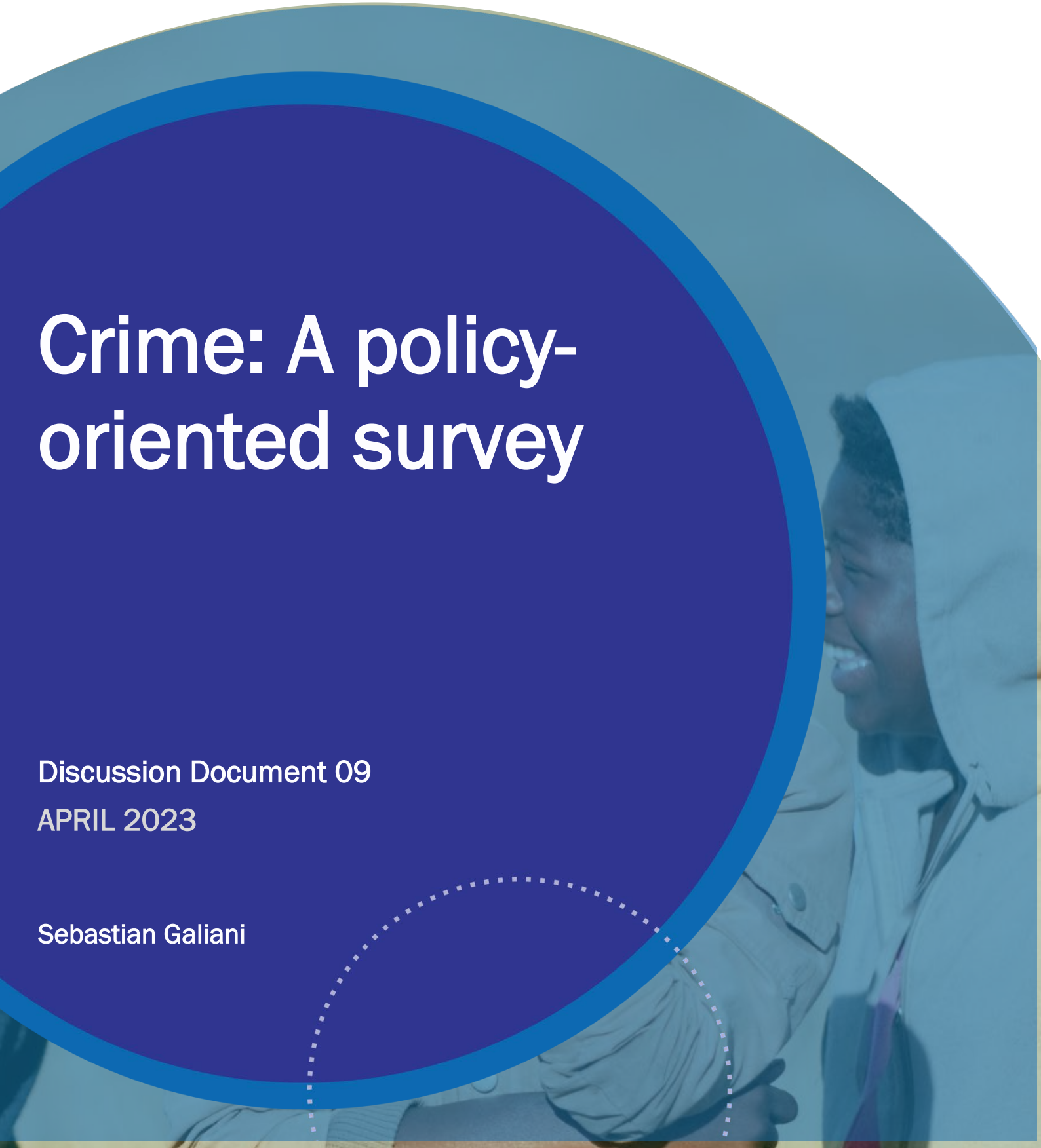
Economic Research Southern Africa

Crime: A policy-oriented survey



Discussion Document 09

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Matthew Simmonds

Director

Crime: A policy-oriented survey[1]

Abstract

This report focuses on the theoretical framework for crime studies and applied research in the literature on crime and its impact on urbanicity. The section on the theoretical framework synthesizes Becker's 1968 work and highlights the main extensions developed since then. The section on applied research discusses papers that use rigorous research designs to measure the impact of crime on different aspects of urbanicity, such as property values, business activity, consumer behavior, etc. It also includes a summary of the most relevant studies on how crime can be prevented and reduced and discusses how they are helpful for governments and policymakers.

1. Introduction

Criminal and other violent behavior has become a major concern around the world. Violence and crime threaten social stability and undercut human development, social inclusion, and economic growth (see, among others, Glaeser 1999). According to the World Health Organization, high rates of violent crime have a major impact on social and human capital by reducing life expectancy and leading to the loss of years of healthy life. There is no doubt that crime in urban areas has effects over and above its direct impact on victims; many other people's quality of life is seriously undermined by the threat of crime as well.

Since Becker's treatise on crime and punishment (1968), there has been a huge increase in the literature on the economics of crime. A great deal of progress has been made on both the theoretical and applied fronts in developing estimates of its costs, main causal factors and effects, and principal consequences. Estimates vary, but there can be little doubt that, the world over, crime is one of the most destructive social problems.

Research suggests that the fear of becoming a victim of crime impacts the routine activities of consumers, workers, and entrepreneurs (Hamermesh, 1999). Fear for one's

[1] I thank Emilia Chocobar for her research assistance and Antony Altbeker, Stefan Schirmer, and workshop participants for all their valuable comments and suggestions, which helped me in improving the quality of the report.

safety may lead consumers to buy less, while fear of extortion and theft may lead companies to adopt a lower profile, scale back production and employment, adopt costly security measures, or even abandon a line of business altogether. Workers may be reluctant to work or travel after dark or may demand higher wages for doing so, or they may even relocate to places that they feel are safer (Montoya, 2016). Crime and its consequences may also affect the development path of entire neighborhoods (Greenbaum and Tita, 2004).

The spatial concentration of crime can have dynamic effects on household location decisions. Fear of crime and the direct costs associated with property crime may discourage home buyers and lower home prices. Higher-income households and families that have children are much more likely to decide to move away from high-crime areas. This mobility differential is associated with a cost differential in that the individuals or households that remain in those areas will face a decline in property values and the consequences of a shrinking tax base (Cullen and Levitt, 1996).

This study will start out by exploring the theoretical framework developed by Becker (1968), which was then elaborated upon by Glaeser (1999), and the most relevant extensions of his work. The next section will present rigorous evidence concerning the ways in which crime impacts different aspects of urbanicity, such as property values, GDP, mobility, business activity, and consumer behavior. The discussion will then move on to an analysis of evidence concerning various strategies for reducing crime or its impact, including the implementation of different policies (e.g., on the role of prisons or increases in the staffing of police forces) and personal decisions (e.g., to install surveillance cameras or to move to an area where crime is less of a problem). Conclusions are presented in the final section.

2. Conceptual framework

The economic theory of crime originated in a paper published by Gary Becker in 1968. According to his theory, criminal acts result from a rational decision based on a cost-benefit analysis. The model presented below uses a framework sketched out by Edward Glaeser (1999) which incorporates the existence of a disadvantaged group, the

presence of wealth, the likelihood and severity of punishment, the ease with which crimes can be committed and society's standards of conduct.

This economic model of crime is a standard model of decisions where individuals decide to become either legitimate workers or criminals. The expected benefits are given by the difference between the amount of profit derived from criminal behavior ("the loot") and the opportunity cost of crime; the costs are given by the penalties imposed upon apprehended criminals.

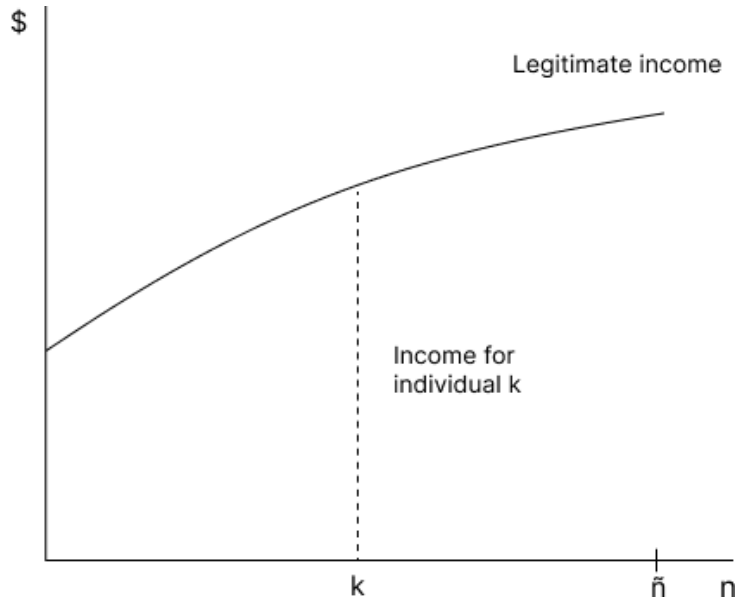
The model assumes that participation in criminal activities is the result of an optimizing individual response to incentives. These incentives are "(i) the expected gains from crime relative to earnings from legal work; (ii) the chance (risk) of being caught and convicted; (iii) the extent of punishment; and (iv) the opportunities in legal activities" (Witte and Witt, 2000). This model does not consider the last of these factors, as it is assumed that each criminal commits a single crime per period.

Assume a city with ñ residents, indexed by n = 1, 2, ⋯, ñ, each of whom earns a different income from legitimate employment because each person has different skills, levels of education, and levels of sociability. Also suppose that resident $n + 1$ has a higher income than resident n (as shown in Figure 1).

Figure 1 shows how much a criminal can earn. For the sake of simplicity, in this model we assume that the income from crime is the same for everyone and depends on how much loot (L) the criminal can steal per period; the amount of loot may depend on the city's characteristics.

Criminals may be caught and convicted, and if this occurs, their loot is lost. The probability of apprehension is denoted by α, so the expected value of the criminal's loot is $(1 - \alpha)L$. If the criminal goes to jail, an extra cost is added: J represents the cost of being incarcerated. Then, the expected cost of punishment is αJ. The apprehension probability α will depend on the size of the city's police force, and the incarceration cost will depend on the length of the prison sentence and on prison expenditures, which determine prison capacity.

