# Appendix

## Appendix A. Deriving the Share of Program Participants that become a Bystander

As described above, equation (3) gives the share of program participants that become a bystander. Suppose program participants ($PARTICIPANTS$) are drawn from the total population ($Total population$). Targeting occurs according to their risk potential. The share of bystanders within the total population is given by $Risk population$. In comparison, $BYSTANDER$ is the share of program participants that become a bystander after training. Targeting thus translates $Total population$ into $PARTICIPANTS$, and $Risk population$ into $BYSTANDER$. Accordingly, the total number of individuals within the population who become a bystander is given by $Risk population×Total population$. For the sake of simplicity, we assume that targeting assigns all of these individuals to the program. Hence, the total number of program participants who will become a bystander also given by $Risk population×Total population$. Logically, the total number of individuals within the total population who will not become a bystander is given by $(1-Risk population)Total population$. How many of these individuals are assigned to the program is determined by targeting precision. We denote targeting precision as $PRECISION$.[[1]](#footnote-1)

Hence, the share of program participants who will not become a bystander is given by $(1-PRECISION)(1-Risk population)Total population$. Taken together, the total number of program participants is given by the following expression:

|  |  |  |
| --- | --- | --- |
|  | $$PARTICIPANTS=Risk population×Total population$$$$+(1-PRECISION)(1-POPULATION)Total population$$ | (15) |

In consequence, the share of program participants who will become a bystander after can be expressed as follows:

|  |  |  |
| --- | --- | --- |
|  | $$BYSTANDER=\frac{Risk population×Total population}{PARTICIPANTS}$$ | (16) |
|  | $$=\frac{Risk population×Total population}{Risk population×Total population+(1-PRECISION)(1-Risk population)Total population}$$ | (17) |
|  | $$=\frac{Risk population}{Risk population+(1-PRECISION)(1-Risk population)}$$ | (18) |
|  | $$=\frac{Risk population}{1-PRECISION(1-Risk population)} $$ | (19) |

## Appendix B. Overview of Alternative Costing Methodologies

Section 5 described the *discrete choice experiments* method, which is a top-down approach to estimating the costs of crime. Top-down approaches aim to provide a single estimate of the crime costs based on the public willingness to pay for crime reduction. Bottom-up approaches aim to estimate each single component of the crime costs seperately. The components can be categorized into tangible costs and intangible costs. The tangible costs of crime can be measured directly in dollar values. In case of violent crime, medical expenditures are likely the biggest cost factor. Hospital databases provide information on medical expenditures.[[2]](#footnote-2) Estimating the tangible costs of crime relies on the *cost-of-illness method*, which aims to measure all the costs of a certain disease (Yates, 1999). Another important pool of costs are government expenditures on the criminal justice system. Government budgets provide the relevant data. Cost measures include, for example, police expenditures and criminal justice system costs (Aos Lieb, R., Mayfield, J., Miller, M & Pennucci, A., 2004).[[3]](#footnote-3) The following tables show the taxonomy of crime cost by Cohen & Bowles (2010). Table B1 provides an overview of the costs resulting from the anticipation and consequences of crime. Table B2 contains the costs of the different responses to crime.

**Table B1. Anticipation and Consequences of Crime**

|  |  |
| --- | --- |
| Crime cost category | Who bears the cost |
| **Anticipation of crime** |  |
| Precautionary expenditures | Potential victims |
| Avoidance behaviors | Potential victims |
| Fear of crime | Potential victims |
| Crime prevention programs | Society/government |
| * Government
 | Society/government |
| * Non-government agencies
 | Society |
| **Consequences of crime** |  |
| Property losses |  |
| * Losses not reimbursed by insurer
 | Victim |
| * Losses reimbursed by insurance
 | Society |
| * Administrative costs of insurance
 | Society |
| Productivity losses |  |
| * Lost wages for unpaid workdays
 | Victim |
| * Lost productivity for paid workdays
 | Society/employers |
| Household service losses | Victim/family |
| Lost school days |  |
| * Foregone wages due to lack of education
 | Victim |
| * Foregone nonpecuniary benefits of education
 | Victim |
| * Foregone social benefits due to lack of education
 | Society |
| Medical and mental health costs |  |
| * Losses not reimbursed by insurer
 | Victims/family |
| * Losses reimbursed by insurance
 | Society |
| * Administrative costs of insurance
 | Society |
| Pain, suffering and lost quality of life |  |
| * Pain, suffering & lost quality of life
 | Victim |
| * Loss of affection/enjoyment, trauma
 | Victim family |
| Victim support services |  |
| * Expenses charged to victim
 | Victim |
| * Expenses paid by service agency
 | Society/government |
| Legal costs associated with tort claims | Victim/society |
| Long-term consequences of victimization | Victim family/Society |
| Offender costs | Offender |

Source: Cohen & Bowles (2010)

