of testimony, then witness protection will do the same.

But in addition to changing equilibrium p and q, witness protection also changes the distribution of γ. In particular, for every q the associated rate of threatening falls:

$$t' = F'(\tilde{\gamma}(q)) < F(\tilde{\gamma}(q)) = t$$

In equilibrium this shift in the distribution of γ offsets in part or in whole the rise in q. Thus witness protection can reduce the rate of threatening even when increases in prosecutor effectiveness work in the opposite direction. Thus witness protection will sometimes raise the rate of testimony when increases in prosecutor effectiveness reduce it. On the other hand, if witness protection reduces the rate of testimony, it also reduces the rate of conviction. Increases in prosecutor effectiveness can offset decreases in the rate of testimony, but witness protection cannot.

An alternative to a comprehensive witness protection policy is one that specifically targets the making of symbolic or literal threats, and hence affects only the $h(\gamma)$ function. Specifically, suppose that h and h' are threat cost functions, $h'(0) = 0$, and $h'(\gamma) > h(\gamma)$ for all $\gamma > 0$. Then we say that the change from h to h', everything else being equal, is a *threat reduction policy.* It turns out that the effects of such policies are very different from the effects of changes in prosecutor effectiveness and witness protection. Threat reduction policies are most effective precisely when increases in prosecutor effectiveness are *ineffective* in raising the level of testimony:

Proposition 5. *A threat reduction policy raises the likelihood of attack conditional on testimony, and lowers the likelihood of testimony conditional on a threat. If increases in prosecutor effectiveness lower the rate of testimony, then threat reduction policies raise the rates of testimony and conviction.*

The logic underlying this result is as follows. When the costs of making threats rise, fewer people make threats, but relatively more of them are people who will carry out those threats. Threats become more credible, and the criminal reaction curve shifts to the right. This is the opposite of what happens when prosecutor effectiveness improves or witness protection is increased. Hence p rises and q falls relative to the initial equilibrium. The effect of such a policy on the rate of testimony is therefore precisely the opposite of the effect of improvements in prosecutor effectiveness.

This raises an interesting possibility: rates of testimony and conviction could be increased by making symbolic threats *more* rather than less common. This dilutes the information that they carry, and makes them less effective deterrents to witness testimony. When threats are symbols like gangster clothing, there may be gains to subsidizing such activities. Encouraging people to adopt the indicia of gangsterhood erodes the value of these symbols; p falls for any q, and in the new equilibrium, "threats" are more frequent but less credible and more often resisted. If increases in prosecutor effectiveness raise the rate of testimony, then so does paying people to acquire MS-13 tattoos.[5]

To summarize, both witness protection policies and threat reduction policies affect the location of the criminal reaction curve, but in opposing ways. The former act like an increase in prosecutor effectiveness, while the latter have the opposite effect. Each of the two approaches an be effective given the right circumstances. But neither is guaranteed to work, and for each policy there are some circumstances in which it reduces conviction rates.

What about adopting both witness protection and threat reduction policies simultaneously? This question is important because many of the traditional tactics for reducing witness intimidation—holding defendants on high bail, for instance—do both. In (p, q)-space, these two policies shift the criminal reaction curve in opposite directions. The easiest combination to think about then is one where these shifts are perfectly offsetting and the criminal reaction curve is left unaffected. This means that equilibrium p and q stay the same. But since the distribution of γ changes, the rate of threatening falls in equilibrium, and the rate of testimony rises. This increases the rate of conviction. Thus combinations of the two policies raise the rate of conviction when they are perfectly offsetting, or close to it.[6]

[5] MS-13, or Mara Salvatrucha, is "a fast-growing, violent, and increasingly mobile street gang" whose members "often wear clothing or sport tattoos incorporating MS-13 or the number 13." (Federal Bureau of Investigation, 2005).

[6] Note, however, that these results arise in models where criminals can only intimidate witnesses; they cannot kill them. Increases in secondary and tertiary prosecutor effectiveness raise the relative incentive to kill rather than intimidate, and so a more complete model could produce more counterintuitive results.

