

The Impact of Gun Laws: A Model of Crime and Self-Defense

Hugo M. Mialon^{a,*}, Thomas Wiseman^b

^aDepartment of Economics, Emory University, Atlanta, GA 30322, USA

^bDepartment of Economics, The University of Texas at Austin, Austin, TX 78712, USA

Abstract

We develop a model of crime and self-defense that provides a rationale both for the right to bear arms and for regulating this right. It also suggests that a severe punishment for gun crime might best guarantee both the security and freedom of potential victims.

JEL code: K42

Keywords: gun control, Second Amendment, deterrence

* Corresponding author. Department of Economics, Emory University, Atlanta, GA 30322-2240, USA.
Phone: (404) 408-8333; Fax: (404) 727-4639.

E-mail address: hmialon@emory.edu (H. Mialon).

1. Introduction

Gun-control advocates argue that guns have a facilitating effect on crime, because they inevitably end up through loss or theft in the hands of criminals. Gun-rights advocates argue that guns have a deterrent effect on crime, because victims may be carrying a concealed weapon.

We propose a simple, strategic model of crime and self-defense. We analyze the impact of gun control on gun use by criminals, gun carrying and non-gun prevention or lying low by potential victims, and completed gun and non-gun crime. A marginal increase in gun control from a moderate level increases completed non-gun crime, but reduces completed gun crime, and so may on net be desirable. However, with total gun control potential victims always seek to avoid crime by lying low, suffering a substantial loss of freedom. The model thus provides a rationale both for a right to bear arms and for regulating this right.

In contrast to full gun control, we show that a severe punishment for committing a crime with a gun leads to no gun crime and no lying low by victims. The gun-crime penalty eliminates gun crime but preserves the threat of armed response, and so may best ensure safety while preserving freedom.

In the large literature on the economics of crime, stemming from the work of Becker (1968) and Ehrlich (1972), few studies model theoretically the connection between guns and crime.¹ There is, though, a growing empirical literature on gun control

¹ One notable exception is Donohue and Levitt (1997), who model the impact of guns on criminals fighting against other criminals for the possession of an external prize. In contrast, our model is about criminals attacking victims for their endowments. In this context, guns also play a role in self-defense.

and crime. Starting with Lott and Mustard (1997), several studies (including Bronars and Lott, 1998, Benson and Mast, 2001, Plassmann and Tideman, 2001, and Lott, 2003) find that allowing concealed handguns has significantly reduced crime across America. Other studies (including Dezhbakhsh and Rubin, 1998, 2004, Black and Nagin , 1998, Ludwig, 1998, Duggan, 2001, and Ayres and Donohue, 2002) do not support that finding.

The empirical debate lacks a strong theoretical basis to guide it, as evidenced by the failure to distinguish between guns used for self-defense and guns used in crime, the latter of which is the real problem. Our result that a harsh penalty for gun-crime could eliminate such crime without losing the deterrent effect suggests that empirical research might productively focus on the impact of gun-crime sentencing laws.

2. Model

The population is divided into two groups: potential criminals and potential victims. Victims have an endowment $w > 0$. Criminals have no endowment, but can take it from victims, which is a crime. Potential criminals choose not to commit crime ($\neg C$), to commit crime without a gun ($\neg GC$), or to carry a gun, at a cost $g > 0$, and commit crime with it (GC). Potential victims choose not to carry a gun ($\neg G$), to carry a gun (G) for protection, also at a cost g , or to take alternative preventive measures, such as lying low by staying home at night or avoiding certain places or situations (L), at a cost $l > 0$, which represents the loss of freedom. Agents from each population are paired at random to play the game in Table 1. Let α_1 and α_2 be the probabilities that the criminal chooses

GC and $\neg GC$, respectively, and let β_1 and β_2 be the probabilities that the victim chooses $\neg G$ and G .

Table 1: Normal Form of the Game of Crime and Self-Defense

	$\neg G$	G	L
$\neg C$	$0, w$	$0, w-g$	$0, w-l$
$\neg GC$	$\frac{1}{2}(w), \frac{1}{2}(w)$	$-d, w-g$	$0, w-l$
GC	$w-g, -d$	$\frac{1}{2}(w-d)-g, \frac{1}{2}(w-d)-g$	$-g, w-l$

By lying low, potential victims avoid meeting a criminal. If an unarmed potential victim meets an armed criminal, the criminal takes the victim's endowment and possibly shoots the victim in the process, creating an expected cost, $d > 0$. If an armed victim meets an armed criminal, then with equal probability the victim either defends his endowment and possibly shoots the criminal, or loses his endowment and is possibly shot. If an unarmed victim meets an unarmed criminal, then again equal chance determines the outcome, but neither party is shot. An armed potential victim meeting an unarmed criminal defends his endowment and possibly shoots the criminal.