Figure 1. Legitimate-income curve

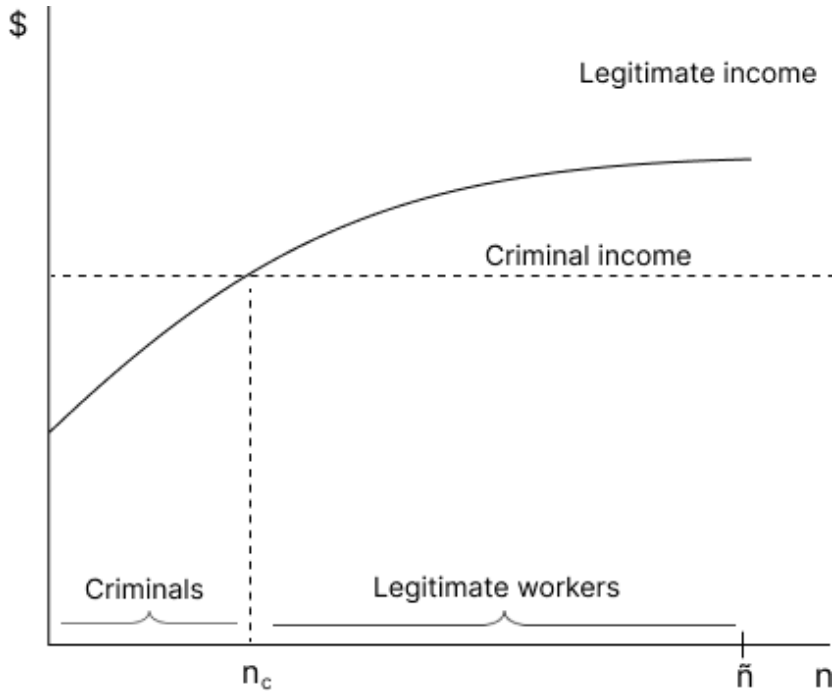


Criminals will bear extra costs that will depend on the amount of effort involved (for example, the purchase of a gun and ammunition) and the social stigma associated with being a criminal; this extra cost will be denoted by e. This cost can also be determined or influenced by the criminal's specific social, cultural and economic background.

The criminal's expected net income will therefore be $(1 - \alpha)L - \alpha J - e$. Since the criminal's income does not depend on his or her individual identity, it is denoted as a horizontal line in Figure 2. This line intersects the legitimate-income curve at $n = nc$, so individuals with index values above the intersection value nc will choose to be legitimate workers, while those with index values below nc will earn a higher income by engaging in criminal activity and will therefore choose to be criminals.

The model thus predicts that a city's criminals will be its most disadvantaged residents, such as individuals with few job skills and a low level of education, who cannot earn sufficient incomes as legitimate workers. Consequently, these individuals make a rational choice to engage in criminal activity, from which they can earn a higher income.

Figure 2. Occupational choice



2.1 How a city's characteristics influence crime

The model also predicts that the number of criminals in a city and the amount of criminal activity will depend on the city's characteristics. For example, if the skills and education levels of disadvantaged individuals decrease, the legitimate-income curve will shift downward into its lower range, as shown in Figure 3. When this occurs, the intersection point between the curves for income from criminal activity and for income from legitimate forms of employment moves to the right (n'c > nc), which signifies an increase in the number of criminals in the city.

Positive changes in a city's characteristics can, by the same token, reduce the level of income derived from criminal activity. For example, if the police force is expanded, the probability of apprehension (α) will increase and, consequently, criminal income will fall. If the criminal- income curve shifts downward, its intersection point with the legitimate-income curve will move to the left (n''c < nc) (see Figure 4). A similar situation will arise if the city spends more on prisons or if sentences for convicted criminals are more severe; in these cases, the incarceration cost J increases, and the income derived from criminal activity decreases. If the stigmatization of criminal activity

increases, the income from such activity will also be reduced. Stricter gun control measures would have the same effect because they would increase the effort required to commit a crime and, if the required effort is greater, the income to be derived from criminal activity will be lower.

Figure 3. The effect of the presence of a more disadvantaged population

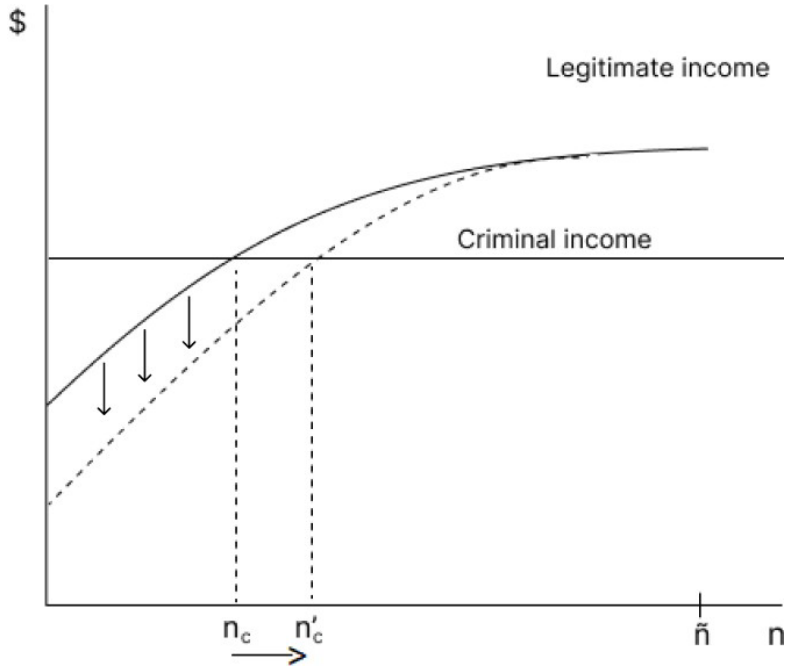
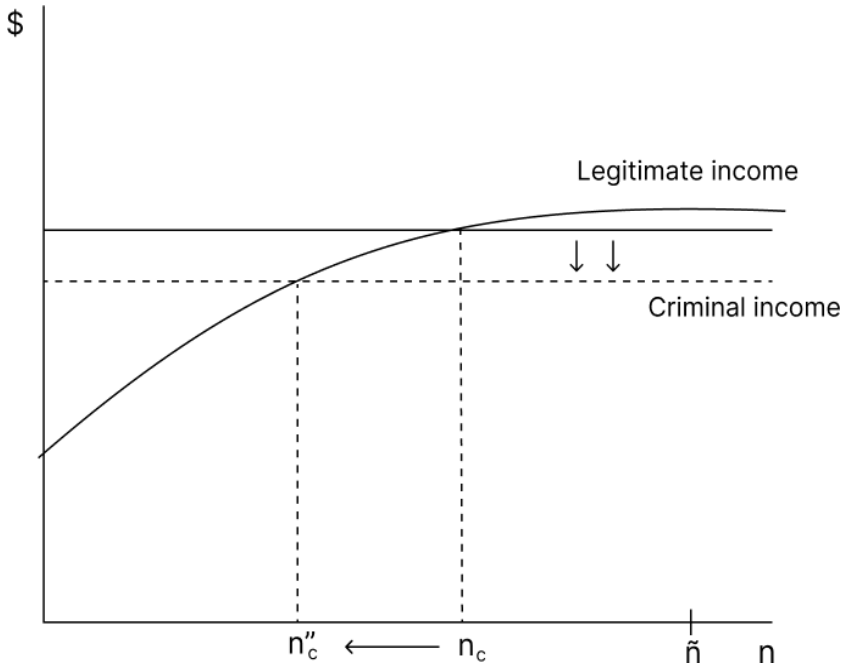


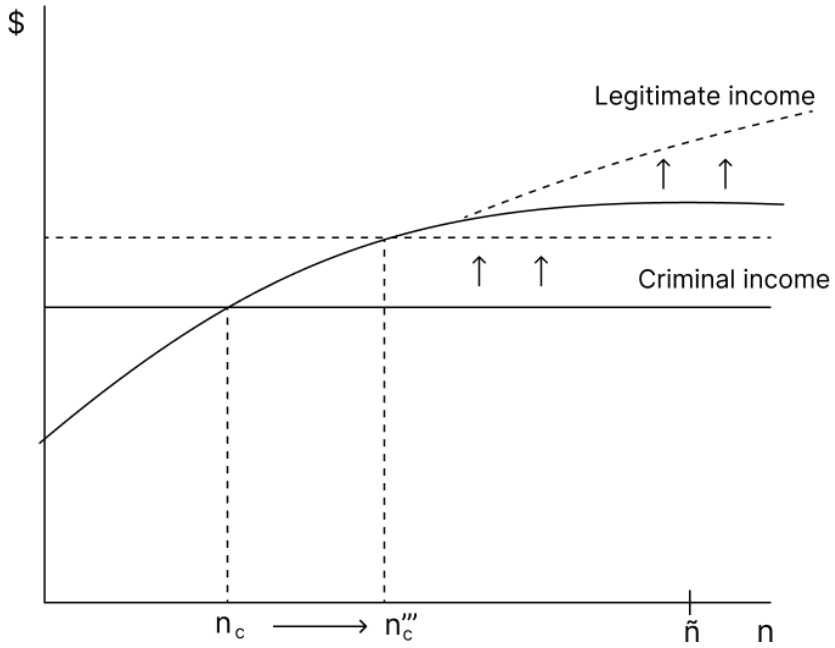
Figure 4. The effect of a larger police force



Now, suppose that the loot has been stolen from the city's highest-income residents, who are legitimate workers. If their incomes increase, (i) the legitimate-income curve moves up to a level just above its earlier upper range; this increase has no effect on the intersection point but it does have an effect on the variable L because, since crime victims are richer, the amount of loot increases, as does the amount of income derived from criminal activity, thereby shifting the horizontal line upward. The intersection point therefore moves to the right (n'''c >nc), as shown in Figure 5. This model thus predicts that an increase in wealth will boost the number of criminals and crimes.

All these effects make intuitive sense and can be easily extended to other non-economic crimes such as crimes of passion and rape. In these cases, we have to reinterpret variable L, which, instead of representing loot, will now represent whatever benefit the criminal gets from a particular crime; for example, in the case of crimes of passion, the benefit may be the satisfaction gained by inflicting harm on another person.