5 Police-Community Relations

Akerlof and Yellen (1994) have emphasized the importance of public cooperation with police. Such cooperation can be diminished if law enforcement agencies are perceived as being unjust or discriminatory, or if codes of silence become fashionable through the behavior of trend setters. The *stop snitchin'* phenomenon exemplifies the spread of such norms (CBS News, 2007):

> Reluctance to talk to police has always been a problem in poor, predominantly African-American communities, but cops and criminologists say in recent years something has changed: fueled by hip-hop music, promoted by major corporations, what was once a backroom code of silence among criminals, is now being marketed like never before. The message appears in hip-hop videos, on T-shirts, Web sites, album covers and street murals. Well-known rappers talk about it endlessly on DVDs. It is a simple message heard in African-American communities across the country: don't talk to the police.

In our model, willingness to assist the police is represented by the distribution $G(\beta)$ of gains from testifying. What happens when this distribution shifts to the left—people become more reluctant to testify—either because of infuriating actions by law enforcement, or because of the spread of oppositional culture like Gangsta Rap? The effect on convictions is unambiguously negative. The witness reaction curve shifts down, and in the new equilibrium both p and q are lower: fewer witnesses testify, more criminals threaten, and a smaller proportion of threats are carried out. The rate of testimony falls, as does the rate of conviction.

The criminal justice literature (Finn and Healey, 1996) outlines a number of tactics police and prosecutors might use to shift the distribution $G(\beta)$ to the right, and raise the rates of testimony and conviction (but possibly increase the number of witnesses who are harmed). Simply being kind and generous to witnesses can help prosecutors, since most people feel bad about disappointing those whom they like. Community policing and active engagement with community organizations can help potential witnesses understand how their testimony is protecting their neighbors, not feeding youths into the jaws of a racist system. (This is the reason why many police do not want to enforce immigration laws, since doing so is likely to make illegal aliens their enemies.) Some prosecutors have even established "neighborhood support groups" for witnesses—neighbors who sit in the courtroom when the witness testifies so she sees friendly faces as well as hostile ones, and can immediately experience the admiration and gratitude of her friends.

6 Extensions

6.1 Conviction-Contingent Damages

To this point we have assumed that the damages δ inflicted on witnesses are contingent only on whether the witness testifies, and not on the outcome of the trial. However, a criminal who is convicted and incarcerated may be unable to harm a witness even if he wishes to do so. Witnesses in the 1988 Bronx survey thought that incarceration was conducive to their safety, as the overwhelming majority felt safer with the defendant in jail. In the British surveys analyzed by Tarling et al. (2000), the original offender was the person doing the intimidating in three quarters of the cases in which intimidation occurred. This is especially true of offenders who are not affiliated with a gang or criminal organization, and who cannot therefore rely on proxies to act on their behalf, and witnesses who are not likely to find themselves in prison later. If the conviction of an offender reduces the likelihood or extent of damage to the witness, then an increase in prosecutor effectiveness could increase the likelihood of witness testimony conditional on a threat being made. This in turn could affect the behavior of criminals and result in a change in the likelihood that a witness will be threatened.

To explore the implications of this, suppose that a criminal who is convicted does not have the capacity to harm a witness. If a witness is harmed (by a criminal who escapes conviction) the damage is δ as before. The criminal reaction curve (3) is left unaffected by this change since the threshold $\tilde{\gamma}(q)$ is the same under both specifications.[7] However, the witness reaction curve must be modified, since the expected harm from testifying now depends on prosecutor effectiveness. Specifically, instead of (4), the witness reaction curve is given by

$$q = 1 - G((1-e)\,p\delta).$$

Note that with this specification, increased prosecutor effectiveness affects both reaction curves. The criminal reaction curve is shifted upwards as before: more criminals threaten witnesses and hence the credibility of the threats p declines for any given level of q (see Figure 2). In addition, the witness reaction curve shifts upwards since a rise in e implies a higher value of q for any given p. The combined effect of these changes is to raise q (even more than would be the case if damages were not contingent on conviction). As one might expect, allowing for the possibility that criminals

[7] To see this, note that under the previous specification the cost $\tilde{\gamma}(q)$ at which a criminal is indifferent between threatening and not threatening the witness is non-negative, so the marginal criminal has no intention of carrying out his threat. Reducing his ability to do so therefore has no effect on his expected payoffs. Formally, $\min\{0, \tilde{\gamma}(q)\} = \min\{0, e\tilde{\gamma}(q)\} = 0$ so (2) is unaffected for the marginal offender.

who are convicted cannot harm witnesses results in a more pronounced effect of greater prosecutor effectiveness on the likelihood that a threatened witness will testify.[8]

6.2 Multiple Witnesses

Crimes often have more than one witness, and the presence of multiple witness can significantly increase the likelihood of conviction. In such cases an offender may choose to threaten only a subset of witnesses, and witnesses must consider the possibility that others may also testify. This makes the decisions of all parties more strategically complex. We begin with the simpler case in which the ability of an offender to inflict damages on a witness is not conviction-contingent, and relax this in the section to follow.

