




RESEARCH ARTICLE

A heavy hand or a helping hand? Information provision and citizen preferences for anti-crime policies[†]

Daniel W. Gingerich¹ and Carlos Scartascini^{2*} 

¹Associate Professor of Politics, Department of Politics, University of Virginia. S254 Gibson Hall, 1540 Jefferson Park Ave, Charlottesville, VA 22904, USA and ²Head of the Development Research Group and Leader of the Behavioral Economics Group, Inter-American Development Bank. 1300 New York Ave, NW, Washington, DC 20577, USA

*Corresponding author. E-mail: carlossc@iadb.org

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Abstract

Anti-crime policy is often unresponsive to reductions in crime. To address why, we provide a model and empirical test of how citizens' anti-crime policy preferences respond to information. Our model shows that preferences for anti-crime policy hinge on expectations about the crime rate: punitive policies are preferred in high crime contexts, whereas social policies are preferred in low crime contexts. We evaluate these expectations through an information experiment embedded in the 2017 Latin American Public Opinion Project survey conducted in Panama. As expected by our theory, a high crime message induced stronger preferences in favour of punitive policies. Unanticipated by our theory, but in line with cursory evidence and survey results, we find that a low crime message did not induce stronger preferences in favour of social policies. These findings are consistent with policy ratcheting: punitive policies increase during periods of high crime and remain in place during periods of low crime.

Keywords: anti-crime policy; endogenous preferences; information; Panama; survey experiment

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In order to be effective, public policies must be properly tailored to the context and the historical moment. For instance, policies implemented during wars or times of crisis may be sub-optimal during times of peace. Yet, it is well-known that policies often exhibit inter-temporal “stickiness”, a state of affairs that prevents them from addressing the changing needs of the public. One source of such stickiness is the existence of public policy “ratchet effects”: policies initially implemented during moments of genuine need remain on the books long after their utility has waned, due to aspects of the democratic system that lock-in the initial changes (Peacock and Wiseman 1961; Higgs 1987; O’Reilly and Powell 2015).

Evidence suggests that anti-crime policy suffers from such ratchet effects. In the case of the United States (US), mass incarceration began in the mid-1970s in part as a response to public concern with drug use and generalised social decay (Weiman and Weiss 2009).¹ The punitive anti-crime policies of the era were introduced during a period in which rates of violent crime – homicide, rape, robbery, and aggravated assault – were rising at a rapid rate (James 2018). Yet, in spite of a prodigious and sustained decrease in crime since the early 1990s, these policies have persisted to the present day, contributing to the world’s highest incarceration rate.

Available evidence indicates that this persistence is detrimental: Punitive crime policy appears to have had at best a modestly reductive impact on crime rates, but it has significantly distorted labour markets, reduced childhood wellbeing, and undermined civic and political participation (Redburn et al. 2014).² There is also evidence that incarceration has many negative spillovers, including, among others, lower employment, lower long-term earnings, worse teenagers’ school outcomes, and disenfranchisement (Western et al. 2001; Cho 2010; Bhuller et al. 2018). Moreover, longer recommended sentences are associated with higher rates of recidivism, conditional on actual punishment (Bushway and Owens 2013). Given the lowered risks of crime and the high costs of punitive law-and-order policies, the continued popularity of such policies among voters leads one to suspect that an information processing problem is at play. To this point, Gallup polls consistently reveal that a majority of US respondents (since the early 1990s) believe that there was *more* crime in the country during the survey year than the year before. Such a disconnect between public beliefs and facts on the ground presents an obvious challenge to policy-making.

Of all the regions of the world, Latin America and the Caribbean (LAC) is arguably the one that would benefit the most from implementing good anti-crime policy. In the region, the pecuniary cost of crime alone is equal to 4% of GDP

¹Another contributor to mass incarceration was the politicisation of race. In particular, scholars have argued that mass incarceration – which resulted in much higher levels of imprisonment for African Americans than for other groups – can be interpreted as a political strategy designed to appeal to white voters who were unhappy with the civil rights reforms of the 1960s (Weaver 2007; Alexander 2012).

²According to interviews conducted with crime experts, increasing penalties and incarcerating more criminals were not policies of choice among their top 20 preferred ways to reduce crime in the world’s most violent cities. See *The Guardian*, “24 ways to reduce crime in the world’s most violent cities”. Available in: <https://www.theguardian.com/global-development-professionals-network/2015/jun/30/24-ways-to-reduce-in-the-worlds-most-violent-cities>.

(Jaitman 2017).³ About one and a half million people are held in penal institutions in the region (Vilalta and Fondevila 2019). The current high level of incarceration reflects explosive growth in the prison population over the last few years due to an increasing social demand for *Mano Dura* (“heavy hand”) policing. Such demands have tended to follow violent crime spikes linked to gang activity and narcotics trafficking. Although recent evidence suggests that *Mano Dura* policies have not been particularly effective in reducing crime (Gingerich and Oliveros 2018; Bullock 2018), they have imposed huge costs for inmates and for the population at large.⁴ Thus, understanding why citizens in LAC come to support or reject such policies is of the utmost importance.

The current article addresses the issue of how information shapes the policies citizens demand from their governments.⁵ It does so by providing an examination of how different types of information shocks shape citizen preferences over anti-crime policy. The article proceeds in two steps. Firstly, we develop a formal model of optimal anti-crime policy preferences to characterise the preferred anti-crime policies of rational citizens given their beliefs about crime. In our model, a representative citizen employs a Becker-style (rational cost-benefit) framework to assess how the crime rate responds to investments in three distinct anti-crime policies: strengthening penalties, improving detection, or expanding social policies that increase the opportunity costs of crime. The relative returns to different policies hinge critically on the social expectations of crime, since widespread crime operates as a tax on income (including income generated from social policies). Consequently, the citizen’s preferred allocation of resources to policies also hinges on expectations about crime. We show that a citizen who anticipates a high (low) crime state of the world will prefer higher (lower) penalties and lower (higher) social policy and detection efforts. In this way, the model captures the different policy vectors that countries have historically tended to gravitate towards: a high carceral, low safety net in the US versus a low carceral, high safety net in Northern Europe.

Next, we utilise an information experiment that we designed and embedded in the 2016/2017 round of the Americas Barometer Survey conducted by the Latin American Public Opinion Project (LAPOP) in Panama. The unique recent history of Panama makes it possible for us to manipulate beliefs about crime by randomly exposing respondents to different messages about crime. Some individuals were presented with statistics and images showing a high crime scenario

³Nonpecuniary costs are substantial as well. For example, studies from the region have shown that exposure to violence impairs the educational performance of schoolchildren (Koppensteiner and Menezes 2018; Monteiro and Rocha 2017), reduces childbearing (Gerardino and Camacho 2018), and worsens birth outcomes (Koppensteiner and Manacorda 2013).

⁴In spite of the terrible living conditions faced by inmates in the region, regional spending on incarceration was over 10 billion US (ppp) in 2014 (Serrano 2018).