Figure 5. The effect of greater wealth



Since these other crimes are not economically motivated, the formula used to capture the net income derived from crime is no longer relevant, as the variable of interest in this case is the net benefit obtained from a crime. If the net benefit is positive, the individual has an incentive to commit the non-economic crime. As described in the

previous models, an increase in the strength of the police force, in prison spending and in the cost of committing a crime will all also reduce the net benefit derived from the crime and, in consequence, the number of crimes and criminals in the city.

2.2 Inequality and crime

As described in the foregoing discussion of the theoretical framework, individuals will allocate their time between the job market and criminal activity by comparing the expected return from each and by weighing the likelihood and severity of punishment entailed by engaging in the latter. In these models, inequality leads to crime by placing low-income individuals who obtain low returns from legal activities in proximity to high-income individuals who have things that are worth taking.

Assume that two adjoining neighborhoods are identical and have identical income distributions. Also assume that the households in one of those neighborhoods have incomes and transferable assets that are worth twice as much as those of the households in the other neighborhood. Consequently, inequality is equal within each of the two neighborhoods.

Assume that individuals can observe the mean income of households but not the welfare levels of individual households. Also, individuals can freely travel between the two neighborhoods at zero cost. This implies that any person who allocates some time to committing property crime will prefer to conduct that activity in the richer neighborhood, where the expected returns are twice as high. Thus, if travel costs are nil or very low, the crime rate will be higher in wealthier neighborhoods.

This model predicts that crime rates may be partially determined by the wealth of individuals' own neighborhoods relative to other neighborhoods in the same catchment area.

Now, if we imagine multiple neighborhoods that differ only in terms of their mean level of income and assets, then, all other conditions being equal, it is likely that criminals will conduct all of their illegal activities in the richest of those neighborhoods. However, crimes may still take place in the poorer areas if travel is costly, the amount

of protection from crime varies across neighborhoods, or criminals have better information on returns from crime in their immediate neighborhood.

There are other hypotheses concerning the link between crime and inequality as well. For example, local economic welfare may be associated with the level of protection. Chiu and Madden (1998) provide a model that allows for richer areas to have lower crime rates because they may deploy more effective crime defense strategies, such as guard dogs, bars on windows, electric fences, alarm systems, and cameras linked to armed security response systems. Another possible explanation is that richer neighborhoods may also have better access to legal protection (Black, 1983). Pradhan and Ravallion (1998) suggest that collective crime prevention mechanisms, such as neighborhood watch programs, may also be less common or less effective in communities with low levels of social capital. If these hypotheses are linked with the theoretical model, it becomes clear that the apprehension parameter in the crime-income equation is altered, such that crime-derived income will be lower in richer neighborhoods.

On the other hand, according to Merton's strain theory of deviance (1938), "... when a system of cultural values extols, virtually above all else, certain common symbols of success for the population at large while its social structure rigorously restricts or completely eliminates access to approved modes of acquiring these symbols for a considerable part of the same population, that antisocial behavior ensues on a considerable scale". According to Merton, poverty is not sufficient to induce high levels of crime. It must, in addition, interact with other interdependent social and cultural variables in order to have that effect. People also may be particularly sensitive to inequalities across ethnic, racial, or religious groups, or across geographical areas. These assumptions can also be reflected in parameter e of the crime-income equation because they can be interpreted as social stigma or environmental conditions.

2.3 Crime prevention

What about the costs? Brueckner (2011) describes a model that shows that a good way to reduce crime is by increasing the police force. This means that there is an inverse relationship between crime and the cost of the police force, which is represented as crime prevention costs in Figure 6. This figure also shows that the curve rises at an

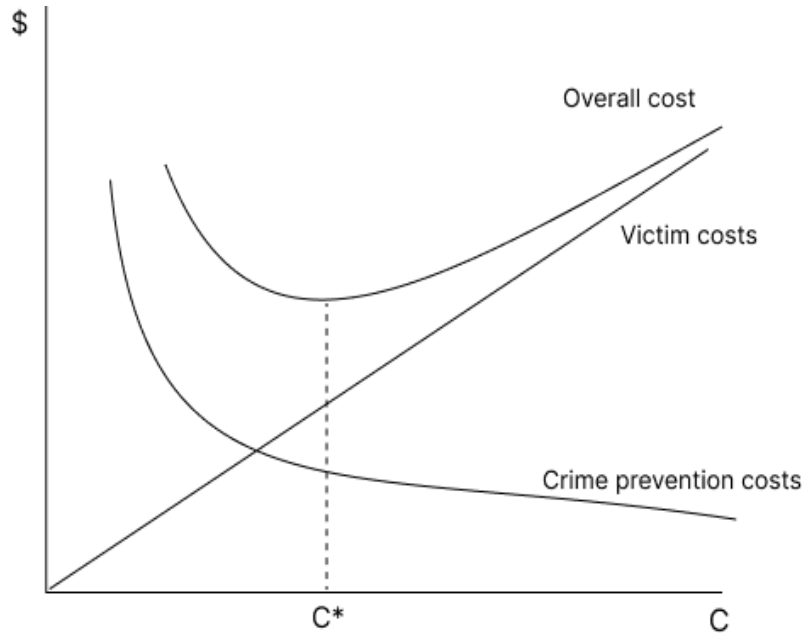
increasing rate as the number of crimes falls, which means that successive reductions in crime are increasingly difficult and costly to achieve.

The victim costs curve in Figure 6 represents dollar losses from being victimized. It is shown as being linear based on the assumption that any additional crimes will always entail the same incremental cost to victims.

Using these two cost curves, we can determine the optimal level of crime. Although zero crime is always preferable, the model predicts that the optimal level is not zero but is instead associated with the lowest overall costs (the sum of the crime-prevention and victim-cost curves). In other words, the socially optimal level of crime is the one that minimizes the sum of crime prevention costs ($C*$), as shown in Figure 6.

We can also consider an increase in the amount of money spent on prisons. In this case, for each level of crime, we have to find the least expensive combination of expenditures on the police force and prisons and then determine the level of crime that minimizes the overall cost (the sum of victim costs and police and prison costs).

Figure 6. The socially optimal level of crime



2.4 Multiple crime equilibria

This model can also explain the spatial concentration of criminal activity if we introduce some additional factors as it is described in Brueckner (2011). First, let us suppose that

the model is applied to individuals and that it is possible to determine the crime level in each neighborhood separately. Now, if each neighborhood has a fixed total amount of loot that can be stolen and if there are more active criminals, then the amount of loot that each criminal can obtain will be smaller.

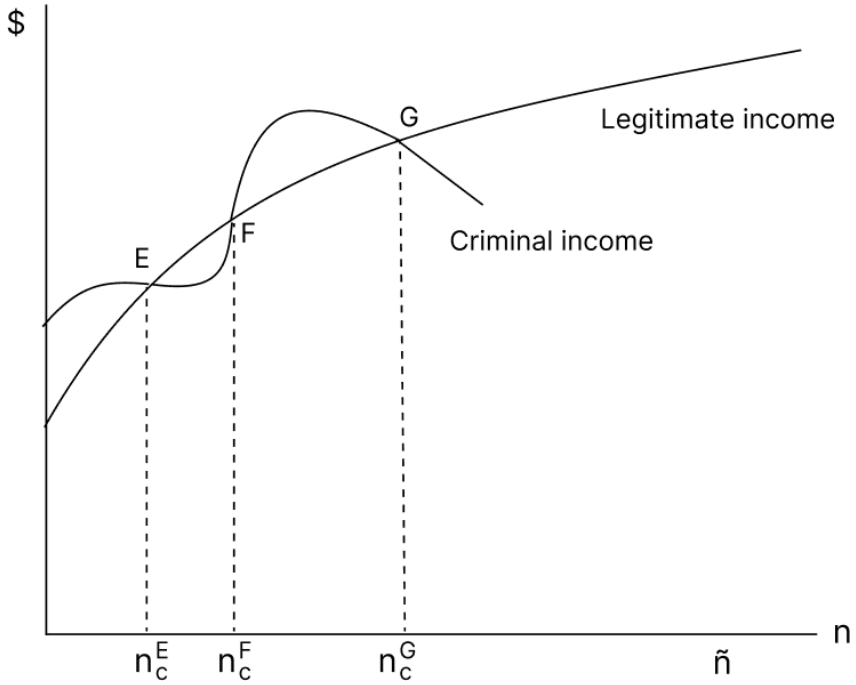
However, if there are more criminals, the probability of catching any single criminal will be lower. This effect works in the opposite direction as the loot congestion effect because now the income derived from criminal activity will increase.

The net effect of these two congestion effects is therefore unclear. If, when the number of criminals is small, the apprehension effect dominates, then income from crime initially rises with nc. Then, the loot congestion effect dominates, so income from crime falls. These two effects generate the S-shaped criminal-income curve depicted in Figure 7.

This figure shows three different possible equilibria if we consider both congestion effects. Suppose that the neighborhood is at equilibrium F, that it has n_c^F criminals and that all of them are happy with their choice since their incomes are higher than what they could earn from legitimate employment. Legitimate workers are also happy with their choice. Now suppose that a few workers with index values just above n_c^F were to mistakenly switch to criminal activity and then discover that they are happy with their mistaken switch: more legitimate workers would then switch as well. This would imply that the number of criminals would increase until the intersection point G was reached.

Equilibrium F is unstable to a small perturbation, but point G is not. If legitimate workers with index values just above n_c^G again mistakenly switch to criminal activity, they will regret their move because, to the right of G, the legitimate-income curve is higher than the criminal-income curve. They will therefore return to legitimate occupations. The same stability property also applies to point E; the crucial feature is whether the criminal-income curve is above or below the legitimate-income curve.

Figure 7. Multiple equilibria



In conclusion, the neighborhood has two stable crime equilibria with very different amounts of crime: equilibrium E has few criminals and little crime, while equilibrium G has many criminals and lots of crime.

2.5 The durability of the goods

As was noted earlier, economic incentives are drivers of crime, and the main aim of acquisitive crimes is the subsequent sale of stolen goods. In the case of durable goods, their durability is an important feature because it affects the prices that consumers are willing to pay for them. Acquisitive crime and the durability of the goods in question are then closely connected issues. Thus, for example, if there is an intervention that reduces the durability of the goods concerned, stealing them will become less profitable; this, in turn, will lead to a reduction in the incidence of acquisitive crimes. To study this connection, Galiani, Jaitman, and Weinschelbaum (2020) develop a theoretical model which incorporates the cost of crime into the standard framework for the production of durable goods developed by Waldman (1996).