We make the following assumptions about payoffs: (1) $l > g$, (2) $2g > l$, (3) $w > 2l$, and (4) $d > w - 2g$. Lying low is costlier than carrying a gun, but there is always the possibility of an accident, so the cost of carrying a gun cannot be too low. The endowment is valuable relative to the cost of lying low, and the disutility from being shot is also high.

Given Assumptions 1-4, the game has a unique, fully-mixed equilibrium:

$$\alpha_1 = \frac{2(l-g)}{d+w}, \alpha_2 = \frac{2(2g-l)}{w}, \beta_1 = \frac{4gd}{w(3d+w)}, \beta_2 = \frac{2gw}{w(3d+w)}. \quad (1)$$

The assumptions ensure that these are well-defined probabilities.

3. The Impact of Marginal Gun Control

Gun control increases the cost of carrying a gun, g , by increasing the risk of legal punishment. It cannot increase g only for potential criminals because victims can lose their guns or have them stolen, and criminals can then obtain them underground. We are interested in the effect of gun control on the following outcomes: gun carrying by potential victims, β_2 , lying low by potential victims, $1 - \beta_1 - \beta_2$, attempted non-gun crime, α_2 , attempted gun crime, α_1 , completed non-gun crime, $\alpha_2(\frac{1}{2}\beta_1)$, and completed gun crime, $\alpha_1(\beta_1 + \frac{1}{2}\beta_2)$, which is possibly the most important element. Let us look at the effect of a marginal increase in g on equilibrium strategies:

$$\frac{\partial \alpha_1}{\partial g} = \frac{-2}{d+w} < 0, \quad \frac{\partial \alpha_2}{\partial g} = \frac{4}{w} > 0, \quad \frac{\partial \beta_1}{\partial g} = \frac{4d}{w(3d+w)} > 0, \quad \frac{\partial \beta_2}{\partial g} = \frac{2w}{w(3d+w)} > 0. \quad (2)$$

Marginal gun control reduces the incentives of potential criminals to commit gun crime and increases their incentives to commit non-gun crime. Thus potential victims reduce their lying low and increase their gun carrying, by the exact magnitudes that restore criminals' indifference. Raising g reduces the incentives of victims to carry a gun for protection and increases their incentives to lie low. Thus potential criminals commit less gun crime and more non-gun crime, so as to make victims indifferent again. The effects of marginal gun control on completed non-gun and gun crime are:

$$\frac{\partial \alpha_2(\frac{1}{2}\beta_1)}{\partial g} = \alpha_2 \left[\frac{1}{2} \frac{\partial \beta_1}{\partial g} \right] + \frac{\partial \alpha_2}{\partial g} \left[\frac{1}{2} \beta_1 \right] = \frac{4d(4g-l)}{w^2(3d+w)} > 0 \quad (3)$$

$$\frac{\partial \alpha_1(\beta_1 + \frac{1}{2}\beta_2)}{\partial g} = \alpha_1 \left[\frac{\partial \beta_1}{\partial g} + \frac{1}{2} \frac{\partial \beta_2}{\partial g} \right] + \frac{\partial \alpha_1}{\partial g} \left[\beta_1 + \frac{1}{2}\beta_2 \right] = \frac{2(4d+w)}{w(d+w)(3d+w)} [l-2g] < 0. \quad (4)$$

Gun control increases attempted non-gun crime and reduces lying low by victims, so it increases completed non-gun crime. Since it reduces attempted gun crime and increases gun carrying by victims, it reduces completed gun crime. Comparing (3) and (4) reveals that the effect on completed non-gun crime is larger, so total completed crime rises. The expected utilities of criminals and victims are unchanged. However, since gun crime may generate more negative externalities (e.g., on family members of shooting victims), and because potential victims who do not lie low have more freedom, which may create positive externalities for society, marginal gun control may be beneficial.

4. The Impact of Full Gun Control

To examine the effect of full gun control, implemented through a large g , we relax Assumption 1 (that $g < l$). If $g > l$, then G is strictly dominated for potential victims. Table 2 shows the resulting game.

Table 2: The Game of Crime and Self-Defense with Full Gun Control

	$\neg G$	L
$\neg C$	$0, w$	$0, w-l$
$\neg GC$	$\frac{1}{2}(w), \frac{1}{2}(w)$	$0, w-l$
GC	$w-g, -d$	$-g, w-l$

Now no crime is weakly dominated for the potential criminal. There is a continuum of equilibria, in all of which victims lie low with probability one, and

criminals randomize between no crime and no-gun crime, with probability $\frac{2l}{w}$ or more on the latter. Expected utilities are unchanged. There is no completed crime, but the threat of crime leads potential victims to always lie low and suffer the loss of freedom. The result suggests that some right to bear arms is fundamental to the freedom of potential victims.