Suppose that there are precisely two witnesses to a crime and they are *ex ante* identical. In this case the offender may threaten none, one, or both of them, and each of the threatened witnesses may or may not testify. As before, let p denote the likelihood that a threatened witness who testifies will be attacked. Then a witness will testify if $\beta > p\delta$, and hence the likelihood that a threatened witness will testify is $q = 1 - G(p\delta)$ as in the case of a single witness. But the likelihood of attack p is more complicated. The criminal could threaten one, both or none of the witnesses.

Let $e' \geq e$ denote the likelihood of conviction if both testify, where e is the likelihood of conviction of one testifies. The difference reflects the extent to which a second witness raises the effectiveness with which a case can be brought. The following result establishes that when the recruitment of a second witness more than doubles the likelihood of conviction, some criminals choose to threaten just one of the witnesses.

Proposition 6. *Suppose $e' > 2e$. Then there exist thresholds $\bar{\gamma} > 0$ and $\tilde{\gamma} > \bar{\gamma}$ such that criminal threatens both witnesses if $\gamma < \bar{\gamma}$, threatens none if $\gamma > \tilde{\gamma}$, and threatens one if $\gamma \in (\bar{\gamma}, \tilde{\gamma})$.*

What if $e' \leq 2e$? In this case $\tilde{\gamma} < \bar{\gamma}$ so it is never optimal to threaten just one of the witnesses. Criminals with sufficiently low costs will threaten both, and the remainder will threaten none.

We focus on the empirically more relevant case of $e' > 2e$, where corroboration of one witness' testimony is critical in obtaining a conviction. From the point of view of a witness who has been threatened, the likelihood of attack conditional on testimony is simply

$$p = \frac{F(0)}{F(\tilde{\gamma}(q))}$$

[8] We have assumed here that convicted criminals have no capacity to harm witnesses, but the argument applies more generally. What matters is that a witness has less to fear from an offender who is behind bars than from one who remains at large.

as before. The only difference between this model and the single witness case is the manner in which $\tilde{\gamma}$ varies with q.

7 Collective Silence

The most interesting case arises when there are multiple witness and damages are conviction-contingent. In this case, from the perspective of a witness who has been threatened, the expected loss from testifying depends on whether or not the other witness testifies. The interaction here is characterized by strategic complementarity: the greater the likelihood that the other witness testifies, the lower the expected damages, and hence the greater the incentive to testify oneself. This can give rise to multiple equilibria with varying levels of witness testimony.

Suppose that if convicted, a criminal cannot make good on his threat to harm a witness, and let q denote the likelihood that a witness will testify conditional on being threatened. A witness who has been threatened cannot know whether or not the criminal has also threatened another witness, but can be certain that the criminal's cost parameter is no greater than $\tilde{\gamma}$. The threat will be carried out only if $\gamma < 0$, the likelihood of which is $p = F(0)/F(\tilde{\gamma}(q))$. Note that conditional on the criminal having cost $\gamma < 0$, the likelihood that both witnesses are threatened is 1. Hence the expected loss from testifying is $p\delta\left(q\left(1-e'\right)+(1-q)\left(1-e\right)\right).$ We therefore have, in equilibrium,

$$q = 1 - G\left(p\delta\left(q\left(1-e'\right)+(1-q)\left(1-e\right)\right)\right) \tag{8}$$

For any given p, (8) can have multiple solutions. Hence the witness reaction function can be multi-valued, and the complete system can admit several equilibrium pairs (p, q). This is illustrated for a particular example in Figure 5.[9]

There are three pairs (p, q) consistent with equilibrium in the example depicted. We ignore the intermediate solution (which will be unstable under best-response dynamics) and focus on the other two. These two solutions are $(p, q) = (0.98, 0.95)$ and $(p, q) = (0.54, 0.06)$. In the first equilibrium (at the top right of the figure), the likelihood of witness testimony is very high, and hence the incentives to threaten are low. This means that threats come largely from those criminals who would in fact carry the threats out if given the opportunity. Despite this, witnesses are willing to testify because they are confident that others will testify, and that this will almost certainly lead to conviction. This dramatically reduces the danger entailed in testifying, and justifies the decision to do so.