Waldman (1996) considers a world without crime and a monopolist that faces pricing problems regarding a quality-differentiated spectrum of goods of the same generic type. In this case, it is a durable good that yields units of service that are not

perfect substitutes in production or in consumption, irrespective of the durability of the product. The seller knows the distribution of tastes and demand in the market but cannot distinguish between buyers so cannot engage in price discrimination.

There are two types of consumers, and each type lives during two periods: t = 1, 2. In the first period, the firm sets the durability choice and price for a new unit of output, and consumers decide what to purchase; in the second period, the firm sets the durability choice and price for a new unit of output, consumers decide what to purchase from the firm, and a secondhand market also emerges in which consumers can trade used goods at prices that equate supply and demand.

The underlying reasoning is that if the monopolist produces durable output in t = 1, then in t = 2, the price of the good on the secondhand market limits what the firm charges for new units, as consumers have older units and otherwise would keep consuming those units rather than buying new ones.

To allow for crime to occur, Galiani, Jaitman, and Weinschelbaum (2020) introduce a stealing function that can be regarded as a reduced form of a crime model. At the beginning of the second period, consumers who own a given good can become victims of theft or robbery.

In this setting, the utility function for the consumer also changes as it incorporates the possibility of buying goods on the black market. On the demand side, there are still two types of consumers, and they can perfectly distinguish between used and stolen goods.

The sequence of the game is as follows. In the first period, production takes place and firms market their output. In the second period, goods bought during the first period can be stolen, production takes place, and firms, owners of used goods, and thieves can all sell their goods.

Note that if a technology were available to make the durability of goods contingent upon the good being stolen, it would be optimal to set durability equal to 0 for the stolen goods. Therefore, the model reverts to Waldman's world without crime.

However, such a technology is not available for all goods. Thus, we examine the case where it is not possible to make durability contingent upon goods being stolen. We implicitly assume that, if it is possible to provide a differential durability for goods when they are stolen but the technology cannot make the good completely worthless, this would reduce consumers' valuation of stolen goods but not to zero.

Galiani, Jaitman, and Weinschelbaum (2020) then introduce two different technologies for stealing goods. In the first, whenever the goods are heterogeneous, the ones with a higher level of durability and thus a higher resale value are stolen; they refer to this as "selective stealing". In the second, thieves are not able to distinguish between goods of differing quality or, equivalently, the stolen goods arrive randomly, so any good has the same probability of being stolen. The authors refer to this as "random stealing".

With the random stealing technology, the thieves arrive at a decision based on the quantity of goods to be stolen, not the cut-off point of durability. The quantity that is chosen is the quantity that will maximize the thieves' gains, which equal the quantity stolen times the average price minus the cost of stealing the goods. With selective stealing, the costs of stealing are independent of the durability of the good, and the price depends positively on the durability of the good. Therefore, in the case of selective stealing, the goods that the thieves choose to steal are those that are more durable.

It is important to note that, in the case of selective stealing, thieves decide on a durability threshold and steal the goods that are above that threshold, whereas, in random stealing, they choose the optimal quantity of goods to steal. In the case of random stealing, then, the probability of goods being stolen is derived from the optimal quantity.

Under perfect competition, the problem that firms need to solve is how to choose the optimal level of durability for the goods that they will produce in the first period, taking into account the fact that goods can be stolen during the second period.

After solving the model, under perfect competition and selective stealing, the authors arrive at the conclusion that there are no durable goods because it is not possible to sustain any positive level of durability for a used good. Under random stealing

and perfect competition, however, there are durable goods and there is also crime. If we then compare the optimal level of durability under perfect competition in the presence of crime with Waldman's results, we see that the durability level without crime is lower than it is with crime.

If consideration is also given to the non-market externality that emerges when firms take into account the fact that higher durability increases crime, along with the fact that crime reduces welfare, then the socially optimal level of durability declines. As a consequence, the difference between the socially optimal level of durability and the level that prevails under monopoly decreases. Thus, the authors find that, if this externality is big enough, even the monopoly will overproduce durability.

In conclusion, this new model shows that less durability is an effective means of reducing crime because lowering the level of durability leads to a decrease in the number of thefts and an increase in welfare. The authors solve the model for perfect competition and monopoly markets. Their results show that, under perfect competition, the durability level is higher than the social optimum (durability is overproduced under random stealing, and there is zero durability under selective stealing), while, under a monopolistic market structure, the durability level is lower than the social optimum (durability is underproduced).

2.6 Geographic distribution of crime

Galiani et al. (2018) develop a general equilibrium model to study how the geographic distribution of police protection affects the decision to become a criminal, the intensity and location of crime, residential choices, housing prices, and the welfare of different socioeconomic groups.

The building block is a model of a city populated by agents of different socioeconomic groups and made up of several residential areas, which are denoted as neighborhoods. There is one homogenous group of skilled agents, and several homogenous groups of unskilled agents, each of them with a different per capita endowment of unskilled labor. The city is treated as a small open economy and the prices of tradable goods and inputs are exogenously given. Agents select their

occupation, work in firms, or become a criminal; their residence; consumption and housing. The government provides public protection by deploying police forces in the city, which reduces the amount that criminals can otherwise extract from their victims.

Given the prices of tradable goods and inputs and the allocation of public protection, the model determines the three endogenous variables mentioned above by employing a combination of a standard small and open-economy competitive equilibrium and a spatial notion of equilibrium.

There are two ways to allocate the police across the city:

- Under concentrated public protection, the police only protect some neighborhoods and leave the rest of the city completely unprotected.
- Under dispersed public protection, the police are evenly deployed across the entire city, inducing an equal level of public protection in all neighborhoods.

Regarding occupational choices, the payoff from crime does not vary with a citizen's labor endowment, while the payoff from working is obviously increasing in a citizen's labor endowment. This makes relatively poor citizens more prone to become criminals.

Regarding residential choices, the wealthier the agents, the more harmful criminal activities are for them. Under concentrated public protection, these differences in the willingness to pay for a safe neighborhood produce a concentration of rich agents in protected neighborhoods and poor agents in unprotected neighborhoods. Under dispersed public protection, there is no essential differences among neighborhoods, crime distributes evenly in the city, and agents only consider housing prices in their residential choices.

Employing a simple utilitarian welfare function, the authors show that concentrated protection may induce higher aggregate welfare than dispersed protection. Moreover, income inequality matters. The authors show that aggregate welfare is higher under concentrated protection for a society with a high wage-income share of skilled agents, while aggregate welfare is higher under dispersed protection

for a society with a low wage-income share of skilled agents.

Regarding distributive effects, concentrated protection may maximize aggregate welfare but exacerbate social disparities, in contrast, in more equalitarian societies, dispersed protection simultaneously maximizes aggregate welfare and reduces social disparities. One solution to the regressive distributive consequences of concentrated protection is to supplement the regime with a set of taxes and transfers. Conceptually, the compensation received by each socioeconomic group considers the impact of the protection regime on income (different for each group) and housing prices (common for all groups).

3. Evidence on the impact of crime

Since Becker (1968), numerous studies have been conducted in an effort to gain a better understanding of the economics of crime and its impacts either by adding extensions to his theoretical model or by estimating causal effects. Although there has been a surge of interest in this area, there is as yet a quite limited amount of rigorous empirical evidence on the subject.

In order to arrive at a credible estimation of the causal relationships involved, the causal variable must be at least partly exogenous (Mitchell, 2015). This means that crime must be uncorrelated with unobserved factors that determine variables of interest (property values, business activity, consumer behavior, etc.). Measuring the impact of crime may therefore suffer from endogeneity in most cases, with the result that the outputs will be biased.

Nevertheless, there are some authors who have employed rigorous methodologies to estimate the causal effect of crime. This study will therefore focus exclusively on those studies whose research designs involve before-and-after measures of crime in multiple areas assigned to experimental or control conditions on the basis of either randomization or exogenous variation in the causal variable arising from external factors. We also include studies that have used a synthetic control methodology.

3.1 Impact on property values

As noted in our discussion of the conceptual framework, income is a key factor in the

economics of crime theory, as well as a city's characteristics. In Figure 3, we gave an example where the skills and education levels of disadvantaged persons decrease, which translates into an increase in the number of criminals; under these conditions, if the level of income derived from crime does not change, the legitimate-income curve should shift downward to intersect with the criminal-income curve at the new level of criminal activity.

This scenario readily describes the impact of crime on property values. Now, imagine that the increase in the number of criminals/crimes is caused by an exogenous shock, such as an increase in high-crime neighborhoods, more murders, a higher crime risk, etc., and that income from legitimate employment is represented by property values. If income from crime does not change, then property values will fall.

Another hypothetical scenario could be an increase in the degree of social stigma. If social stigma increases, income from crime will fall, and the intersection point of the crime-income curve and the legitimate-income curve will shift to the left.

A number of studies have looked into the relationship between property values and crime risk because it is important to know how much people will pay in order to reduce their exposure to crime. In line with the theoretical model, most of those studies have provided empirical documentation of an inverse relationship between property values and local crime rates.

Linden and Rockoff (2008) were the first researchers to estimate the impact of the presence of sex offenders on property values in a rigorous way. They combine data from the North Carolina housing market with data on registered sex offenders to estimate individuals' valuation of the cost of living near a convicted criminal. North Carolina's 1996 sex offender registration law established that all convicted sex offenders, including persons convicted in other states who then move to North Carolina, must register for ten years after being released from prison. This information is provided to the public via a web-based interface. The reports include each offender's current address, the offense for which the person was convicted, and a picture and physical description of the individual. The housing market data was obtained from the Mecklenburg County Division of Property Assessment and Land Record Management and includes information on the physical characteristics of each parcel, such as the

number of rooms, square footage, the exact address, etc. The Mecklenburg County Tax Assessor's Office also separates parcels into 1,004 different "neighborhoods" that have similarly valued properties. The relative homogeneity of property within these neighborhoods allows the authors to control for unobservable fixed and time-varying characteristics at the neighborhood level.

