

Cost-Benefit Methodology

July 2011



Criminal Justice Commission

State of Oregon

Michael Wilson

This publication was supported in part by US Department of Justice grant # 2008-BJ-CX-K003 awarded to the Oregon Criminal Justice Commission by the Office of Justice Programs. Points of view in this document do not necessarily represent the official position or policies of the US Department of Justice.

Methodology of Oregon's Cost-Benefit Model

In 2006, the Oregon Criminal Justice Commission (CJC) began the work of creating a statewide cost-benefit model for the criminal justice system. The purpose of this work was to provide information to policy makers and the public about the relative costs and effectiveness of programs designed to reduce future crime. Other states have already done similar work with the most notable being the Washington State Institute of Public Policy (WSIPP). They created a cost-benefit model that has been used extensively by their state legislature. Leveraging the work already done in Washington, in 2007 the CJC reported on the costs and benefits of incarceration.

In 2007, the Oregon legislature passed House Bill 3563, creating the Public Safety Strategies Task Force. The task force was charged with evaluating investments in programs designed to reduce crime and victimization and making recommendations based upon cost-benefit analysis. The report below describes the methodology used to perform cost-benefit analyses of programs designed to reduce recidivism.

Effect size

The first step in determining if a program is cost-effective is to estimate if the program reduces future crime. If an agency has the data and the resources available they can conduct evaluations of their own programs. This provides an 'effect size' which gives an estimate of how effective a certain program is at reducing recidivism. If the data and resources are available this is the best way to estimate an effect-size for a program. Ongoing evaluations allow agencies to test if their specific programs are effective and if the level of effectiveness changes over time.

However, it is often difficult or impossible to determine if a specific program is effective at reducing crime. If a program has few participants or has recently been implemented there will not be enough data to estimate if the program actually reduces future criminal behavior. Some programs may have plenty of data but agencies may not have the resources available to evaluate the program. For many of the programs in Oregon it is not feasible for agencies to conduct their own evaluations. When there are not specific evaluations within the state a meta-analysis can be used to estimate the effect of a program on recidivism.

A meta-analysis examines the results of numerous studies to summarize the results of a given set of research. For example, a meta-analysis of drug courts would look at all the studies available on adult drug courts and see if on average they are effective at reducing future crime of drug court participants. Statistical techniques are used to determine if on average a certain type of program is effective at achieving a measurable goal.

WSIPP conducted a meta-analysis of hundreds of evaluations of adult corrections, juvenile corrections and prevention programs to determine what works to reduce crime.¹ Their meta-analysis only included rigorous evaluations that had a well matched business-as-usual comparison group. They also discounted some of the effect sizes depending on the research methodology.

In their meta-analysis WSIPP categorized these studies into program categories that they believed had enough research to estimate an effect size. The meta-analysis provides an average effect-size based on the literature, so some programs will have a larger effect size and some a smaller effect-size. Many of these programs are used in Oregon. Using the meta-analysis already done by WSIPP, estimates can be made on how effective programs in Oregon are expected to be at reducing crime of participants.

¹ Aos, S., Lee, S., Drake, E., Pennucci, A., Klima, T., Miller, M., Anderson, L., Mayfield, J., & Burley, M. (2011). *Return on investment: Evidence-based options to improve statewide outcomes* (Document No. 11-07-1201). Olympia: Washington State Institute for Public Policy.

Effect size to avoided crime

The meta-analysis described above provides estimates of how effective a program is at reducing crime, but it does not report how much crime is actually avoided. In order to estimate avoided crime the recidivism patterns of offenders must be estimated. Assumptions must also be made on how long the effect of the program will last and what types of crimes should be included.

For this analysis recidivism was estimated for 10 years following the program. This was done by examining recidivism patterns of those released from prison or those on probation in 1999. This year was chosen because recidivism patterns in earlier years are different than current recidivism patterns. Due to data constraints only felonies were measured over this 10 year period. The effect size is multiplied by the actual recidivism of similar offenders to estimate the number of crimes avoided.

Avoided Felony Convictions from Re-Entry Centers (per participant)							
Year	Homicide	Sex	Robbery	Assault	Property	Other	All
1	-0.0001	-0.0001	-0.0014	-0.0020	-0.0172	-0.0308	-0.05
2	-0.0001	-0.0004	-0.0022	-0.0020	-0.0170	-0.0308	-0.05
3	-0.0007	-0.0002	-0.0017	-0.0031	-0.0167	-0.0239	-0.05
4	0.0000	-0.0004	-0.0010	-0.0021	-0.0158	-0.0184	-0.04
5	0.0000	-0.0003	-0.0015	-0.0021	-0.0132	-0.0197	-0.04
6	0.0000	-0.0004	-0.0010	-0.0022	-0.0118	-0.0165	-0.03
7	-0.0001	-0.0002	-0.0012	-0.0010	-0.0084	-0.0178	-0.03
8	-0.0003	-0.0003	-0.0014	-0.0012	-0.0093	-0.0165	-0.03
9	0.0000	-0.0002	-0.0008	-0.0014	-0.0081	-0.0140	-0.02
10	-0.0003	0.0000	-0.0008	-0.0010	-0.0051	-0.0130	-0.02
All	-0.0017	-0.0028	-0.0130	-0.0181	-0.1225	-0.2016	-0.36

Table 1

Table 1 shows an example of using the effect size from our own evaluation of Offender Re-entry Programs and estimating the avoided felonies from one participant. The effect size from our study estimated that this program reduced recidivism by 26.6 percent.² Table 1 is estimated by looking at the recidivism patterns of similar offenders in 1999 and tracking their felony convictions over a 10 year period. Offenders that used re-entry programs were similar to the average offender released from prison except there were few sex offenders. The recidivism numbers used above are for all offenders, except sex offenders, who were released from prison in 1999.³ It is assumed that re-entry programs are equally effective at reducing all crime types. Table 1 estimates that for every re-entry program participant there are 0.36 felony convictions avoided over a 10 year period. Most of the convictions are for property and other crimes (which are mostly drug crimes) but some person crimes may be avoided as well.