**Table B2. Response to Crime**

|  |  |
| --- | --- |
| Crime cost category | Who bears the cost |
| **Response to crime** |  |
| Police | Society/government |
| Prosecution | Society/government |
| Courts | Society/government |
| Legal fees |  |
| * Public defenders
 | Society/government |
| * Private lawyers
 | Offender |
| Criminal sanctions | Society/government |
| Victim and witness costs | Victim/Witnesses |
| Jury service | Jurors |
| Victim compensation | Society/government |
| Offender costs |  |
| * Productivity
 | Offender/society |
| * Injury/death to offender while incarcerated
 | Offender/society |
| * Loss of freedom to offender
 | Offender |
| * Offender’s family
 | Offender’s family/society |
| Overdeterrence costs |  |
| * Innocent individuals accused of offenses
 | Innocent “offenders” |
| * Restrictions on legitimate activities
 | Society |
| * Costs of additional detection avoidance by offenders
 | Offender |
| Justice costs | Society |

Source: Cohen & Bowles (2010)

#### Jury Awards to estimate the Intangible Costs of Crime

The intangible costsof crime include the costs of pain, suffering, and lost quality of life (Cohen, 1988). Jury awards for compensatory damages provide good estimates of intangible costs. This is because they compensate victims with a sum that will put them to the level of well-being they maintained prior to victimization (Cohen, 2000, 2004).[[4]](#footnote-4) Jury awards include compensation for out-of-pocket expenses (tangible costs) and non-economic losses (intangible costs). Jury awards therefore reflect the decline in the level of well-being that is caused by victimization. Cost estimation based on jury awards functions as follows: data is collected on jury awards in cases of violent assault. *Ordinary least squared* (OLS) regression is used to estimate compensatory damage awards as a function of medical expenditures and wage losses as well as a set of offense, injury, victim, and defendant specific variables. This yields estimates of jury awards by type of injury. From this, the medical expenditures and wage losses are subtracted. The result is the non-economic loss by injury type (Miller, Cohen, & Hendrie, 2017).

A number of reasons supports the use of the method. Society placed the system of compensation in the hands of juries and thus decided that their awards are just compensation. Estimates based on jury awards are used in regulatory contexts (Cohen & Bowles, 2010). Jury awards are predictable in large samples (Cohen & Miller, 2003). Analysts belief they provide a good proxy for the value of lost life and health (Crowley & Jones, 2015). However, juries are likely to fail to predict the hedonic consequences of injuries by overestimating the impacts of physical health conditions. They are also prone to affective forecasting errors, anchoring effects, and random source variability in their decisions (Ubel & Loewenstein, 2008).

### Top-Down Approaches

Top-down approaches estimate the costs of crime based on the willingness to pay for reduced crime. They can be categorized into approaches based on stated preferences or revealed preferences. The *discrete choice experiments* method described in chapter 5 is a stated preferences approach. It derives the willingness to pay from survey data. In contrast, revealed preferences approaches use real-life market transactions to elicit the willingness to pay. One revealed preferences approach uses differences in housing prices between neighborhoods with different crime rates. The price premium for neighborhoods with low crime rates reflects the WTP for crime reduction (Thaler, 1978). Another approach uses wage differentials between professions with different risk profiles. Here, the higher wages paid in professions with higher mortality risk reflect the value of statistical life (VSL, Viscusi & Aldy, 2003).

Revealed preferences approaches have high external validity as they draw on real decisions and market transactions. However, they rely on the assumption of market efficiency and full information on prices and risks. Therefore, the extensive data requirements often inhibit the application of the method. Researchers need information on location-specific housing characteristics, housing prices, crime rates, and other location-specific amenities. Furthermore, different crimes are highly collinear, which prevents isolating the value of a specific crime. For example, a neighborhood with a high homicide rate is also likely to have high rates of other types of crime. Finally, the approach is sensitive to income effects and likely to underestimate the cost of crime. It is therefore difficult to implement in practice (Cohen & Bowles, 2010; Picasso & Cohen, 2019).

#### Life Satisfaction Method

The *life satisfaction method* combines information from revealed preferences and stated preferences. For this purpose, income changes (revealed preferences)are related to changes in life satisfaction because of victimization (stated preferences). Hence, the income changes reflect the decline in well-being because of victimization and thus provide good cost estimates. Johnston et al. (2018) apply an extended life satisfaction approach to panel data from two Australian longitudinal surveys that ask respondents for their subjective life satisfaction and experiences of criminal victimization. In order to provide cost estimates, they model life satisfaction as a function of victimization, a large positive income shock, and a set of control variables. Then, they relate the life satisfaction effect of victimization to the life satisfaction effect of the income shock leading to the so-called discounted life satisfaction ratio. To calculate the final cost estimates, they multiply the ratio by the average change in household income associated with a large positive income shock (cf. Frijters, Johnston, & Shields, 2011).