⁵A first generation of scholarship on this topic assessed the impact of information by using observational data from surveys in conjunction with various forms of regression adjustment (Bartels 1996; Carpini and Keeter 1997; Althaus 1998; Caplan 2007). This work used the conditional association between measures of political sophistication and policy preferences to impute the preferences that the electorate would have had if everyone was informed. The challenge for such an approach is that political sophistication reflects, at best, a choice made by voters, and, at worst, indelible attributes of the same.

and others were presented with statistics and images consistent with a low crime scenario. Both messages are factually accurate and based on crime statistics for the country. The abrupt changes in crime trends that took place in Panama permit us to send qualitatively distinct messages simply by changing the starting year we use to present the information to individuals. In particular, homicides show a stark inverse U-shape, with crime going from about 10 homicides per 100,000 population in 2000 to about 23 in 2009, and back down again to around 10 by 2017. By presenting the first part of this trend (and framing the message accordingly), we are able to send a strong message about rising homicides. Similarly, by presenting the second part of the trend, we are able to send a strong message about decreasing homicides. Since both messages are based on the relatively recent lived experiences of Panamanians, they are likely to have a degree of credibility that would not be encountered in polities where recent homicide trends are unidirectional. Thus, they should affect individuals' beliefs about crime (Esberg and Mummolo 2018).

By comparing the policy allocation decisions in the survey experiment to the expectations of the model, we are able to ascertain if policy demands change in the direction aligned with the rational choice model or whether individuals respond to one type (increase) of information but not the other (decrease), as the evidence from the US seems to suggest. Our conclusion is that citizens' policy demands skew towards punitive policies following the introduction of information indicating an increase in crime. Yet, the converse is not true: citizens' policy demands do not skew towards social policies or monitoring following the introduction of information indicating a decrease in crime. If anything, relative to the no information scenario (control group) they also skew towards punishment (although the effect here is not statistically significant). In this sense, our findings lend themselves to the conclusion that all news about crime trends – regardless of the direction – tend to elicit punishment-oriented responses by the electorate.

Our findings imply that crime policy is an area where the potential scope for voter manipulation is high. This may help explain why anti-crime efforts around the world tend to be of poor quality. Since voters do not carefully parse out the information content of messages about crime, attempts to frame elections around the crime issue may be effective in generating preferences for punitive policies even in contexts in which the facts on the ground do not justify this approach. Moreover, our findings help explain the surprising resilience of punitive anti-crime policies over time. Although demands for punitive policies rationally increase during outbreaks of high crime, they are not replaced by demands for social policy or other alternatives during periods of low crime. Consequently, anti-crime policy is subject to a policy ratchet effect: punitive policies are adopted during bad times and remain in place during the good.⁶

⁶See Huber and Stephens (2001) for a discussion of policy ratchet effects in the context of welfare state policies. We note that the literature on the social construction of target populations also points to the possibility of policy ratchet effects (Schneider and Ingram 1993; Ingram et al. 2007). The central claim in this work is that policies are formulated in line with socially constructed assessments of the deservingness of different populations for generous or harsh treatment instead of being based on efficiency criteria. To the extent that these social constructions persist, so may inefficient policies.

Our work builds upon a recent experimental (and quasi-experimental) literature on how information shapes policy relevant beliefs.⁷ Esberg and Mummolo (2018) shows that individuals update their beliefs when presented with accurate crime statistics, but the extent to which they do so depends on the format in which the information is presented and the existence of countervailing messages by elites. Similarly, Ardanaz et al. (2014) find that information about decreasing crime rates improves citizens' perceptions of safety and leads to greater trust in police. Exploiting a natural experiment in Italy, Mastrococco and Minale (2016) show that lower exposure to crime-related news reduces concerns about crime. However, none of the aforementioned articles explore how information about crime shapes the trade-offs citizens are willing to make across anti-crime policies.⁸

There are several important contributions of this study vis-à-vis the extant work. First, we provide evidence that an information shock can affect public policy demand even if it does not portray the *recent* evolution of crime, and that those affected most by such shocks are the least informed in the population (Caplan 2007).

Second, our analysis evaluates a theoretical framework that explicitly models the trade-offs associated with investments in distinct policies. In particular, our framework and empirical strategy take seriously the prospect that both sanctioning and social policies may – to different degrees depending on context – be effective in combating crime. In this regard, we build on the insights of an emerging literature on crime and social policy that shows how various forms of human capital enhancement and redistributive strategies are employed by states to address concerns about crime (Hummelsheim et al. 2010; Rivera and Zarate-Tenorio 2016; Rueda and Stegmüller 2016). Our simple theoretical model, which extends the traditional Becker model to a context of multiple policies, provides a rationalisation of the crosscountry evidence showing roughly two patterns of countries: one with high punishment and small safety nets (the US model) and another featuring lower punishment and larger safety nets (the Northern European model).

Third, in the survey, we measure policy preferences (not sentiments) by presenting subjects with a fixed budget that they can allocate across a set of specific activities designed to reduce crime. Consequently, our results illuminate how information shapes the *relative* attractiveness of different policy options in voters' minds. We believe that this is an important step forward in analyses of policy preferences, as it provides a strategy for estimating the trade-offs voters are willing to make as a function of the information available to them.

Fourth, to the best of our knowledge, our article provides the first experimental evaluation of the impact of information on anti-crime policy preferences outside of

⁷In this article, we do not engage with a related but conceptually distinct literature on the role of victimization on support and satisfaction with democracy (Ceobanu et al. 2011; Cruz 2008) or victimization and trust (Corbacho et al. 2012; Malone 2010).

⁸Other recent papers in this field examine the impact of government propaganda on beliefs about water privatisation (Di Tella et al. 2012), the impact of information about one's place in the income distribution on tastes for redistribution (Cruces et al. 2013), the impact of corrective information on the rejection of false rumors about health care (Berinsky 2017), information about unemployment forecasts on economic expectations (Alt et al. 2016), information about government provision of public goods on tax compliance (Castro and Scartascini 2015a), and information about government promises and performance on trust (Alessandro et al. 2018).

the US.⁹ Evaluating the responsiveness of policy preferences to information in such settings is important, since there are good reasons to doubt that the degree and nature of information responsiveness encountered in the US can be easily extended to democracies in the developing world.¹⁰

Fifth, our article contributes to a newly emerging literature on the political origins of punitive criminal justice and policing policies in Latin America. One strand of research on this topic consists of case studies that concentrate on the political decisions that produce such policies, examining their authoritarian origins as well as their consequences for party branding efforts and attempts at blame avoidance (Pereira and Ungar 2006; Holland 2013; Flom and Post 2016). Another strand of research on the topic uses survey data to explore the factors that drive public support for aggressive and punitive policing in the region. The findings of this second strand on the effects of information are mixed. Survey experiments conducted in Guatemala and Mexico have found that exposure to media reports and (favourable) government statements about crime do not shift attitudes much, or do so only for those not directly exposed to crime (Krause 2014; Romero et al. 2015).¹¹ Our contribution to this literature is to demonstrate that certain types of information about crime can indeed shape voters' tastes for punitive policies.

Finally, we explicitly study the impact of information that conveys either a positive or negative message. This permits us to assess not only if information about crime drives policy preferences, but also to ascertain if voters respond differently to information based on its content. Accordingly, our analysis offers insight into whether punitive decisions by individuals are rationally or emotionally motivated (Ouss and Peysakhovich 2015).

Optimal crime policy with rational citizens

We begin by characterising the induced preference of a rational citizen over different forms of anti-crime policy based on her beliefs about the state of the world. For our purposes, the only relevant information about the state of the world is the level of crime. Depending the level of crime, some forms of anti-crime policy will be more effective than others, leading the citizen to select different bundles of policies based

⁹Recent work has utilised information experiments to study the impact of factual information on preferences over budgetary procedures and support for the estate tax (also in the US), finding that preferences in each of these policy areas are shaped by policy relevant information (Boudreau and Mackenzie 2014; Sides 2016). Yet other studies find little or no impact of information. Kuklinski et al. (2000), for instance, randomized information about the US welfare system, finding that respondents provided with information on this subject did not have significantly different policy preferences than respondents not provided with information. In the closest parallel to the present paper, Gilens (2001) randomises information about the crime rate in the US, finding that those informed that the crime rate had decreased were significantly less likely to support increased spending on prison construction than those not provided with specific information about the crime rate.