Having this data on the exact location of these offenders and the prices and characteristics of properties in the area allows the authors to exploit variations in the threat of crime within (homogeneous) groupings of homes. The authors limit their analysis to offenders who have lived at their current location for at least one year and examine sales occurring within a four- year window around the offenders' arrival. They also limit their examination to sales occurring within a 0.3-mile radius.

Figure 3.b in Linden and Rockoff (2008) shows that living close to a sex offender has a negative impact on property values, as the prices of homes near an offender's dwelling fall after the offender's arrival. It is important to notice that the impact dissipates with distance.

Linden and Rockoff (2008) estimate a reduction of roughly 4%, but this effect is extremely localized and dissipates quickly with distance. Homes directly adjacent to a sex offender's dwelling decline in value by 12%, but the authors find no evidence of any impact on homes located more than a tenth of a mile away from a sex offender's address.

Another study that measures the impact of crime on property values was conducted by Ajzenman, Galiani and Seira (2015). These authors provide proof of the negative effect of the violence associated with drug-trafficking organizations on housing prices in Mexico. Drug production and trafficking are a major problem in many countries because they are associated with violence, a lack of security and corruption in the police force and in the legal system. To measure this causal impact, the authors exploit the increase in homicides in 2008-2011 in Mexico that resulted from the government's war on organized drug traffickers.

The homicide data used in the study was provided by the Office of the President and by hospitalization records, which register all homicide deaths, whether drug-related or not. This dataset contains variables that identify the cause, date, and location

of death. Information on house prices was obtained from a house appraisal database covering the period from 2008 through 2011. This database includes the price variable and a number of dwelling characteristics, such as the size of the plot, the built-up area, accessory areas, the remaining useful life of the dwelling, the age of the dwelling, the number of bedrooms and bathrooms, etc.

The causal variable is the cumulative number of homicides in a municipality, i.e., the sum of such incidents over the previous 6, 12, and 24 months. The causal effect is derived from within-municipality variations in cumulative homicides and housing prices after controlling for a large number of housing characteristics and other determinants of appraisals. In other words, to identify the effect of interest, the authors assume that changes in cumulative homicide rates are strictly exogenous.

The validity of this identification strategy would be undermined if changes in homicides rates were also driven by economic factors. To reject this, these authors investigate the link between formal employment and crime at the municipality level; they find that the correlation between these two variables is not statistically different from zero, which is consistent with the identifying assumption that homicides are not related to the labor market or, more broadly, to economic variables.

The authors find that an increase in homicides equivalent to one standard deviation leads to a 3% decrease in the price of low-income housing. Their results also indicate that homicides have a regressive distributive effect, since they reduce the value of the homes of poorer individuals more than they do the homes of more moneyed persons.

Dealy, Horn, and Berrens (2017) investigate the impact of the discovery of clandestine methamphetamine laboratories on house prices. The dataset used in this study includes sophisticated methamphetamine lab discovery and decontamination data collected by the State of Oregon in order to actively manage properties which have been used to produce this drug. Oregon has a special agency tasked with collecting information on the discovery of meth labs and administering the decontamination process. Using the comprehensive data obtained from this agency on the discovery of such labs and the timing of their decontamination, the authors are able to arrive at a more precise estimation of the impact of meth lab discovery on nearby property values

before and after decontamination.

The possibility that meth producers' choices regarding the location of their labs could be correlated with unobserved neighborhood qualities that are also correlated with price is a relevant concern. This selection bias is controlled for using a spatial difference-in-difference model in which treatment and control group assignments are determined by proximity to the lab.

The idea behind this identification strategy is that, while meth house location choices may be endogenous and related to unobserved neighborhood factors, these omitted variables are correlated with proximity. Thus, a quasi-control group can be constructed using houses that are in close proximity to houses affected by the presence of meth labs.

Figure 4 in Dealy, Horn, and Berrens (2017) shows the house price gradients for the treatment and control groups before and after the discovery of a meth lab. A year before the discovery, the prices of homes in the treatment and control groups generally track together, whereas, following the discovery, a clear-cut structural change is observed.

These results suggest that when a meth lab is discovered, there is an approximately 6.5% reduction in property values that are in close proximity to a lab, even when accounting for the fact that meth labs are generally located in less desirable neighborhoods with lower home prices. Additionally, nearby property values significantly increase (by approximately 5%) after a meth lab has been decontaminated. This suggests that recent state laws mandating the decontamination of meth labs may yield positive net benefits, although nearby home values do not fully recover following lab decontamination.

3.2 Mobility

There is also evidence that children's exposure to neighborhood violence in spatially concentrated disadvantaged areas negatively impacts their chances in life. The evidence also points to a strong negative association between violent crime and upward mobility measured at the level of counties and commuting zones (Chetty and Hendren, 2015). Sharkey and Torrats-Espinosa (2017) assess the robustness of the hypothesis that rising crime rates in the suburbs tend to keep people in cities. Almost all of the impact

of crime in terms of shrinking city populations is due to increased out-migration rather than a decrease in new arrivals. Migration decisions on the part of high-income households are much more responsive to changes in crime rates than those of the poor. Households with children are also more responsive to crime rates. People leaving the city for crime-related reasons are much more likely to stay within the urban perimeter than those leaving the city for other reasons.

This situation can be translated into the theoretical model because exposure to violence can be a proxy for an increase in the amount of crime, while chances in life can be interpreted as wellness, which can be represented by legitimate income.

Cullen and Levitt (1996) demonstrate that rising crime rates in U.S. cities are correlated with city depopulation. To establish a causal link between these two factors, these authors use an instrumental variable. A valid instrument must affect the crime rate but not otherwise belong in the equation that explains urban population changes. The logical source for such an instrument is changes in the punitiveness of the criminal justice system. The instrumental variables to be used are lagged changes in the commitment and release rates of state prison systems per reported crime rates in the state. Commitments include both new prison terms resulting from criminal convictions and commitments resulting from probation and parole violations. These variables capture both incapacitation effects and deterrence via the certainty and severity of punishment in the state. A high commitment rate implies a high likelihood of detection and conviction. A low release rate translates into a longer mean punishment per conviction.

These authors find that crime-related out-migration is concentrated among wealthy people, as a one standard deviation increase in city crime rates translates into a decline in the urban population of slightly less than one percent. They also find that the impact of crime is greater in cities that account for no more than a small fraction of their state's total population.

3.3 How crime affects different income groups

Di Tella, Galiani, and Schargrodsky (2010) study how an increase in crime is distributed across income groups. In normal times, such a strategy would be impractical, but during the 1990s and up until 2001, Argentina experienced a sharp increase in crime rates. The total victimization rate rose by 24 percentage points, but the poor witnessed an increase of 28 percentage points, while wealthier segments of the population saw an increase of just 19 percentage points. The research strategy used in this study exploits the salience of crime in Buenos Aires, Argentina, following the sharp increases in crime during the second half of the 1990s and particularly during 2001.

A household victimization survey is the main source of information for this study. That survey collected information on victimization events, crime reporting, behavioral responses to crime, consumption of private protection, possession of durable goods and assets, and household demographics. Although the survey was cross-sectional, respondents were asked to report retrospective information for the entire decade. While retrospective information is sometimes subject to recall bias, the design of this survey used several techniques that were specifically developed to minimize this problem.

The authors of this study used a difference-in-difference approach to test several propositions regarding the relationship between victimization and income. Their main findings suggest that crime increased more for the poor than for the rich, as the increase in the total victimization rate for the poor was 1.5 times the increase in the total victimization rate for the rich. Changes in victimization in the streets were similar for both income groups. In contrast, the increase in victimization at home was larger for the poor than for the rich. Richer households are significantly more likely to hire private security services and to install alarms than poor households are. The rich and the poor report similar increases in the avoidance of dark places.

This section has reviewed a number of rigorous empirical studies that measure how crime impacts different aspects of urbanicity and highlight the negative effects that crime has on people and their development. The information gathered through research in this area thus contributes to the ability of governments and policymakers to take action to combat crime.

3.4 Impact on GDP

As noted in the previous subsection, the theoretical model applied to individuals can be extended to the country level. Here, an increase in crime can be represented by the increase in conflicts and violence in a country, while legitimate income can be represented by GDP.

"While there is broad agreement that high levels of violent crime constrain growth, there is very little known about how it does so and by how much" (Stone, 2006). This author highlights some of the reasons why crime restrains growth:

1. Crime imposes costs on businesses, such as lost sales and security and prevention costs.
2. Governments are obliged to spend money on law enforcement, crime prevention, and the administration of justice that could otherwise be used to stimulate growth.
3. Crime induces households to spend money on health care and security precautions rather than on school fees and other investments.
4. Crime encourages emigration, which reduces the available workforce.
5. Crime keeps workers out of the labor market by discouraging them from accepting jobs in off-hours and far from home.
6. Crime discourages foreign investment.
7. Crime disrupts schooling and other public investments (such as in public transport) aimed at supporting long-term growth.

Although there are many well-founded assumptions to be found in the literature, the most serious constraint is that, at least in this case, a natural experiment is needed in order to determine the causal effect, and natural experiments are hard to come by. Having been said, another complication is the difficulty of isolating this effect, since crime destroys some economic activities and generates others; it also has redistributive effects between households and between productive sectors. Here we present two studies whose authors have measured how crime impacts GDP.

Abadie and Gardeazabal (2003) were the first researchers to measure this

impact. They examine the effects of terrorism in the Basque Country of Spain from 1968 to 2000, a period that saw an average of 0.82 terrorism-related killings per 100,000 persons per year in that region (and a peak of 4.3 killings per 100,000 in 1980). They use a combination of other Spanish regions to construct a synthetic control region which resembles relevant economic characteristics of the Basque Country before that period of terrorist activity. The authors then compare the subsequent economic development of this counterfactual terrorism-free Basque Country with the region's actual experience and find that terrorism caused a 10% decline in GDP per capita relative to a synthetic control.

Based on Abadie and Gardeazabal (2003), Pinotti (2015) studies an increase in mafia activity in two regions of Italy – Ampulia and Basilicata – and its impacts on GDP. To address the causal effect, Pinotti compares the economic development of these regions, before and after the increase in crime, with that of a control group of regions not significantly exposed to the presence of criminal organizations. The results suggest that the increased mafia presence led to a differential increase in the homicide rate of up to 5 per 100,000 and a 16% decline in GDP per capita. This loss is explained by a reduction in productivity which, the author suggests, is in turn attributable to the fact that criminal organizations discourage productive investment by private entrepreneurs while at the same time securing profit opportunities in public procurement systems.