#### Quality-Adjusted Life Years Method

The quality-adjusted life year (QALY) is a measure of disease burden that combines information on both the quantity and quality of live.[[5]](#footnote-5) Dolan et al., (2005) use data on the duration (quantity) and disability weights (quality) of different injuries and quality-adjusted life years (QALYs) methodology to estimate the intangible cost of crime in the U.K. Disability weights capture how much a medical condition (injury) affects the individual’s state of health. Combining the disability weights with the corresponding duration, they are able to calculate QALY losses from physical injuries and psychological traumas for different categories of criminal offence. In order to convert the QALY losses into monetary values, they introduce two general approaches. Approach (a) uses evaluations made by experts, while (b) uses the public’s WTP. The QALY values based on the two approaches each are multiplied with the QALY losses incurred from the different categories of offenses. This results in the monetary value of the QALY losses (per incidence). For example, the value of a serious wounding is estimated at £5,723 (Dolan et al., 2005). Table B3 provides an overview of different cost estimates.

**Table B3. Overview of Cost Estimates**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Authors | Country | Costing method | Crime type | Estimate  | Unit |
| Miller et al. (2017) | USA | Jury awards | Physical assault (all) | 19,627 | 2015 USD |
| Miller et al. (2017) | USA | Jury awards | Physical assault (injured) | 35,349 | 2015 USD |
| Miller et al. (2017) | USA | Jury awards | Physical assault (non-injured) | 3,478 | 2015 USD |
| Cohen et al. (2004) | USA | Contingent valuation | Serious assault | 70,000 | 2000 USD |
| Picasso & Cohen (2019) | Argentina | Discrete choice experiments | Violent crime | 2,000 | 2014 USD (ppp) |
| Dolan et al. (2005) | UK | Quality-adjusted life years | Serious wounding | 5,723 | 2000 GBP |
| Dolan et al. (2005) | UK | Quality-adjusted life years | Other wounding | 945 | 2000 GBP |
| Dolan et al. (2005) | UK | Quality-adjusted life years | Common assault | 218 | 2000 GBP |
| Johnston et al. (2018)o | Australia | Life satisfaction method | Violent crime | 88,000 | AUD |

*Notes:* The table shows an overview of cost estimates for different countries based on different costing methods.

## Appendix C. The Process of Real-Time Bidding

The *real-time bidding* process is initiated when the browser of the user requests a webpage. In response, the content server of the publisher transmits the webpage content to the browser. The transmitted webpage contains links that cause the browser to connect with the publisher’s ad server and request that the ad space available is filled with ads. At the same time, information identifying the user is transmitted to the ad server.

The ad server then connects with a supply-side platform offering ad space for sale. The supply-side platform transmits the information identifying the user to a data management platform. On this platform, the identifying information is enriched with geographic, demographic, psychographic, and behavioral data. The enriched user information is sent back to the supply-side platform, where the offer of ad space along with the information on the user who will view it is merged. The supply-side platform transmits the offer to an ad exchange. The ad exchange puts the offer up for auction to demand-side platforms.

Demand-side platforms bid on behalf of ad agencies. They have ads ready for display and search for suitable users. Based on the information on the particular user who requested the website, demand-side platforms decide how much to offer for the corresponding ad space. The ad exchange picks the best bid, informs both parties, and transmits the link to the ad through the supply-side platform and the publisher’s ad server to the user’s browser. The browser then requests the ad from the ad agency’s ad server. Thus, the ad agency can confirm to their customer that the ad was delivered to the browser (Wang et al., 2017).

1. Our basic idea is inspired by the work of Martin & Lotspeich (2014). [↑](#footnote-ref-1)
2. Further data sources include victimization surveys, crime data, budget data, and salary data. Examples of such data sources from the U.S. include the *National Crime Victimization Survey* (NCVS), the *Federal Bureau of Investigation* (FBI) *Uniform Crime Reporting* (UCR) Program, the *National Violence Against Women Survey* (NVAWS), and different medical expenditure surveys (Lugo & Przybylski, 2018). [↑](#footnote-ref-2)
3. However, while aggregate costs of the criminal justice system may be available, the costs per crime may be not. Proxy measures include the marginal costs of police resources associated with investigating a crime or the marginal costs of to the criminal justice system having to process a repeat offender (see e.g., Aos Lieb, R., Mayfield, J., Miller, M & Pennucci, A., 2004). [↑](#footnote-ref-3)
4. Jury awards commonly result from victims suing third parties who are responsible for the crime because of some form of negligence. Violent offenders often lack sufficient assets and thus are infrequently sued (Miller, Cohen, & Wiersema, 1996). [↑](#footnote-ref-4)
5. Generally, the quantity is measured in life years. The quality is measured by an index (e.g. disability weights), which takes the value one if the observed individual is in perfect health and the value zero if it is dead. For all other health conditions, the index takes a value between zero and one depending on the extent of medical restriction. To calculate an individual health profile, the number of life years spent in a particular state of health is multiplied by the index value capturing that state. [↑](#footnote-ref-5)