[9] The figure is based on the following specification: $e = 0$, $e' = 1$, $\delta = 7$, $\rho = 0.15$, $h(\gamma) = \gamma/2$, and both distribution functions F and G are normal with mean 2 and variance 1. The example is robust in the sense that any small perturbation to this set of specifications leaves intact the qualitative properties of the equilibrium set.

The other equilibrium involves a much smaller incidence of witness testimony. Threatened witnesses rarely testify, which makes criminals eager to threaten. This includes a significant number of criminals with positive values of γ, who would not carry out their threats even if testified against. Hence the equilibrium value of p is relatively low, especially compared with the other equilibrium. Despite this, witnesses face greater danger since their testimony is likely to be uncorroborated by another witness, and hence conviction is unlikely. The expectation that no witness will testify then becomes self-fulfilling, resulting in a state of collective silence.

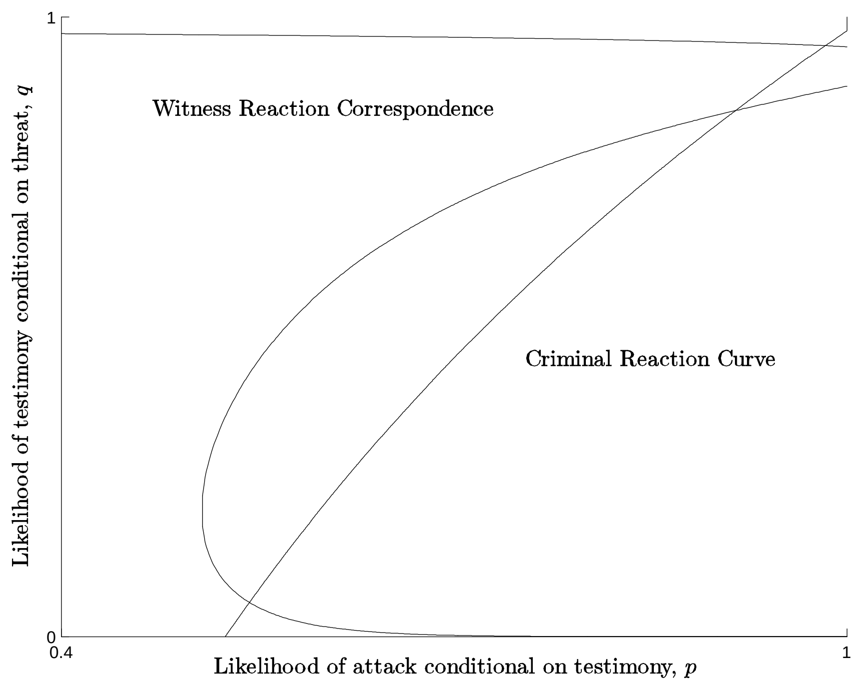

Figure 5. High and Low Levels of Equilibrium Testimony

8 Conclusions

Empirical data on witness intimidation are almost entirely lacking. It is easy to understand why: witnesses who never come forward are very hard for outside observers to detect. Given the paucity of empirical information, we have relied largely on theoretical arguments in our attempt to understand witness intimidation. We have confirmed the result of Akerlof and Yellen (1994) that community respect for law enforcement and willingness to cooperate are indispensable. In fact, improving community relations is the only policy we found to have an unambiguous positive effect on convictions of guilty offenders. For multiple witness cases, moreover, multiple equilibria are possible, and so small changes in community relations or perceptions might trigger major improvements in outcomes.

On the other hand, our results about prosecutorial effectiveness are all ambiguous. Each kind of prosecutorial initiative works under some conditions but not others, with the distinctions depending on the slope and position of the witness response curve. This ambiguity indicates that empirical work is likely to be valuable. Data may be available on potential witnesses who are killed and on witnesses who recant, but these phenomena are not at all direct measures of witness intimidation (the first is a measure of witnesses who were incapacitated, not intimidated, and the latter is a measure of witnesses who came forward enough at some point that they could go back). Perhaps the best way to measure witness intimidation is the conviction rate on murders, with appropriate lags to reflect the length of time it takes to bring a murder case to trial (since the payoff from witness intimidation is usually greatest in homicide cases, and these cases don't rely on victims to file a complaint). State laws and policies on witness tampering, and average time to trial could be used to proxy for differences in witness protection and threat reduction strategies. There appears to be considerable variation in these laws and policies. Empirical work in this vein could probably tell us something about witness reaction curves.