3.5 Impact on business and consumers

Another application of the theoretical model concerns exposure to crime and violence and its impacts on legitimate income. In this subsection, legitimate income is represented by consumer and business well-being. Fe and Sanfelice (2022) study this topic and estimate the average effect of different local crimes on consumer visits to retail establishments in Chicago. Fortunately, they have access to specific crime and consumer visit data from the Chicago Police Department and point-of-interest visit data from SafeGraph, a company that collects foot-traffic pattern data from mobile devices. The authors combine these two datasets and have access both to crime records that include the respective coordinates and times and to data on consumer visits to venues in the food and entertainment industries.

To identify the parameter of interest, they leverage on longitudinal data and geographic variations. The identification strategy is based on the fact that the impacts of crime occur at fine levels of time and geography, whereas most confounders vary only at fine levels of time or geography but not both. While the causal response to a crime will likely remain close to the crime scene and be strongest in the time period immediately following the crime, confounders tend to vary at more aggregated levels in at least one of the two dimensions. The authors therefore use fixed effects varying at different temporal and geographical levels from the variables of interest, which are measured monthly and at the block group level.[2]

Their findings suggest that the effects of property crimes and street crimes on consumer visits in the following month are negative. One additional property crime incident near a venue result in 1.13 fewer visits to that venue in the following month, which is a 12% reduction in consumer visits with a one standard deviation increase in property crime. However, the response is only on the extensive margin measured by number of visits and number of consumers, not on the intensive margin measured by venue dwell time.

Regarding firms and business, Rozo (2018) exploits annual and municipal exogenous reductions in violent crimes driven by U.S. international anti-drug expenditures to identify the effects of violent crime (homicides) on market outcomes. To address endogeneity, Rozo uses a panel-instrumental variable methodology; firm or municipality fixed effects solve the cross- section endogeneity problems, while the instrument used for homicide rates addresses the time-feedback effects between homicide rates and market outcomes. The time variation of the instrument is driven by changes in U.S. international anti-drug expenditures and a political competition index. The identification comes from the fact that areas with greater political competition had more firmly established violent groups and less empowered local governments. Hence, they were also more responsive to higher expenditures on security. The higher responsiveness of areas with a greater degree of political competition in the past to transfers in security is accounted for by the fact that these funds were used to recover

[2] Fe and Sanfelice (2022) present validity tests that confirm that the estimates are not likely to suffer from endogeneity.

a monopoly on authority. Rozo tests for the correlation between the instrument and violent crime rates and confirms that there is a strong correlation between them.

She finds that a 10% increase in the homicide rate leads to a 0.4% decline in the total number of firms, a 1.7% decline in average revenue, a much larger increase in output prices of 5.3%, and only a 0.7% increase in nominal wages.

4. Combating crime

4.1 Measuring the costs

As was shown in Figure 6 in the section on the conceptual framework, there is a socially optimal level of crime, which is the level at which the total sum of the costs of crime (prevention and victim costs) is minimized. To find this socially optimal level, it is important to measure all the costs first. These include not only the physical costs of crime or just the costs of maintaining jails and prisons and paying police officers' salaries; many other costs are also involved, such as those associated with migration, loss of clientele, changes and closures of businesses and others that are more difficult to quantify, such as feelings of anxiety and insecurity.

For policy purposes, it is important to understand the costs of crime because this information is needed in order to raise awareness of the magnitude of the problem, position the topic on national and international agendas, identify ways of improving private and public resource allocation, and design better crime prevention and crime control policies.

Determining how to measure those costs is not trivial. Generally speaking, there are two main approaches. One basically entails an accounting exercise whereby researchers simply try to add up all of the losses occasioned by crime. The study conducted by Donohue and Siegelman (1998) is an example of this sort of exercise. The largest loss category is usually the value of lives lost to murder. Other straightforward costs include the amount that is spent on crime prevention, including the amount spent by the government on the police force and the judiciary. Crime cost estimates have generally failed to quantify the social costs that accrue from underinvestment in the legal sector because the returns are appropriated by criminals.

Another approach to estimating the social costs of crime is to examine housing price hedonics. Housing prices reflect the willingness of individuals to live in a community with a given set of characteristics. Thus, the difference in prices between a high-crime and a low-crime community will reflect the willingness of consumers to live in a high-crime area. The goal of this type of research is to estimate the gains in social welfare to be derived from a marginal reduction in the crime rate (Glaeser, 1999).

In conclusion, there is no single methodology capable of incorporating all social losses, and different methodologies produce different types of estimates. Estimates of the welfare costs of crime therefore vary widely and are rarely consistent from country to country. One excellent example of an approach for measuring the cost of crime is found in the report "The Costs of Crime and Violence: New Evidence and Insights in Latin America and the Caribbean" published by the Inter-American Development Bank (2017) for Latin America.

4.2 The role of prisons

In expressing the net income derived from crime, $(1 - \alpha)L - \alpha J - e$, the role of prisons is represented by J as the cost of being incarcerated, which can be driven by changes in incarceration rates, the imposition of longer sentences, or ill-treatment of inmates. This means that, if the cost of going to jail increases, the net income from crime will be lower. And, if the income from crime is lower, then there will be fewer criminals (see Figure 4). Prisons can serve three functions in crime prevention: deterrence, the incapacitation of criminals and rehabilitation.

There is a large body of literature that focuses on isolating pure incapacitation effects. Levitt (1996) estimates the marginal productivity of increased incarceration in reducing crime in the U.S. To do so, he uses an instrumental variable that is correlated with changes in the size of the prison population but is otherwise unrelated to the crime rate. This instrumental variable is prison overcrowding litigation. The existence of overcrowding litigation reduces prison growth rates. For example, in the three years prior to the initial filing of litigation in the states where the entire prison system eventually was placed under court control, prison population growth rates outpaced the national average. This means that litigation will be related to crime rates only through its impact

on prison populations, making the exclusion of litigation status from the crime equation valid. Levitt proves this, first, by using tests for over-identifying restrictions, which turn out to be consistent with the exogeneity of the instruments across all of the specifications considered, and second, by finding that changes in litigation status appear to affect crime rates, but not vice-versa.

The results are robust across all the crime categories examined and show that incarcerating one additional prisoner reduces the number of crimes by approximately 15 per year. Levitt also estimates the costs of crime to victims and finds that the marginal social benefit in crime reduction of adding one prisoner for one year is approximately $45,000, which is substantially higher than the cost of incarceration ($25,000 to $35,000 per year).

Johnson and Raphael (2012) also estimate the effect of changes in incarceration rates on changes in crime rates using state-level panel data for the U.S for the period 1978–2004. Their principal innovation is that they develop an instrument for future changes in incarceration rates based on the theoretically predicted dynamic adjustment path of the aggregate incarceration rate in response to a shock to prison entrance or exit transition probabilities. Given that incarceration rates adjust to permanent changes in behavior with a dynamic lag (given that only a fraction of offenders are apprehended in any one period), it is possible to identify variations in incarceration rates that are not contaminated by contemporary changes in criminal behavior. These authors isolate this variation and use it to tease out the causal effect of incarceration on crime rates.

For the entire period, they find average crime-prison effects with implied elasticities of between 0.06 and 0.11 for violent crime and between 0.15 and 0.21 for property crime. The instrumental variables estimate for the period 1978-1990 suggests much larger crime-prison effects, with elasticity estimates consistent with those presented by Levitt (1996), who analyzes data for a similar period but using an entirely different identification strategy.

In another study along these lines, Owens (2009) attempts to directly estimate incapacitation effects by observing the criminal behavior of former inmates after release. The author exploits a sentence disenhancement exercise in Maryland to estimate the

effect of shorter sentences on overall crime. In 2003, the State of Maryland discontinued the practice of taking juvenile records into consideration in the determination of sentences for adult offenders between 23 and 25 years of age. Owens estimates that this change in sentencing procedures reduced the time served by 200–400 days for adult offenders who had prior juvenile convictions. By observing arrests during the period when they would have been incarcerated had they been sentenced under the prior sentencing regime, Owens estimates that sentence disenhancement increases the number of serious offenses by roughly 2–3 index crimes per offender per year of street time.

There are two papers that exploit the natural experiment generated by massive releases in Italy (which liberated approximately one third of the prison population) to estimate the reverse incapacitation effect. In the study by Barbarino and Mastrobuoni (2014), the identification of the incapacitation effect based on yearly panel data allows them to control deterrence funneled by criminals' expectations and to disentangle deterrence from incapacitation. Given that, immediately after a pardon is authorized, criminals should be less prone to commit crimes (since the next pardon is unlikely to happen very soon, and pardoned sentences might be added to a new sentence), the incapacitation effect should be larger than the total effect. Finally, the elasticity of total crime with respect to incapacitation is between -20% and -35%.

The literature on deterrence has generally not found much support for the idea of rehabilitation. Indeed, many other studies have suggested that prisons actually train inmates to be criminals and reduce their suitability for legal employment, which would suggest that prison sentences create criminals rather than rehabilitate them.

“The only cases where we know that something like rehabilitation can occur is when criminals get extremely long sentences. As it is well known that the propensity towards crime falls sharply among older men, very long sentences can in some sense rehabilitate criminals.” (Munyo and Rossi, 2015)

Munyo and Rossi (2015) study criminal recidivism, with a focus on recidivism during the first day of freedom in Uruguay. They first estimate the impact of the number of inmates released on a given day on the number of offenses committed that day. They

claim that releases are exogenous in a model for daily crime. The bureaucratic burden needed to release a prisoner implies that the exact day of release is very difficult to predict in advance. In addition, prison authorities have no discretion in implementing the release policy; daily releases proceed as soon as dated official notification comes from the judge and, without these signed papers, prison authorities are unable to open the door. Under the usual procedure, inmates are informed of their pending release as little as one day prior to their actual release. Also, since the authorities do not inform an inmate's family of any details pertaining to the release, the former prisoner typically leaves the prison facility alone.