5. The Impact of Severe Gun-Crime Punishment

So far, government only plays a role through gun control. In reality, it can also set the punishment for committing crimes. In particular, it could punish gun crime more severely than non-gun crime. We now introduce a cost $s > 0$ to the criminal's payoff for the strategy pairs $(GC, \neg G)$ and (GC, G) , representing the expected additional punishment for committing a gun crime. (For simplicity, we set the sentence for non-gun crime to zero.) If s is high enough, then GC is dominated for the criminal, so L is conditionally dominated for victims.

Table 3: The Game of Crime and Self-Defense with a Severe Gun-Crime Penalty

	$\neg G$	G
$\neg C$	$0, w$	$0, w - g$
$\neg GC$	$\frac{1}{2}(w), \frac{1}{2}(w)$	$-d, w - g$

The resulting game, shown in Table 3, has a unique equilibrium: criminals commit non-gun crime with probability $1 - \frac{2g}{w}$, and victims carry guns with probability $\frac{d}{d + \frac{1}{2}w}$.

Criminals' utility is unchanged, but victims' increases. A harsh punishment for gun crime keeps criminals from using guns, but preserves the threat of an armed response by

victims, so that potential victims never lie low. In contrast, under the no-gun regime they always lie low. The gun-crime penalty is focused on the real problem, which is not guns, but using guns to commit crime.²

6. Conclusion

Our model of crime and self-defense distinguishes between gun crime and non-gun crime, between lying low and carrying guns for self-defense, and between gun crime and gun carrying in self-defense. Our results are that (1) marginal gun control increases non-gun crime but reduces gun crime, (2) full gun control eliminates gun crime but also reduces the freedom of potential victims, and (3) severe gun-crime punishment eliminates gun crime and preserves freedom. The second result suggests that the Second Amendment's right to bear arms cannot be revoked without severely threatening individual freedom, while the first result shows that some gun control may also benefit society, by reducing gun crime. The third result suggests that gun-crime punishment could curb gun crime while preserving the gun rights of potential victims. A severe penalty for committing gun crime may be the best way to guarantee both security and freedom.

² Helsley and O'Sullivan (2001) consider a refundable deposit policy that would encourage law-abiding gun-owners to protect their guns from being stolen by criminals. In terms of our model, that policy would correspond to increasing g only for potential criminals, and so would have a similar effect to independently increasing the punishment for committing crime with a gun.

Acknowledgements

We thank Preston McAfee, Sue Mialon, Paul Rubin, and an anonymous referee for helpful comments and suggestions.

References

- Benson, B.L. and B.M. Mast, 2001, Privately Produced General Deterrence, *Journal of Law and Economics* 44, 725-746.
- Bronars, S.G. and J.R. Lott Jr., 1999, Criminal Deterrence, Geographic Spillovers, and Right-to-Carry Concealed Handguns, *American Economic Review Papers and Proceedings* 88, 475-479.
- Black, D.A. and D.S. Nagin, 1998, Do Right-to-Carry Laws Deter Violent Crime?, *Journal of Legal Studies* 27, 209-219.
- Becker, G.S., 1968, Crime and Punishment: An Economic Approach, *Journal of Political Economy* 76, 169-217.
- Dezhbakhsh, H. and P.H. Rubin, 2003, The Effect of Concealed Handgun Laws on Crime: Beyond the Dummy Variables, *International Review of Law and Economics* 23, 199-216.
- Dezhbakhsh, H. and P.H. Rubin, 1998, Lives Saved or Lives Lost: The Effect of Concealed Handgun Laws on Crime, *American Economic Review Papers and Proceedings* 88, 468-474.
- Donohue III, J.D. and S.D. Levitt, 1998, Guns, Violence, and the Efficiency of Illegal

- Markets, American Economic Review Papers and Proceedings 88, 463-467.
- Duggan, M., 2001, More Gun, More Crime, Journal of Political Economy 109, 1086-1114.
- Ehrlich, I., 1973, Participation in Illegitimate Activities: A Theoretical and Empirical Investigation, Journal of Political Economy, Vol. 81, No. 3, 521-565.
- Helsley, R.W. and A. O'Sullivan, 2001, Stolen Gun Control, Journal of Urban Economics 50, 436-447.
- Lott, J.R. Jr. and D.B. Mustard, 1997, Crime, Deterrence, and Right-to-Carry Concealed Handguns, Journal of Legal Studies 26, 1-68.
- Lott, J.R. Jr., 2003, The Bias Against Guns: Why Almost Everything You've Heard About Gun Control Is Wrong (DC, Regnery Publishing).
- Ludwig, J., 1998, Concealed Gun-Carrying Laws and Violent Crime: Evidence from State Panel Data, International Review of Law and Economics 18, 239-254.
- Plassmann, F. and T.N. Tideman, 2001, Does the Right to Carry Concealed Handguns Deter Countable Crimes? Only a Count Analysis Can Say, Journal of Law and Economics 44, 771-798.