¹⁰For example, the perceived racial identity of perpetrators of crime plays a powerful role in shaping Americans' preferences for crime policy. When cues suggest perpetrators are African-American, US respondents tend to favour punitive crime policies (Gilliam and Iyengar 2000; Hurwitz and Peffley 2005). This strong racial attribution dynamic is likely to be less relevant in societies, like those of Latin America, where racial boundaries are more fluid and subtle.

¹¹Observational work emphasises the importance of experiential factors like crime victimization in determining anti-crime policy preferences (Visconti 2020).

on her beliefs. Holding the accuracy of these beliefs constant, we describe how an instrumentally rational citizen's preferences over crime policies change as her beliefs about crime change. This provides the basis for the theoretical expectations that we evaluate in our empirical analysis.

Preliminaries

Consider a setting in which a citizen is tasked with setting policy to reduce crime. Three instruments are available to achieve this objective: public investment in activities that augment the punishment for those caught engaging in criminal behaviour, such as the building of additional prisons (making possible longer prison sentences), investment in activities that make crime more likely to be detected, such as subsidies for private alarm systems or the installation of public camera systems, and investment in activities that target the social conditions that breed crime, such as vocational training and anti-poverty programs. Denote the amount of funds directed to the three instruments as c (stronger punishment), s (improved monitoring), and t (targeting social conditions), respectively, where investment in each instrument is non-negative and must obey the budget constraint, $c + s + t = 1$

The relevance of the instrument rests with the manner in which they shape incentives to engage in crime. The polity contains a set of potential criminals, with a representative member of this set indexed by i . For each individual in this set, greater investment in punishment (higher c) increases the costs of criminal behaviour if detected, greater investment in monitoring (higher s) increases the likelihood that criminal behaviour will be detected, and greater investment in improving social conditions (higher t) augments an income subsidy that increases the potential returns to noncriminal behaviour. In particular, t is added to the income of any potential criminal who is not caught engaging in criminal behaviour. (For simplicity, legal labour market income is normalised to zero).

We assume potential criminals experience linear utility in punishment but diminishing marginal returns to income. This can be justified by the fact that the experience of punishment is not constrained to lie on a pecuniary scale: the (dis)utility of an additional period of time in prison is unlikely to dissipate as quickly as an additional disbursement of income. Thus, a potential criminal i who engages in crime and gets caught receives utility $U_i(c) = -\alpha c$. By contrast, any monetary disbursement in the amount x is valued according to the function $U_i(x) = u(x)$, where $u' > 0$, $u'' < 0$, $u(0) = 0$ and $u'(0) = +\infty$.

Each potential criminal employs a Becker-style choice model (Becker 1968) in contemplating the decision of whether or not to dedicate themselves to a life of crime.¹² In calculating expected utility from either option, i must incorporate expectations about the overall crime rate. This is because a high rate of criminality places i 's income at risk: the more extensive is crime, the more likely it is that an individual will be victimised and lose her income. We formalise this intuition through the use of the function $\nu(q^e) \in [0, 1]$, which represents the probability of crime victimisation. It is a sigmoid function of $q^e \in [0, 1]$, which in turn represents the expected proportion of potential criminals who dedicate themselves to a life of crime. The greater this

¹²In using the phrase "Becker-style model", we refer to an analytical framework in which instances of criminal behavior are assumed to reflect the rational cost-benefit calculations of would-be criminals.

proportion, the more likely it is that a potential criminal will be robbed of his legitimate and/or ill-gotten income, depending on the career path he pursues.

If i chooses a life of crime, his expected utility is equal to:

$$\begin{aligned}
 EU_i(\text{crime}) &= p(s)(-\alpha c) + (1 - p(s))\{v(q^e)u(0) + [1 - v(q^e)]u(\pi + t)\} - \varepsilon_i \quad (1) \\
 &= p(s)(-\alpha c) + (1 - p(s))[1 - v(q^e)]u(\pi + t) - \varepsilon_i,
 \end{aligned}$$

where $p(s) \in [0, 1]$ is a function representing the probability that criminal behaviour is detected by authorities, $\pi \in \mathfrak{R}^+$ is the monetary return to crime, and ε_i is i 's idiosyncratic moral taste for engaging in criminal behaviour. The function $p(s)$ is concave increasing with $p(0) = 0$ and $p'(0) = +\infty$. Moral tastes in the population of potential criminals are distributed uniformly with support $[-1/2\beta, 1/2\beta]$. Note that in the best-case scenario for a criminal – that in which he evades detection and receives both the return from crime and the income subsidy – there is still a probability $v(q^e)$ that he will be victimised by another criminal and lose all of his income.

Similarly, if i chooses to avoid a life a crime, his expected utility can be written:

$$\begin{aligned}
 EU_i(\neg\text{crime}) &= v(q^e)u(0) + [1 - v(q^e)]u(t) \quad (2) \\
 &= [1 - v(q^e)]u(t).
 \end{aligned}$$

As expressed in the equation above, rampant criminality dampens the value of the income subsidy because it reduces the likelihood that the subsidy is actually enjoyed by the individuals who engage in good behaviour.

Equilibrium

Holding constant the choice of policy instruments, a potential criminal i chooses to engage in crime if $EU_i(\text{crime}) \geq EU_i(\neg\text{crime})$. Utilising the distribution of moral tastes for crime, this inequality defines the objective crime participation rate q . Setting the expected and objective rates equal to one another, an equilibrium crime participation rate q^* is a solution to the following equation:

$$q^* = \beta\{p(s)(-\alpha c) + [(1 - p(s))u(\pi + t) - u(t)][1 - v(q^*)]\} + 12 \quad (3)$$

As shown in Figure 1, the sigmoidal shape of the victimisation function $v(\cdot)$ results in three equilibrium levels of crime: a high equilibrium (q^H), a low equilibrium (q^L), and an intermediate equilibrium (q^M). The two extreme equilibria are stable, whereas the intermediate equilibrium is not. Thus, the polity can plausibly be under one of two different types of crime regimes: a high crime regime or a low crime regime.

Denote the citizen's belief about which of the two regimes is in place as $\tilde{q} \in \{q^L, q^H\}$. Given her belief about the extant regime, she chooses crime policy to maximise the proportion of potential criminals who abstain from crime:

$$\max_{c, s, t} 1 - \tilde{q} \quad (4)$$

$$\text{s.t. } c + s + t = 1.$$

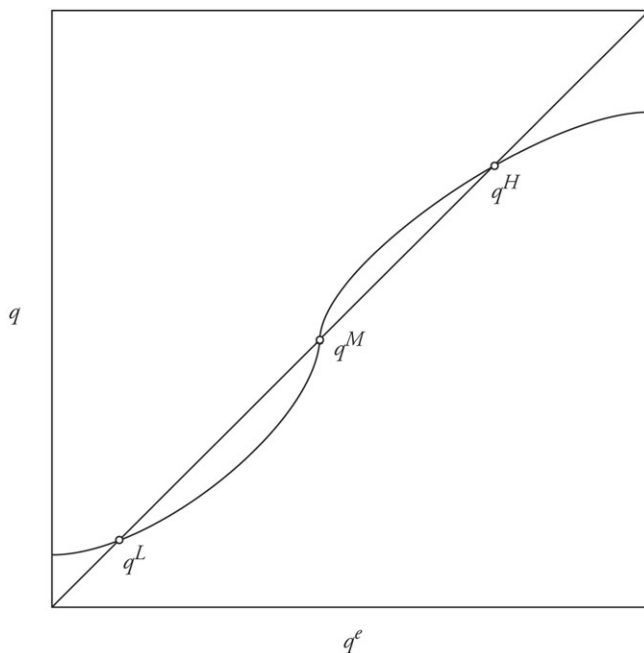


Figure 1. Crime Equilibria.