After documenting the evidence on first-day criminal recidivism, these authors consider whether an increase in the stipend provided to an inmate upon his or her release produces a decrease in first-day recidivism. To explore this possibility, they exploit the fact that the gratuity furnished from former prisoners upon their release was increased in order to gauge the effect on first-day rectivism. The amount of money given to these former inmates was 20% more than the amount needed to purchase a basic daily food basket.

Munyo and Rossi (2015) test for a discontinuous break in first-day recidivism associated with the increase in the gratuity. The increment in the gratuity is note correlated with any other policy or intervention that could also have had an effect on the commission of crimes. The results suggest that the increase in the gratuity at the time of release is associated with a decrease in first-day recidivism from 0.587 crimes per release. This reduction costs $11,000 per year in gratuities and appears to avert 550 first-day reported offenses.

4.3 Expanding the police force

Another reason why the income derived from crime falls could be an increase in the probability of apprehension (α). There is an ample related body of literature on the effects that police monitoring has on crime. For example, Levitt (1997) identifies the causal effect of policing on crime in 59 U.S. cities. He uses an approach involving the implementation of an instrumental variable that affects the size of the police force but does not belong directly in the crime production function. The instrumental variable

employed is the timing of mayoral and gubernatorial elections. The most obvious ways in which elections might affect the crime rate are through electoral cycles in other types of social spending, or through politically induced fluctuations in economic performance. That is why spending on education, unemployment rates, and public welfare programs are included in the equations. Having controlled for those variables, it seems plausible to argue that election timing is otherwise unrelated to crime. Nevertheless, the instrumental variable used is imprecise because it explains only a small part of the variation in police hiring. The point estimates are generally not statistically significant for individual crime categories, but they are significant for violent crime taken as a whole.

Di Tella and Schargrodsky (2004) use a different approach to estimate the exogenous effect of policing on crime. On July 18, 1994, a terrorist bombing completely destroyed the Israeli Argentine Mutual Association (AMIA), the main Jewish center in Buenos Aires, Argentina. Eighty-six people were killed and more than 300 were wounded in the attack. One week later, police protection was placed at each Jewish and Muslim institution (such as synagogues, mosques, clubs, cemeteries, and schools) in the country. Since the distribution of these institutions can be presumed to be exogenous in a crime regression, this hideous event can be used as a natural experiment to break the simultaneous determination of crime and police presence.

These authors collected information on the number of motor vehicle thefts per block in three large neighborhoods in Buenos Aires before and after the terrorist attack. Their data covers the nine-month period starting April 1st and ending on December 31, 1994. They also collected information on the location of each protected institution in those neighborhoods. Using all this information, they then estimate the effect of police presence on car theft.

They find that blocks that receive police protection experience significantly fewer car thefts than the rest of the neighborhood. The effect is economically large. Relative to the control group, it is equivalent to a drop of 75%. However, the effect is extremely local, because they could not find evidence that police presence in a given block reduces car theft one, two, or more blocks away from the protected buildings.

Klick and Tabarrok (2005) apply a similar approach. On March 11, 2002, the Office of Homeland Security introduced the Homeland Security Advisory System (HSAS) to inform the public and other government agencies about the risk of terrorist attacks. During high-alert periods, the police increase their presence on the streets of Washington, D.C. The authors use these high-alert periods to break the circle of endogeneity and estimate the effect of policing on crime.

The hypothesis is that crime decreases on high-alert days in Washington D.C. because of a greater police presence on the streets. An alternative hypothesis is that tourism is reduced on high-alert days and, as a result, there are fewer potential victims, leading to fewer crimes. The authors explain that the second hypothesis is dubious because daily crime is unlikely to vary significantly based on the number of daily visitors.

Using a variety of specifications, they show that an increase in police presence of about 50% leads to a statistically and economically significant decrease in crime of around 16%. They also provide an analysis that suggests that this decrease is not an artifact of changing tourism patterns induced by changes in the terror alert level.

Galiani and Jaitman (2022) undertake two randomized controlled trials to assess: (I) the introduction of a predictive policing software system[3] in Montevideo, Uruguay; and (II) a place- based police training experiment conducted in that city.

The authors explain that Montevideo has 25 police precincts and that the police department assigned three of them to use the predictive software; those precincts were therefore excluded from the experiment. To ensure that the remaining 22 police precincts assigned to treatment and control groups were, on average, comparable in terms of their observable and unobservable characteristics, the police department randomized half of the precincts to the software group (treatment) and half to the crime analysts' group (control group). The control group (11 precincts) used the status quo crime analysts' patrol allocation, and the treatment group (11 precincts) used the predictive software.

[3] Predictive policing uses sophisticated computer algorithms to predict changing patterns of crime in the future; these systems often claim to be able to identify the exact locations where specific types of crimes are likely to occur next.

To verify that the randomization was successful, they compared the treatment and control groups not only with regard to robbery rates in 2014, but also in relation to a number of other variables that might have an influence on crime rates. They demonstrate that no statistically significant differences were found for any of the variables that were analyzed: literacy rate, unemployment rate, the proportion of males and youth, and the proportion of single-parent households. Hence, they determined that the treatment and control groups were comparable in terms of their observable characteristics, and there is no evidence that they would differ in terms of unobservable ones.

The results show no statistically significant differences in terms of overall crime or robberies between the two methods in either a cross-section or a panel regression. There was even a slight increase in thefts in the precincts assigned to the software. The software is very costly, so expanding the scope of crime analysts' work to cover the whole city would be more cost- effective, as well as better for local capacity-building purposes, and would potentially enhance community relations as the police department could turn its attention to other issues when targeting patrol sites. The cost of the software license for a year was, in that case, about four times as much as the cost of staffing the Tactical Information Directorate (DIT) with enough personnel to cover the entire city. These results suggest that agencies that are willing to invest large sums of money in software should first carefully assess the value added by such services.

In the second experiment, the effect of a specially trained police force on crime is estimated. The precinct selected for this experiment was Precinct 25 because it has an average crime rate and had been excluded from the first experiment. The government's objective was to reduce robberies, which occur mainly during shifts 1 and 2.

Each day, the police commander for this precinct was informed which ten 500 x 500 feet boxes per shift were to be prioritized in patrol activities at roll call for each of the three shifts. Within this precinct, the police chief decided to have five boxes randomized per shift and per day to the treatment group and five to the control group.

The boxes randomized to the treatment group were assigned to a specially trained police task force called the GRT. The GRT group received a 15-day training course that

involved four hours per day of in-class training on crime patterns and place-based policing and four hours per day of patrol work in the company of instructors.

The results show that the trained GRT force had a positive effect in terms of reducing crime, with the decrease being driven by a reduction in robberies only in shifts 1 and 2 (8 a.m. - 4 p.m. and 4 p.m. - midnight), the periods in which crimes are concentrated.

4.4 Private security

Private security also has an important role to play. In the theoretical model, private security works in the same way as an expansion of the police force or improvements in prisons do. Understanding the impact of private efforts to avert criminal victimization is important not only because of their scope, but also because of the potential externalities associated with such actions. There are many types of precautions that potential victims can take, some of which are visible and some of which are not. For example, visible car alarms and home security systems may serve to redistribute crime across victims rather than to reduce crime, with households or individuals who make use of observable self-protection mechanisms imposing a cost on those who do not. Other types of precautionary systems, such as silent alarms and passive disabling devices in automobiles, may provide positive rather than negative externalities.

Ayres and Levitt (1998) provided the first empirical evidence of the externalities associated with non-observable self-protection mechanisms. They study the Lojack car retrieval system implemented in the U.S. This system uses a small radio transmitter hidden in one of many possible locations within a car. When the car is reported stolen, the police remotely activate the transmitter, allowing them to track the precise location and movement of the stolen vehicle. The important thing here is that there is no indication anywhere on a Lojack-equipped vehicle that Lojack is installed. Thus, Lojack is a good example of an unobservable self-protection mechanism that generates positive externalities.

Official approval was required prior to Lojack's entry into the market because it necessitates the cooperation of the state police force and local police departments. The

delay in the issuance of that approval ranges from 14 weeks to 7.5 years. The authors therefore exploit this variability. Figure 11 in Ayres and Levitt (1998) compares auto theft rates in cities where approval for the use of the Lojack system has been given with auto theft rates in cities that have not yet given the required approval. As may clearly be seen in Figure 11 in Ayres and Levitt (1998), prior to Lojack approval, the trends in the treatment and control groups were similar, whereas, after the issuance of approval, treatment cities exhibited a sharp decrease in auto theft rates.

Because Lojack is unobservable, auto theft rates are influenced by thieves' perceptions concerning the mean Lojack installation rate, which are only imperceptibly affected by a given car owner's choice.

If the timing of city governments' regulatory approval of Lojack devices is endogenous, OLS estimations will be inconsistent. Nevertheless, the authors also instrument for the Lojack variables using the number of years that have elapsed since Lojack initiated the often-lengthy regulatory approval process. They also prove that this variable is highly correlated with the variables of Lojack presence but does not exploit any potentially endogenous variation in the timing of the regulatory approval. The instrumental estimation shows that each additional percentage point of Lojack devices in the market is associated with a greater than 20% reduction in auto theft in central cities.

From the perspective of social welfare, expansion of the geographical coverage of Lojack devices at relatively low levels of vehicle installation is likely to be preferable to large increases in Lojack penetration rates in existing markets. The authors also find that there is no displacement from car thefts to other types of crimes. However, Altbeker (2006) affirms that the scenario is different in South Africa. "Changes in administrative and policing systems, as well as ⋯ changes in vehicle security [have] led to the displacement of some crime from car crime towards robbery. ⋯ the increased risk and reduced rewards for car theft seem to have resulted in some car thieves turning to robbery to secure their income. There was, in other words, a degree of displacement" (Altbeker, 2006).

The effect of observable self-protection, such as, for example, surveillance cameras, on crime is not conclusive. Only a few papers address the question of causality between the installation of such cameras and crime; because institutions often deploy surveillance cameras in response to upward trends in crime, unobserved causes of such trends are likely to be correlated with the installation of cameras. Video surveillance research may therefore suffer from the problem of endogeneity.