This paper, as an exercise in theory, has shown that witness intimidation is indeed a hard problem, with few obvious solutions and considerable danger of perverse outcomes. As Cook (2007, p.30) notes: "In essence the citizens who become involved in crime are invited to make a charitable contribution of their time and possibly their safety, in exchange for knowing they have done a good deed for their community." The rule of law and well-functioning society rely much more on civic altruism than we often care to acknowledge.

Appendix

Proof of Proposition 1. Since all criminals with $\gamma < 0$ threaten witnesses, an unthreatened witness can deduce that the criminal has $\gamma > 0$. This implies $\hat{p} = 0$; an unthreatened witness will not be harmed even if he testifies. Hence all witnesses with $\beta > 0$ will testify if left unthreatened, so $\hat{q} = 1 - G(0)$. Since all witnesses with $\beta < 0$ will not testify regardless of whether or not they are threatened, $q \leq 1 - G(0) = \hat{q}$. Suppose, by way of contradiction, $q = \hat{q}$. Then, comparing (1) and (2), a criminal would threaten if and only if $\gamma < 0$. That is, a threatened witness would be *certain* that he would be harmed if he testified. In this case all witnesses with $\beta < \delta$ would refuse to testify, and we would have $q = 1 - G(\delta) < 1 - G(0) = \hat{q}$, a contradiction. Hence $q < \hat{q}$. ■

Proof of Proposition 2. Using (3) and (4), any pair (p, q) is an equilibrium if and only if

$$p = \varphi(p) = \frac{F(0)}{F(\tilde{\gamma}(1 - G(p\delta)))}$$

Note that $\varphi(p)$ is a continuous and strictly decreasing function satisfying

$$\varphi(0) = \frac{F(0)}{F(\tilde{\gamma}(1 - G(0)))} > 0$$

and

$$\varphi(1) = \frac{F(0)}{F(\tilde{\gamma}(1 - G(\delta)))} < 1.$$

Existence, uniqueness and interiority of equilibrium follow immediately. ■

Proof of Proposition 3. Changes in e clearly leave the witness reaction curve (4) unaffected. However, since $q < \hat{q} = 1 - G(0)$ in equilibrium, a rise in e increases $\pi_1^c - \pi_0^c$ for any given values of q and γ. That is, the incentive to threaten the witness rises. The result is an increase in $\tilde{\gamma}(q)$, the threshold cost below which criminals engage in witness intimidation. Hence the criminal reaction curve (3) shifts to the left, lowering p and raising q relative to the original equilibrium (see Figure 2). The level of witness intimidation t therefore rises. More witnesses are threatened, a greater proportion of threatened witnesses testify, and a smaller proportion of these are subsequently attacked.

The ambiguous effects of an increase in e on s and r are demonstrated by the example in the text, depicted in Figure 4. This example is based on the following specifications: $\delta = 2$, $\rho = 5$, $h(\gamma) = \gamma/2$, and β and γ are both normally distributed with variance 1 and means -0.5 and -0.4 respectively. ■

Proof of Proposition 4. Witness protection policies do not affect the witness reaction curve so consider the criminal reaction curve. For any q, we have

$$\begin{aligned} p(q) &= \frac{F(0)}{F(\tilde{\gamma}(q))}, \\ p'(q) &= \frac{F'(0)}{F'(\tilde{\gamma}(q))}, \end{aligned}$$

where the function $\tilde{\gamma}(q)$ is the same for both levels of witness protection. From MLRP, $f'(x)/f(x)$ is increasing in x, which can be shown to imply that the ratio of distribution functions $F'(x)/F(x)$ is also increasing in x. Since $\tilde{\gamma}(q) > 0$, we therefore have

$$\frac{F'(\tilde{\gamma}(q))}{F(\tilde{\gamma}(q))} > \frac{F'(0)}{F(0)}.$$

This implies

$$\frac{F(0)}{F(\tilde{\gamma}(q))} = p(q) > \frac{F'(0)}{F'(\tilde{\gamma}(q))} = p'(q)$$

for all q. Hence the witness protection policy shifts the criminal reaction curve to the left, which is precisely the effect of an increase in prosecutor effectiveness: p declines and q rises.