In what follows, it will be helpful to introduce the following technical assumption, which places an upper bound on the extent to which c and s complement one another:

$$\text{Assumption 1 : } \alpha < u'(\pi + 1)(1 - v(1)). \quad (5)$$

The above maximisation problem and technical assumption lead directly to the following proposition.

Proposition 1 *A citizen who believes that the polity is in a high (low) crime regime prefers greater (lower) spending on punishment, and less (more) spending on detection and the income subsidy than does a citizen who believes the polity is in a low (high) crime regime.*

Proof. See Appendix A. ■

The proposition establishes the context-dependent nature of preferences on crime policy. According to the model, in a high crime setting, policies that function as income subsidies will be perceived as ineffective because the solidity of the property rights regime is in doubt. Income subsidies and other social policies targeted to vulnerable populations to enhance the returns to legal labour market activity will not be viewed as useful tools in combating crime because widespread crime is expected to erode the value of these benefits. Consequently, investing in activities that augment the formal punishment for crime will be relatively more attractive. In a low crime setting, preferences over policy will be reversed. In this scenario, the elasticity between income subsidies and personal wellbeing for those that eschew a life

of crime will be strong, implying that policies that address the underlying roots of crime may be more effective than increasing punishments. These results are in line with the policy differences observed across the developed world, with some countries adopting the high punishment low safety net combination while others adopt the opposite vector of policies.

More subtly, policies that enhance detection rates for crime will also be less preferred in high crime settings than low crime settings. This is because in high crime settings, criminals expect that if they go undetected there will nevertheless be a high likelihood that they will lose their ill-gotten gains at the hands of other criminals. Consequently, the bite of an increased detection rate is weaker in such contexts, since the lack of property rights protection erodes the returns to crime and makes the detection/nondetection utility differential for criminals less stark. Punishment is again favoured by citizens in this scenario because it represents a “sure thing” deterrent, with marginal returns to investment that are not dissipated by high social expectations of crime.

In this simple model, policies are chosen contemporaneously by a single representative citizen whose beliefs about crime are directly manipulable. The real world differs from this framework in two potentially relevant respects. First, voters communicate their policy preferences to politicians knowing that these can only be implemented in the future. As such, policy demands are based heavily on expectations about the future state of the world (e.g. budget allocations decided in one period take effect in a subsequent period, and will often take into account expected growth in future periods, etc). Consequently, in the context of this article, citizens should consider both levels and time trends in order to form their beliefs about crime and make policy decisions.

Second, changes in beliefs in most democratic societies do not occur via direct manipulation (as in an indoctrination campaign) but rather as the result of the internalisation of new information. This points to an important aspect of heterogeneity among citizens that our model does not directly address: differences across citizens in the degree to which novel information impacts beliefs about crime. Rational theories of learning – drawing upon a Bayesian logic – would imply that the amount of prior information citizens have accumulated about crime will strongly shape the degree to which new information affects their beliefs about this issue.¹³ In particular, the beliefs and policy preferences of citizens who have accumulated a high amount of information about crime will not be as easily swayed as those with a low amount of information.

Information experiment

We assess the results of the model via the use of an information experiment in which subjects are randomly assigned to infographics that provide information consistent with the existence of a high crime or low crime setting, respectively. The logic behind this experiment is to create a source of identification for crime expectations by randomly allocating individuals to those messages. Our information experiment was embedded in the latest round of the Americas Barometer Survey conducted by

¹³For an introduction to the logic of Bayesian inference, see Jackman (2004).

the LAPOP in the country of Panama in early 2017. The survey provides a nationally representative stratified sample of adult Panamanians, with 1,521 respondents in total. Interviews were conducted in face-to-face format using electronic tablets.¹⁴

Each respondent in the survey was randomly assigned to one of three different experimental conditions. The first two conditions presented respondents with graphical displays describing the homicide rate in Panama in recent years.¹⁵ The third condition was a control state in which no information was provided. Randomisation of individuals across treatments was produced by LAPOP using “Survey to Go” software, based on a preprogrammed script in the interviewers’ tablets. Table A1 in Supplementary material shows the balance of the treatments across a broad set of covariates that include socio-economic characteristics, victimisation and political participation history, and access to information. The treatments are generally well balanced across covariates, with a few imbalances that are compatible with chance. As shown later, including those variables in the regressions does not affect the results.¹⁶

The infographics used as treatments were developed by the authors in conjunction with a professional graphic designer. They are presented in Figure 2. The first infographic was designed to provide an information shock consistent with beliefs in a high and increasing level of crime. It depicts the precipitous increase in the homicide rate experienced in Panama from 2000 to 2013. The text states: “*Did you know that the homicide rate in Panama has nearly doubled in recent years?*” A bar graph anchors the text, displaying the level of crime (homicide rate) at two different moments in time. An upwards arrow displays the percentage change (an increase of 75%). The background of the information graphic – a crime scene – conforms with the somber content of the information being provided.

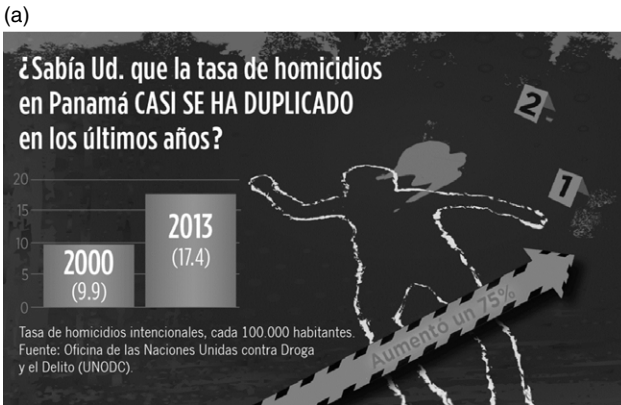
The second infographic was designed to provide an information shock consistent with beliefs in a low and decreasing level of crime. Using different dates of measurement than the first, it depicts the decrease in the homicide rate experienced in Panama from 2009 to 2013. The text states: “*Did you know the homicide rate in Panama has decreased in recent years?*” As with the first graphic, a bar graph anchors the image and an arrow illustrates the percentage change (a decrease of 25%). The background image – a mother walking in a park with her children – conforms with the positive message conveyed by the graphic.¹⁷

¹⁴Full details about the survey and sampling procedures can be found in LAPOP’s Panama survey website: https://www.vanderbilt.edu/lapop/panama/Panama_AmericasBarometer_Tech_Info_2016_17_W_092217.pdf<https://www.vanderbilt.edu/lapop/panama>

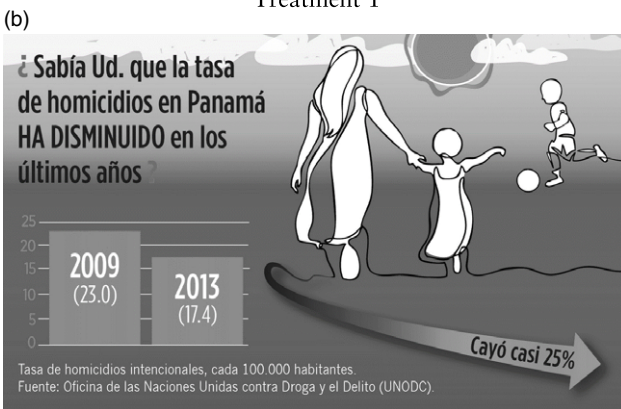
¹⁵The model deals with property crime rather than homicides as the rich literature has done in the past; the experiment uses information on homicides as it is more accurate and does not depend on reporting, which is endogenous. Importantly, the implications of the model travel well across crime types as have been shown in the literature (Becker 2000)

¹⁶Additionally, running a regression only in the control group shows that most of those variables are not significant predictors of variation in the dependent variable.