Two randomized experiments and four natural or quasi-natural experiments on the subject that employ rigorous methodologies are noteworthy. In one of the randomized experiments, Hayes and Downs (2011) study the impact of in-aisle closed-circuit television (CCTV) dome cameras installed in stores in the U.S. on shaving blade theft (counted by employees). The authors report an odds ratio of 3.66 (95% confidence intervals: 2.50-5.37) for the CCTV dome condition. Another randomized experiment was conducted by La Vigne and Lowry (2011) in Baltimore. Their experiment was conducted in parking facilities, with half of the facilities being randomly assigned to the control condition and the others to the treatment group, in which a combination of live and dummy cameras were installed. The authors did not find significant changes in total crime, property crime, larceny crime, car crime or auto theft.

In one of the natural experiments referred to above, Priks (2014) exploits exogenous variations in the timing of the introduction of surveillance cameras in 13 soccer stadiums in Sweden; the variation is due to differential processing times for camera permits and delays in installation. Instances in which spectators threw objects onto the field are the outcome measured in this study, whose results suggest that installing cameras reduced unruly behavior of this kind by 64%. Priks (2015) also undertook a similar study, but this time in subway stations. His evaluation strategy exploited the exogenous variations in the timing of the introduction of cameras due to differential delays in the processing of applications for camera permits. The author did not find any significant change in total crime in all stations but, in stations in the city center, total crime was reduced by 25%, pickpocketing by 23%, and robbery by 60%. He also detected a degree of local displacement, with 15% of the deterred crimes being displaced to areas surrounding the stations where cameras were not used. Munyo and

Rossi (2020) exploit exogenous variations in the timing of the introduction of cameras on public streets in Uruguay; these variations are attributable to the fact that installation sites were not prioritized and that installation decisions were not driven by crime trends. Their results show a 28% reduction in total crime (theft and robbery) but no significant reduction in assaults or domestic violence. These authors also find that the reduction in crime in the target areas was offset by an increase in crime in unmonitored parts of the city. Gómez, Mejía, and Tobón (2017) conducted a similar study in Medellin, Colombia, but in this case, they exploit the time variation generated by the fact that installations were based on bureaucratic permitting procedures and logistical considerations. These authors find a 27% reduction in property crime and no significant change in violent crime. They do not provide evidence about displacement or diffusion of benefits.

4.5 Personal security

The effect of gun laws on crime is also hotly debated. Some studies have found evidence that laws allowing citizens to carry concealed handguns decrease crime; presumably the possibility of encountering a victim with a gun deters potential criminals from committing crime in the first place.

For example, Lott and Mustard (1997) using cross-sectional time-series data for U.S. counties from 1977 to 1992 find that allowing citizens to carry concealed weapons deters violent crimes and it appears to produce no increase in accidental deaths.

In contrast, other studies find that gun laws do not decrease crime. Ayres and Donohue (2002) affirm that more refined analyses of recent state and county data undermine the more guns, less crime hypothesis. Estimating more statistically disaggregated models on more complete county data, these authors show the opposite result. More guns lead to more crime.

4.6 Family relocation

Analysts believe that residential location greatly affects access to opportunities through peer influence on youth behavior and through a variety of neighborhood characteristics correlated with neighborhood wealth, such as school quality and safety from crime.

Kling, Ludwing, and Katz (2005) study the effects on juvenile crime of relocating families from high- to low-poverty neighborhoods under the large-scale "Moving to Opportunity (MTO)" program. The authors look for empirical support for the possibility that criminal activity is contagious in high-crime areas. This can occur because the social penalties for committing crime or the probability of arrest may be lower than in other neighborhoods.

The MTO experiment was launched in Baltimore, Boston, Chicago, Los Angeles, and New York starting in 1994. In order to be eligible for the program, families had to demonstrate that they had children and resided in public housing or project-based assisted housing in census tracts in which poverty rates were above 40%.

The families who signed up for the program were randomly divided into three groups:

(I) The experimental group, whose members received housing vouchers which could only be used in census tracts with a 1990 poverty rate below 10%. This group also received mobility counseling.

(II) The Section 8 comparison group, whose members received vouchers with no special restrictions on the areas where they could be used.

(III) The control group, whose members continued to receive pre-existing social services but received no further assistance under MTO.

Thus, the MTO demonstration facilitated moves by members of the treatment groups out of public housing to areas with more affluent neighbors and a lower incidence of many social problems.

In addition, these authors have information on a sample of MTO youth aged between 15 and 25 in 2001 – which includes the peak age group for criminal offenses (18–20 years of age). They also have access to a second source of information composed of a series of surveys of MTO youth aged 15-20. Those surveys were completed in 2002 and covered self-reported arrests and other forms of criminal behavior. All this information enabled the researchers to study the effect of program

participation on youth delinquency and criminal behavior.

The results of this study point to a significant reduction in total violent crime arrests of female youths (0.145 fewer arrests over a mean of 0.241) but no significant change in arrests for other types of offenses. For males in the experimental group, there is a significant increase in property crime arrests. Those who moved as a result of the program have an average of 0.363 more lifetime arrests than the members of the control group. There is, however, no significant difference in total lifetime arrests, partly because the increase in property crime arrests is offset by a (not statistically significant) reduction in violent crime arrests. The difference in effects between females and males is significant for property and total lifetime arrests

4.7 Why is there more crime in cities?

Glaeser and Sacerdote (1996) test a variety of theories about the correlation between crime and urban size using victimization data, evidence from the National Longitudinal Surveys on criminal behavior, and the Uniform Crime Report. The authors find that approximately 45% of the urban crime premium in cross-city regressions can be explained by observable characteristics.

Almost 30% of the urban crime premium can be explained by higher rewards per crime in cities. Both the Uniform Crime Reports and the victimization records show a strong connection between city size and the value of the average crime. The estimates of this connection from the two data sets are also comparable in magnitude. The natural interpretation of this finding is that theft becomes easier as the potential criminal's environment becomes more densely populated with victims. However, it is also possible that this urban value effect is the result of urban criminals taking bigger risks and stealing more valuable objects because either policing is less effective in cities or because criminals in cities are more tolerant of risk.

The results on arrest rates, defined as arrests per reported crime, suggest a mild relationship between city size and the ratio of arrest rates to reported crimes. Cities seem to respond to high crime levels, and they have many more policemen per capita than non-urban areas. When the authors adjust for higher underreporting rates in big cities, they find that there is a mild correlation between city size and arrests per actual

crime. That correlation works primarily through less reporting. Using arrests per reported crime, authors find that the arrest rate can explain around 3% of the urban crime effect. Using arrests per actual crime, they find the arrest rate effect can explain approximately 13% of the urban crime premium.

The effect of urban anonymity seems to be real and non-urban residents are much more likely to recognize their offender than urban residents. This effect is true even controlling the type of crimes perpetrated in different types of cities. The effect of anonymity may create lower reporting rates or less effective policing. It also may create fewer applications of informal community sanctions against criminal behavior. Under the assumption that community sanctions are approximately 25% of the formal police sanctions for minor crimes (a relatively arbitrary assumption), Glaeser and Sacerdote (1996) find that greater anonymity seems to explain at most 4% of the urban crime premium.

5 Conclusion

Citizen security is a fundamental determinant of the well-being of households and communities. The significant growth in crime and violence in many countries has not only involved high economic and social costs but has also compromised democratic governance and the legitimacy of the State by undermining people's trust in each other and in the authorities. There is no doubt that crime in urban areas has effects over and above the direct costs to victims.

Given these significant social costs, crime is among the most important areas of economic research. Over the years that have passed since Becker's seminal study (1968), there has been a surge of activity as researchers seek to arrive at a fuller understanding of the economics of crime. That is why this report first presents the theoretical framework developed by Becker (1968) and the main extensions developed in the years following its publication. We review a model whereby individuals are making an occupational choice between participation in the legal or the illegal sector and then go on to model what determines the income they will derive from legitimate employment or from criminal activity and the incentives that prompt individuals to

switch from a legal occupation to illegal activity and vice versa.

We then present what we consider to be the most important impacts of crime on urbanicity. As noted earlier, there have been a large number of studies aimed at measuring the impact of crime, but some of them have failed to achieve their objective. That is why this paper focuses exclusively on studies that have employed rigorous methodologies, such as randomized trials, natural experiments, synthetic controls, and instrumental variables.

After reviewing the literature, we find rigorous evidence of the negative impact of crime on different aspects of urbanicity, such as property values, GDP, business activity, consumer behavior, and mobility. Certainly, most of these estimations cannot be viewed as valid for the entire world because most of these studies have been conducted in the United States, not in emerging economies, and it is known that causal estimation suffers from a lack of external validity in most cases. Nevertheless, these studies confirm the intuitive conclusion concerning the negative impact of crime.

However, if we want to focus on developing economies, or at least think how this empirical evidence and theoretical framework can be useful for them, we should also consider parameter e of the crime-income equation. This parameter plays a key role, because the particular social, cultural, economic and historical environment in which a study is conducted can result in very large differences in the estimations, increasing or decreasing the calculated level of income from crime and making crime appear to be more profitable in some scenarios than in others.

Now, given how bad crime is for society and what a strong impact it has on economies and well-being, we have analyzed different ways in which the literature has already established that crime can be reduced. The various approaches to crime and violence prevention outlined in this paper indicate that there are multiple possible entry points for efforts to reduce crime and violence, including the operation of prisons, an expansion of the police force, the provision of stipends to prisoners when they are released, the use of private security systems, and family mobility.

There is no one “ideal” approach for reducing crime and violence, but the common

denominator of all the successful approaches is that they employ evidence-based interventions, starting with a clear diagnostic analysis of different types of violence and ending with a careful evaluation of the intervention's impact that will then inform future actions.

There is no silver bullet to end crime. However, there are many interventions targeted to individuals that reduce both their crime propensity and their criminogenic exposure, i.e., they limit the formation of criminals. These effects are not achieved instantaneously but are rather the result of an investment process that encompasses various stages of life, and in which different actors are involved in addition to the individual himself (Sanguinetti et al. 2014)

There is a clear need for a rigorous evaluation of both the impact of crime and its social/individual costs as a basis for generating scientific evidence and knowledge about what types of interventions for reducing violence are most effective. Furthermore, it is essential to evaluate how these approaches work in emerging economies, since rigorous empirical evidence pertaining to those economies is still scarce. There are also many other ideas and approaches that still need to be examined in a systematic manner, including the impacts of different types of crime, violence or offenses, other crime-reduction programs, policies, or laws, and personal decisions that people may take to protect themselves from crime.

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