Now suppose the witness response curve is such locally that a leftward shift in the criminal response curve increases the rate of testimony, *ceteris paribus*. Let p' and q' denote the new equilibrium after an increase in witness protection. Since by assumption in this case increases in prosecutor effectiveness increase the rate of testimony,

$$s = 1 - \left(\frac{1-q}{p}\right) F(0) < 1 - \left(\frac{1-q'}{p'}\right) F(0).$$

But witness protection decreases the proportion of offenders who would actually do harm: $F'(0) < F(0)$. Hence

$$1 - \left(\frac{1-q'}{p'}\right) F(0) < 1 - \left(\frac{1-q'}{p'}\right) (F'(0) = s'.$$

Thus $s' > s$, and witness protection increases the rate of testimony. Since $r = es$, and witness protection does not affect e, witness protection also raises the conviction rate. ■

Proof of Proposition 5. A threat reduction policy leaves the distribution of γ and $F(0)$ unchanged, but changes $\tilde{\gamma}(q)$. We have

$$h(\tilde{\gamma}(q)) = ep(\hat{q} - q) = h'(\tilde{\gamma}'(q))$$

and so since $h'(x) > h(x)$ for all $x > 0$, and h' is an increasing function, we have $\tilde{\gamma}'(q) < \tilde{\gamma}(q)$. This implies

$$p(q) = \frac{F(0)}{F(\tilde{\gamma}(q))} < \frac{F(0)}{F(\tilde{\gamma}'(q))} = p'(q)$$

and so the criminal reaction curve shifts to the right, raising p and lowering q. Suppose that the witness response curve is such locally that a leftward shift in the criminal response curve lowers the rate of testimony, *ceteris paribus.* Then threat reduction policies increase the rate of testimony, and since they do not affect e, also increase the rate of conviction. ■

Proof of Proposition 6. Let π_i^c denote the criminal's expected payoff conditional on threatening i witnesses, where $i \in \{0, 1, 2)$.Note that all criminals with $\gamma < 0$ will threaten both witnesses since it is not costly for them to do so. Focusing only on those with $\gamma \geq 0$, and recalling that $\hat{q} = 1 - G(0)$ is the likelihood that an unthreatened witness will testify, we therefore have

$$\begin{aligned}
\pi_0^c &= -2\hat{q}(1-\hat{q})e\rho - \hat{q}^2 e'\rho \\
\pi_1^c &= -\left(\hat{q}(1-q) + q(1-\hat{q})\right)e\rho - q\hat{q}e'\rho - h(\gamma) \\
\pi_2^c &= -2q(1-q)e\rho - q^2 e'\rho - 2h(\gamma)
\end{aligned}$$

Let $\tilde{\gamma}$ denote the threshold cost at which criminal is indifferent between threatening none and threatening one. Then:

$$\begin{aligned}
h(\tilde{\gamma}) &= 2\hat{q}(1-\hat{q})e\rho + \hat{q}^2 e'\rho - \left(\hat{q}(1-q) + q(1-\hat{q})\right)e\rho - q\hat{q}e'\rho \\
&= \rho\left(\hat{q} - q\right)\big(e\left(1-\hat{q}\right) + \hat{q}\left(e' - e\right)\big).
\end{aligned}$$

If $\gamma > \tilde{\gamma}$ the threatening no witnesses is preferred to threatening one, and the opposite is the case of $\gamma < \tilde{\gamma}$.

Now let $\bar{\gamma}$ denote the threshold cost at which criminal is indifferent between threatening one witness and threatening two.

$$\begin{aligned}
h(\bar{\gamma}) &= \left(\hat{q}(1-q) + q(1-\hat{q})\right)e\rho + q\hat{q}e'\rho - 2q(1-q)e\rho - q^2 e'\rho \\
&= \rho\left(\hat{q} - q\right)\big(e\left(1-q\right) + q\left(e' - e\right)\big)
\end{aligned}$$

If $\gamma > \bar{\gamma}$ then threatening one witnesses is preferred to threatening two, and the opposite is the case of $\gamma < \bar{\gamma}$. Note that

$$\begin{aligned}
h(\tilde{\gamma}) - h(\bar{\gamma}) &= \rho\left(\hat{q} - q\right)\big(e\left(1-\hat{q}\right) + \hat{q}\left(e' - e\right) - e\left(1-q\right) - q\left(e' - e\right)\big) \\
&= \rho\left(\hat{q} - q\right)^2\left(e' - 2e\right)
\end{aligned}$$

Hence if $e' > 2e$, then $h(\tilde{\gamma}) > h(\bar{\gamma})$, which implies from the monotonicity of h that $\tilde{\gamma} > \bar{\gamma}$. This proves the result. ■

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