¹⁷The intention behind the design was to prime-treated individuals to think about a safe environment, one in which everybody could enjoy being outside without worrying about crime. Of course, even though we tested our treatments in a small and ad-hoc focus group, it could be the case that some people inferred the opposite of what we intended. For example, it may be that some were primed to think about protecting this mother and child from the dangers of violence. We thank an anonymous referee for pointing out this possibility.



Treatment 1



Treatment 2

Figure 2. Information Treatments.

Although the two informational graphics convey very different messages about crime trends in Panama, neither is false. That is because both are based on official statistics from the United Nations Office on Drugs and Crime (UNODC). However, they use different starting points to describe the homicide trend. This difference in start dates, taken in conjunction with Panama's stark experience with homicide trends in the last couple of decades, made it possible to send distinct messages about crime using the same data. We used 2013 as the end date because that was the latest data point available using UNODC data at the moment we designed the treatments. We chose to use only information about homicides based on UNODC data in our treatments so as to eliminate any potential biases due to differences in the perceived credibility of the source.¹⁸ While the actual level of crime indicated for 2013 is the same in both treatments, the evidence shows that individuals tend to evaluate states

¹⁸See Alt et al. (2016) and Weitz-Shapiro and Winters (2017) on the importance of source credibility. We concentrate our analysis on homicides because homicide data tends to be less affected by measurement error than data for other types of crimes.

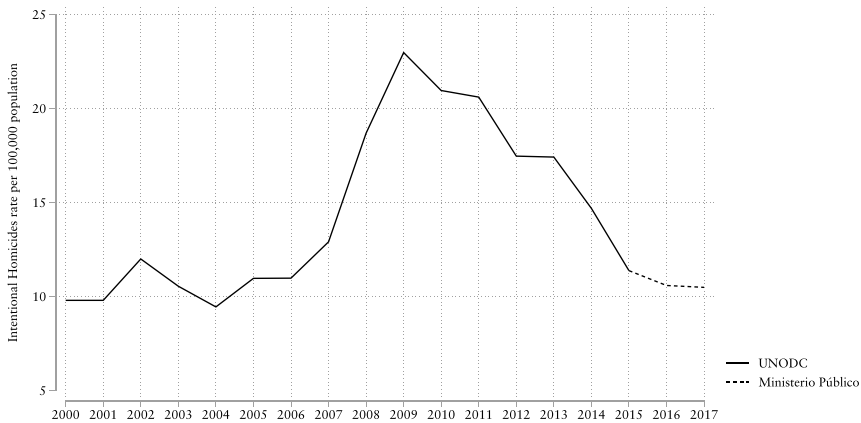


Figure 3. The Homicide Rate in Panama, 2000–2017.

Note: Data from 2000 to 2015 corresponds to UNODC, 2016–2017 provided by Ministerio Público. Survey experiment took place at the beginning of 2017.

of the world according to benchmarks, particularly in the context of information that is difficult to process (such as homicide incidence per 100,000 individuals). Moreover, the evaluation of the state of the world is not independent of the framing and images used to send messages (Castro and Scartascini 2015a, 2015b; Alessandro et al. 2018).

Figure 3 depicts the long-term homicide trend from 2000 to 2017, supplementing the UNODC data with information from police sources (Ministerio Público) for the most recent years. The trend line has an inverted U-shape. After a period of stability, the country experienced a severe uptick in homicides from 2004 to 2009, a 145% increase that saw the country reach a homicide rate of 23.0 per 100,000 people in the latter year. From that point on, however, homicide rates declined precipitously, reaching levels equivalent to those at the beginning of the time series. The fact that both sharp increases and decreases in the homicide rate in Panama occurred in relatively recent history makes both messages *a priori* plausible, a necessary condition for the messages to shape citizens' preferences over anti-crime policies. As shown in Figure A4 in Supplementary material, beliefs have tracked the evolution of crime over time relatively well.

Although the evolution of homicide rates in Panama makes the country uniquely well suited for our purposes in this article, it is not a *sui generis* case in terms of the contributors to crime. The nature of violent crime in Panama shares some broad similarities with other countries in the region. As is the case throughout Central America, violent crime is often perpetrated by gangs, with homicides in particular driven by “score settling” and disputes over territory. Panama's gangs first emerged towards the end of the Noriega dictatorship in the 1980s. They subsequently grew in size and strength following the US invasion, a period of time when the country disbanded its armed forces and citizens faced considerable economic hardship (InsightCrime 2018). In addition to selling drugs and engaging in various other forms of street crime, Panamanian gangs also participate as junior partners in the international drug trade, providing local security and logistical support to

Colombian and Mexican drug cartels as they move narcotics northwards to the US or across the Atlantic to Europe.¹⁹

Our outcome of interest is a citizen's relative preference for different anti-crime policies. To operationalise this outcome in a manner consistent with our theoretical framework, we incorporated into the survey a question prompting respondents to indicate how they would distribute a fixed amount of resources to four different policies. The respondents were first presented with a card displaying ten coins, which represented the total budget to be expended on all policies. Then they were read the following text:

Governments can adopt many measures to combat crime, but they have limited resources to do so. Suppose that the government has a total budget of ten coins to distribute among four measures to reduce crime. I will describe the measures to you and ask that you distribute the ten coins found on the top of your card among the four possible measures as you see fit. You can assign as many coins as you wish to each of the measures. You must use the ten coins. These are the four possible measures:

1. Increase the punishments given to criminals
2. Offer subsidies/help to people to buy security systems and other forms of self-protection
3. Implement preventive measures, such as vocational training and rehabilitation programs
4. Invest more money in anti-poverty programs

Respondents were asked to physically assign the coins to each answer, as shown in Figure 4.

The purpose of this card was to reduce the possibility of computational mistakes, provide a physical representation of the choices being made across options, and allow individuals the opportunity to decide on the overall allocation before answering. This procedure is far superior for highlighting the trade-offs between options than the questions usually used in surveys to elicit policy preferences.²⁰

In what follows, we examine how assignment to the different experimental conditions affects the relative allocation of coins across the anti-crime policies. Since items 3 and 4 above both represent strategies for preventing crime through social policy, we collapse the two items into a single item of that name. That decision, made for simplicity and consistency with the model, does not change in any way or alter our conclusions, as we demonstrate later in the empirical section.

In addition to examining patterns of average treatment effects across the entire sample, we recognise that there may be distinct treatment effects for particular

¹⁹The fact that gangs are an important driver of crime in Panama and its neighbors does not imply, however, that the threat they present to public security is similar across all these countries. Relative to the Northern Triangle countries (El Salvador, Honduras, and Guatemala), for instance, membership in gangs in Panama is many orders of magnitude smaller, as are the levels of violence that they produce (World Bank 2011).

²⁰It is important to note that the respondents themselves distributed the coins among the four categories. On average, participants in the control group assigned 33%, 14%, 20%, and 32% to each category. See Figure A1 in Supplementary material for the distribution of responses by question.



Figure 4. Physical Coin Assignment.
 Note: Individuals were asked to physically assign coins to each category to avoid computational mistakes.

subgroups. For example, people who have access to and consume more information would be expected to react differently than those who do not frequently consume information. For that reason, our analysis also examines subgroup treatment effects based on differential exposure to news media.

Main results

Formally, we estimate the following simple linear regression model:

$$Y_i^v = \theta + \gamma^1 T_i^1 + \gamma^2 T_i^2 + X_i \Delta + \mu_i, \tag{6}$$

where X_i is a vector of characteristics of individual i ,²¹ T_i^1 is an indicator that takes the value of one for the treated individuals shown the infographic of crime increasing, and T_i^2 for the individuals shown the infographic of crime decreasing. μ is an unobserved random term. The coefficients γ^k , $k \in \{1, 2\}$ measure the causal effect of the intervention. Y^v represents each of the outcome variables ($v \in \{a, b, c\}$) described in the previous section for survey participants. To be precise, our outcome variables consist of each pairwise difference in coins allocated to the three policy

²¹We include all the observable characteristics that may be correlated with public policy demand according to the literature, such as sex, marital status, age, education, employment status, victimisation, corruption experience, access to information, political stance and protest participation. The full list is in Table A1 in Supplementary material.

strategies: punishment, social policy, and detection (security systems). Thus, we examine the impact of our treatments on three dependent variables, each of which captures the relative preference of respondents for one policy strategy versus another. This is the most natural way of looking at the data given the predictions of the model. (For the record, our results do not change at all if we examine instead the absolute numbers of coins or shares of coins.)

We utilise ordinary least squares to conduct the analysis, running models with the treatment indicators in isolation as well as models that include a small set of covariates that showed imbalance across treatments, and a full set of covariates, as presented in the balance table.

The findings are presented in Table 1. In line with the expectations generated by the formal model, we find that, relative to the control condition, exposure to information showing an increase in homicide rates led respondents to allocate more coins to punishment and less to social policies addressing poverty or other root causes of crime. This result is statistically significant and holds regardless of whether or not covariates are included in the model.²² Consequently, the experimental findings jibe with the notion that information shocks indicating that society is in a high crime scenario lend themselves to demands for punitive approaches towards crime. Coefficients are statistically different across treatments. Figure A2 in Supplementary material provides a clear visual representation of how individuals in the treatment group assigned relatively more coins to increases in punishment and fewer to social policies than the control group.

A similar finding holds for the trade-off between punitive policy and detection. As expected, relative to the no information scenario, the increasing homicide treatment induced respondents to allocate more coins to punishment and less to subsidies for security systems. Although the magnitude of this effect was smaller than in the case of punishment versus social policy, it was statistically significant nonetheless (with or without covariates) and it still implies a change of about 25% in the budget allocation. For the trade-off between detection and social policy, for which the model does not offer strong expectations, there was no statistically significant impact of information about homicide rates. This result works well as a robustness check of our estimations.²³

The impact of the homicides decreasing treatment did not conform with the expectations of the theoretical framework. Policy preferences did not change much as a consequence of the positive news that homicides were decreasing. To the extent they changed at all, it was in a direction that was suboptimal given the content of the information provided. There are several reasons why this might have been the case.

First, it may be that given the short time frame captured by the graph (2009–2013), some respondents did not feel it was a realistic representation of the actual homicide trend in Panama. Consequently, some may not have fully internalised the

²²The change in the allocation is substantial. Whereas those in the control group assign on average 1.9 more coins to social policy than penalties, this difference falls by more than 40% for those in the treatment group.

²³Importantly, our findings are not an artifact of collapsing the two social policies into a single measure. We find nearly identical results if we analyse the two components of social policies separately, as is shown in Table A2 in Supplementary material.

Table 1. Impact of crime information on policy preferences (OLS regressions)

| | Punishment – Social Policy | | | Punishment – Detection | | | Detection – Social Policy | | |
|---------------------------|----------------------------|--------------------|--------------------|------------------------|---------------------|--------------------|---------------------------|----------------------|---------------------|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| T1 (homicides increasing) | 0.654** (0.304) | 0.766** (0.297) | 0.769** (0.331) | 0.474** (0.179) | 0.513** (0.200) | 0.474** (0.198) | 0.180 (0.230) | 0.253 (0.240) | 0.294 (0.243) |
| T2 (homicides decreasing) | 0.418 (0.297) | 0.383 (0.332) | 0.385 (0.344) | 0.416** (0.195) | 0.396* (0.219) | 0.355 (0.225) | 0.002 (0.226) | −0.013 (0.233) | 0.030 (0.238) |
| Constant | −1.888*** (0.220) | −0.768 (0.816) | −1.480 (1.523) | 1.955*** (0.141) | 1.501*** (0.495) | 0.914 (0.977) | −3.844*** (0.174) | −2.269*** (0.496) | −2.394** (1.019) |
| Observations | 1,494 | 1,404 | 1,358 | 1,494 | 1,404 | 1,358 | 1,494 | 1,404 | 1,358 |
| Controls | No | Narrow | Broad | No | Narrow | Broad | No | Narrow | Broad |
| p-value T1 = T2 | 0.403 | 0.224 | 0.243 | 0.767 | 0.591 | 0.575 | 0.423 | 0.254 | 0.272 |
| Control mean | −1.89 | −1.89 | −1.89 | 1.95 | 1.95 | 1.95 | −3.84 | −3.84 | −3.84 |

Notes: Table displays the estimate of OLS regression models when outcome Y of individual i is regressed on the treatments and a set of covariates. Each column in the table corresponds to a different specification. First column in each set has no controls. “Narrow” corresponds to a set of controls that showed some imbalance. Broad corresponds to the full set of covariates shown in the balance table in Appendix. Clustered standard errors (at the primary sampling unit) in parentheses. *** p0.01, ** p0.05, * p0.1.

information contained in the graph. However, given that crime continued decreasing after 2013, this seems unlikely.

Second, some respondents may have internalised the information about the *level* of the homicide rate instead of focusing on the trend. If the level across the two years was surprisingly high to these respondents, then this fact may have overshadowed the impact of an improving trend. Consequently, it is possible that the ostensibly good news about the homicide rate may not have been interpreted as such by some respondents. This explanation seems unlikely given the regional context in which Panama is embedded. Although by Panamanian standards the homicide spike at the end of the first decade of the new millennium was quite sharp, the overall level of homicides in the country is lower than any other country in Central America save for Costa Rica and Nicaragua. Taking into consideration the endemic levels of violence experienced in neighbouring El Salvador, Honduras, and Guatemala, it is hard to escape the conclusion that the absolute level of homicides in Panama, especially given the presentation of a downward trend, should have been positive news. (See Figure 1 in Supplementary material for a comparative view of homicide rates in Central America).

Third, it may be the case that for many citizens the link between underlying social conditions and levels of crime is less evident than the link between crime and punishment.²⁴ Accordingly, preferences for social policy solutions to crime may be less responsive to information about crime levels than preferences for punishment. Be that as it may, this still would not explain why the homicide decreasing treatment produced slightly stronger preferences for punitiveness than the control condition (which provided no information about crime).

Finally, another possible explanation is that the mechanism at play is what psychologists call attribute substitution, which refers to a cognitive bias in which a simple (knee jerk) emotional response to a stimulus substitutes for a more thoughtful consideration of the same (Kahneman and Frederick 2002). Seen from this perspective, the mere mention of homicides may have triggered in some respondents a perception of threat that led them to favour more punitive policies. Such a knee jerk emotional response could have been exacerbated by the depiction of the mother and child, as this image may have prompted some respondents to focus on the need to protect such vulnerable populations from crime.²⁵ Admittedly, this is a post hoc explanation that our experimental result cannot directly verify. Nevertheless, it is consistent with observational and experimental research that has shown that threat-inducing stimuli on topics such as terrorism can generate knee jerk responses in favour of punitive policies (Huddy et al. 2005; Merolla and Zechmeister 2009). It is also consistent with the results coming from the annual Gallup polls on crime perceptions.²⁶

²⁴We thank an anonymous referee for bringing this possibility to our attention.

²⁵Indeed, the politicisation of victims of crime – especially when victims are women or children – has been associated with a public preference for more punitive anti-crime policies (Dubber 2002; Garland 2001).

²⁶These findings are not inconsistent with the literature that shows changes in beliefs based on new crime information (Esberg and Mummolo 2018). It could be the case that individuals understood that crime was decreasing but still considered crime to be high.

The analysis presented in the next section should help to distinguish between these possibilities.²⁷

The role of heterogeneous access to information

A natural question that arises in interpreting these data is whether or not the reactions of our respondents to the information treatments follow a standard belief updating process. If changes in policy preferences are indeed induced by the updating of prior beliefs, then reactions to the informational treatment should differ according to the level of information of each individual, that is those who are more informed should react less to new information. Towards this end, we examine how the impact of information about crime is mediated by prior exposure to information in the media.²⁸

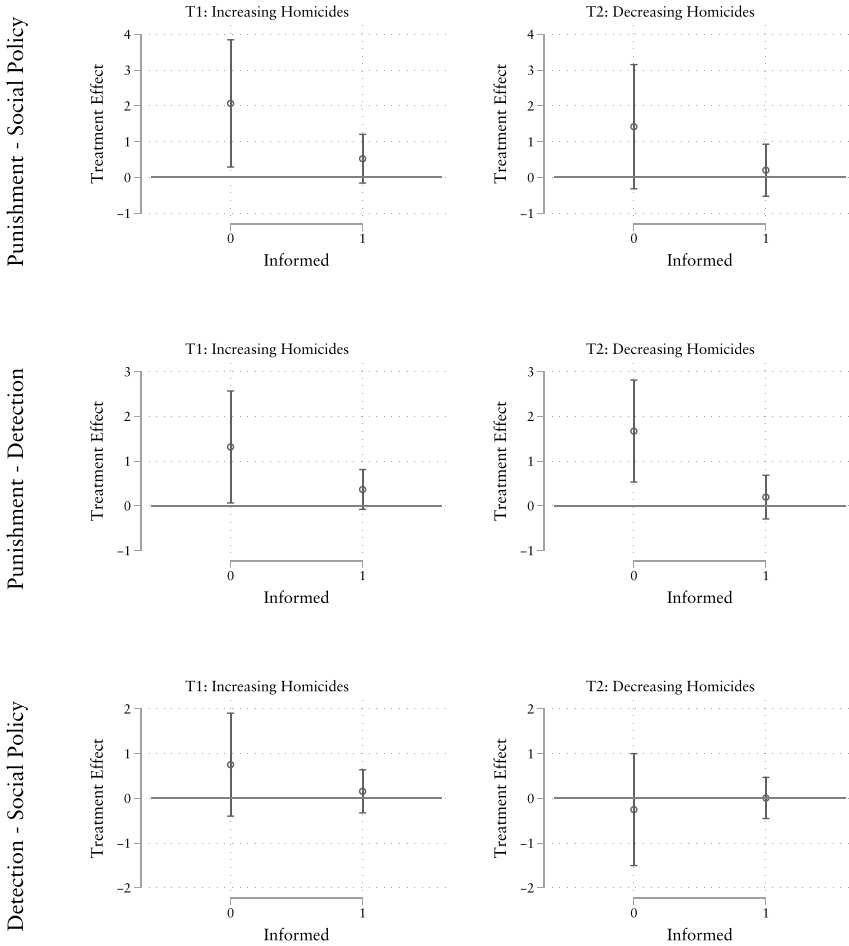
If policy preference change among our respondents reflects a standard belief updating process, then individuals who are highly informed should be least affected by the treatments since they should hold relatively fixed and factually-based prior beliefs about crime trends. Individuals who are poorly informed should be the most affected by the treatments, as they are likely to hold diffuse and easily malleable beliefs about crime trends. We evaluate the degree to which this is the case by estimating regressions that include an interactive term of the treatment and a dummy variable that takes the value one for those respondents exhibiting high levels of news consumption.²⁹

Figure 5 presents dotplots depicting the differential impact of the treatments on the relative preference for the different policies. The first two rows, which compare preferences for punishment over social policy and punishment over detection, show that there are large differences in the impact of the information treatments depending on the level of news consumption. The policy preferences of informed citizens, who consume substantial amounts of news, are relatively unaffected by the introduction of information about homicide rates. By contrast, the impact of the information treatments on preferences for punishment is substantially larger for uninformed citizens, individuals who rarely or never consume news in the media. To be precise, the impact of the increasing homicides treatment on preferences for punishment over social policy (detection) is about 4 (3) times larger for uninformed citizens than for informed citizens. Effects go in the same direction for the decreasing homicides treatment. The uninformed change their policy preferences after

²⁷We concentrate our analysis on the role of information. Given the way we designed the treatments, we cannot rule out the possibility that the results could be shaped by framing (Tversky and Kahneman 1981). Still, framing cannot explain the fact that results for both treatments tend to go in the same direction instead of in opposite directions.

²⁸Informed individuals are more likely to be more educated, have more children, and be retired. Those who trust other people, those who think that news media represents the different views that exist in the country, and those who voted in the past elections are also more likely to be informed. We find no significant differences according to sex, marital status, age, ethnic background, ideology, crime victimization, having protested in the last 12 months, or having higher trust in the media.

²⁹Informed citizens are defined as individuals who denote that they follow the news, be it on television, the radio, newspapers, or the internet, with one of the following frequencies: daily, several times a week, or several times a month. Uninformed citizens are individuals who denote that they “rarely” or “never” follow the news on any of these media.



Note: 95% Confidence Interval

Figure 5. Impact of Information Treatments on Relative Preference for Policies (by Level of News Consumption).

Note: Black circles present the marginal effects of an OLS regression that includes the treatment variable, its interaction with 1(informed) and a set of covariates with clustered standard errors (primary sampling unit).

receiving the new information (in the same direction of those who received the other treatment). We do not find any differences for the last row, as expected from the model.

These results are consistent with a standard belief updating process and they also stress once more that citizens – in particular uninformed ones – seem to react to any type of crime news by increasing their demand for punitive policies. The results also support the idea that the beliefs of a subset of the population may be influenced by the provision of information, even if that information depicts a trend that does not reflect the recent evolution of crime in the country.

Conclusions

Recent political campaigns around the world appear to have been heavily influenced by the use of fake news and other forms of deception. Exaggeration, strategic framing, and misleading use of information have become widespread during policy debates. At the same time, many voters are believed to be strongly locked into their partisan and policy orientations. This raises an important question: Are citizens' preferences for public policy amenable to change in light of new factual information, or do they reflect ingrained cultural biases that are impervious to facts? A great deal rests on the answer to this question. If the average citizen has no factual basis for the policies that she demands and said demands do not evolve in reasonable ways with exposure to relevant information, then democracy is a bad way to make policy. Incorporating citizens into policymaking directly through greater decentralisation and popular participation programs may not improve and in some cases may even worsen public policies.

The current article addresses the issue of how information shapes the policies citizens demand from their governments. By exploiting the peculiar evolution of crime in Panama – an inverse U-shape – we are able to provide individuals with two distinct messages about crime. Both of the messages were factually correct for the dates indicated. However, they differed markedly in the message they sent about crime in the country. A third of the sample was shown visual information that the crime was high and increasing, while another third was shown visual information depicting a low and decreasing homicide rate. In both cases, the figures and the framing intensified the information conveyed by the crime statistics. The expectation from our theoretical model (an extension of the Becker framework) is that in a high crime context citizens will demand higher punitive strategies, while they will favour social and detection policies in a low crime context.

The results show that individuals react as predicted by the model when they receive the information depicting an increase in crime: they demand higher punishment and lower social policy. Yet the converse is not true. When respondents receive the good news that crime is decreasing, they do not shift their policy preferences in favour of social policy over punitive measures. News indicating a reduction in crime had no statistically significant effect on preferences. To the degree it had any discernible impact at all, the crime reduction message actually increased preferences for punitive policy (relative to the no information scenario). This raises the possibility that political communication about crime, in and of itself, may lead citizens to favour punitive policies.

Separating individuals with low and high access to information provides evidence on the types of individuals most effected by messages about crime. Those with low access to information react much more strongly to the new information than those who are better informed.

These empirical results have clear implications. Firstly, they help to explain why carceral state policies tend to be so popular and long lasting, in spite of their ineffectiveness in the face changing societal circumstances (Huber and Gordon 2004). Priming crime as a political issue can have a ratcheting up effect. If voters view crime as constituting a crisis, they will strongly embrace punitive anti-crime strategies. If they eventually abandon this view, they still may favour punitive policies – at least

weakly – over the alternatives. Thus, reversing punitive policies in favour of other (more effective) strategies for combating crime is likely to be quite difficult in a democratic setting.

Secondly, the results highlight the relevance that information, particularly one-sided if-it-bleeds-it-leads journalism, has as a driver of policy preferences. In particular, these results highlight the importance of institutions that promote political competition based on facts and that reduce the incentives of news organisations and social media to exploit individuals' biases and cognitive limitations. As was true for the introduction of the printing press, it does not appear that higher atomisation of news provision has led to more and better information (Ferguson 2017). If anything, it would seem that citizens' policy decisions are very much subject to the whims of those with the ability to manipulate and distort information.

Finally, we would like to note a few areas that we think deserve additional consideration in future work. First, adding policy questions to opinion surveys can provide a better understanding of how policy is formulated. Traditionally, divergences between the policies implemented by countries and those recommended by technocrats have been explained by the incentives of politicians. However, policy choices in competitive political environments must at some level also reflect citizens' demands. A better understanding of how citizens acquire, maintain, or shift their preferences in specific areas of public policy is an essential component of any assessment of the performance of a country's democratic system. Second, if the objective is to implement the most effective public policies, policy makers and researchers alike may want to discuss more explicitly the benefits and costs of the different policy alternatives. Lastly, adding additional policy instruments to the traditional analytical model of crime allows one to better explain actual anti-crime policy choices across democracies. In the future, researchers may want to further extend these models to capture the greater complexity that policymakers and citizens face when constructing policy on this issue.

Supplementary material. To view supplementary material for this article, please visit <https://doi.org/10.1017/S0143814X21000246>

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A Appendix
Proof of Proposition 1

Set $c = 1 - s - t$ and implicitly differentiate $1 - q^*$ with respect to s and t using the expression in (3). The resulting expressions are the first order conditions (FOCs) that define the optimally selected s^* and t^* in terms of \tilde{q} . The FOCs are equal to:

$$F_1 \equiv -\alpha p(s^*) + p'(s^*)[\alpha(1 - s^* - t^*) + u(\pi + t^*)(1 - v(\tilde{q}))] = 0 \tag{7}$$

$$F_2 \equiv -\alpha p(s^*) - [(1 - p(s^*))u'(\pi + t^*) - u'(t^*)(1 - v(\tilde{q}))] = 0$$

A solution to the above system is a maximum if the following second order conditions hold:

$$\partial F_1 \partial s < 0, \partial F_2 \partial t < 0 \tag{8}$$

$$\partial F_1 \partial s \partial F_2 \partial t - \partial F_1 \partial t \partial F_2 \partial s > 0$$

Now, to gauge how s^* and t^* differ by regime, implicitly differentiate with respect to \tilde{q} to obtain:

$$\frac{\partial s^*}{\partial \tilde{q}} = \frac{-\left(\frac{\partial F_1 \partial F_2}{\partial \tilde{q} \partial t} - \frac{\partial F_2 \partial F_1}{\partial \tilde{q} \partial t}\right)}{\frac{\partial F_1 \partial F_2}{\partial s \partial t} - \frac{\partial F_1 \partial F_2}{\partial t \partial s}} \tag{9}$$

$$\frac{\partial t^*}{\partial \tilde{q}} = \frac{-\left(\frac{\partial F_1 \partial F_2}{\partial s \partial \tilde{q}} - \frac{\partial F_2 \partial F_1}{\partial s \partial \tilde{q}}\right)}{\frac{\partial F_1 \partial F_2}{\partial s \partial t} - \frac{\partial F_1 \partial F_2}{\partial t \partial s}} \tag{10}$$

which, in turn, implies that:

$$\frac{\partial c^*}{\partial \tilde{q}} = \frac{\frac{\partial F_1 \partial F_2}{\partial \tilde{q} \partial t} - \frac{\partial F_2 \partial F_1}{\partial \tilde{q} \partial t} + \frac{\partial F_1 \partial F_2}{\partial s \partial \tilde{q}} - \frac{\partial F_2 \partial F_1}{\partial s \partial \tilde{q}}}{\frac{\partial F_1 \partial F_2}{\partial s \partial t} - \frac{\partial F_1 \partial F_2}{\partial t \partial s}} \tag{11}$$

Note that according to (8), at a maximum the denominator of the above expressions must be positive. Thus, the signs of the comparative statics hinge on the numerators of these expressions. It can be shown that $\partial F_1 / \partial s$, $\partial F_2 / \partial t$, $\partial F_1 / \partial \tilde{q}$, and $\partial F_2 / \partial \tilde{q}$ are all negative. Consequently, a sufficient condition for $\partial s^* / \partial \tilde{q} < 0$, $\partial t^* / \partial \tilde{q} < 0$, and $\partial c^* / \partial \tilde{q} > 0$ is that the quantities $\partial F_1 / \partial t$ and $\partial F_2 / \partial s$, which are equal to one another, be positive. A sufficient condition for this latter quantity to be positive is that assumption 1 holds. Ipso facto, the proof is established.