Costs of programs

Any cost-benefit analysis must have estimates of the costs. Sometimes the costs of a program are straight forward but other times they are very difficult to estimate. For a program at the Department of Corrections (DOC) for inmates the cost estimates are fairly straight forward. The number of dollars spent divided by the number of inmates served will give an accurate estimate of the costs per participant. However, this is much more difficult to estimate with drug courts. Drug courts receive some state money, some federal money and some local money. The state money goes through three different agencies and is given to local service providers. Those providers do

² See our Offender Re-entry Program evaluation at: http://www.oregon.gov/CJC/docs/Reentry_Eval_Final.pdf.

³ If the avoided convictions from drug court were estimated the recidivism table would be for drug and property offenders on probation in 1999. The conviction distribution will vary depending on what offender population is evaluated.

not consistently report back to the state agency on what specific programs were funded with that money.

In 2008, ECONorthwest was contracted by the Public Safety Strategies Task Force to do a cost evaluation of certain programs designed to reduce recidivism.⁴ They estimated costs for programs from WSIPP's meta-analysis and that were currently implemented in Oregon. They were unable to estimate reliable costs for some of the programs so they were left off the list. Most of their costs were estimated using data provided by Oregon agencies and a sample of county data. With program's cost estimates and avoided felony estimates the last step is to calculate the costs of crime or the benefit of avoiding crime.

Costs of crime

The first step in estimating the benefit of avoiding a crime is to estimate the cost of crime. The costs of the crimes avoided become the benefits. Any program that reduces crime provides benefits to taxpayers, victims and society. The methods used to calculate the costs of a crime or the benefits of reducing crime are described below.

There are a number of taxpayer costs that are incurred when a crime takes place. They include the cost of an arrest, conviction, incarceration, probation and post-prison supervision. Conceptually these costs are easy to understand, however not all of these are easy to estimate. Taxpayer costs are listed in table 2.⁵ The costs will vary depending upon the type of crime. The costs have been broken down by six broad crime types to capture these differences.⁶

Taxpayer and Victimization Costs of Crime in 2011 Inflation Adjusted Dollars						
	Taxpayer Costs					
	Homicide	Sex	Robbery	Aggravated Assault	Property	Other
Arrest (per arrest)	\$701	\$701	\$701	\$701	\$701	\$701
Conviction (per conviction)	\$159,340	\$19,628	\$10,316	\$5,100	\$210	\$210
Probation (annual cost)	\$2,570	\$2,570	\$2,570	\$2,570	\$2,570	\$2,570
Post-Prison Supervision (annual cost)	\$4,139	\$4,139	\$4,139	\$4,139	\$4,139	\$4,139
Dept. of Corrections (annual cost)	\$14,235	\$14,235	\$14,235	\$14,235	\$14,235	\$14,235
Jail (annual cost)	\$15,697	\$15,697	\$15,697	\$15,697	\$15,697	\$15,697
	Victimization Costs					
Out of Pocket (per victimization)	\$768,347	\$5,788	\$3,437	\$9,064	\$2,002	n/a
Quality of Life (per victimization)	\$8,794,894	\$206,498	\$5,184	\$13,997	\$0	n/a

Table 2

Cost of an arrest

The cost of an arrest is estimated by WSIPP for the state of Washington. They estimate this using a regression model for the operating costs of sheriffs' offices and local police departments in Washington counties. For explanatory workload measures they use data on arrests for murder, violent felonies (rape, aggravated assault and robbery), non-violent felonies and misdemeanors. The arrest data do not include traffic operation so data on the number of traffic filings was also included.⁷

Using similar techniques an estimate for the cost of an arrest was also made using Oregon data. Data are available from the 2002 Census of Governments that can be used to estimate the cost

⁴ See ECONorthwest, *Analysis of Costs and Participation for Selected Evidence-Based Programs in the Criminal Justice System*. (November 2008).

⁵ Cost for the juvenile system have also been estimated but are not listed in this report.

⁶ Due to data limitations misdemeanors are not included in the model.

⁷ For further detail on the cost of an arrest methodology see S. Aos, P. Phipps, R. Barnoski, R. Leib, *The Comparative Costs and Benefits of Programs to Reduce Crime Version 4.0*, (Olympia: Washington State Institute of Public Policy, 2001).

of an arrest in Oregon. The number of arrests is easily available. However, it is difficult to gather good data on the number of traffic infractions in Oregon by local jurisdiction. This is necessary to control for police time that is spent on traffic violations and not on arrests. It is also difficult to get data on the operating costs of the sheriffs' office and local police departments. Because of these limitations the estimate for the cost of an arrest for Oregon was not reliable.⁸

Oregon and Washington are similar in their crime rates and their number of police officers per 1,000 population. In 2009, Oregon had the lowest number of police officers per 1,000 population of any state, Washington was second. Historically, both states have very similar violent crime rates, both well below the national average. Property crime rates in Oregon and Washington are also similar, with Oregon's rate dropping more rapidly in recent years. Because of these similarities and the lack of good data for Oregon the cost of an arrest in Washington was used in the cost-benefit calculations for Oregon.

Cost of a conviction

For the cost of a conviction the estimates from Washington were also used. In WSIPP's estimates the dependent variable is the court costs for each county. Explanatory variables include homicide convictions, sex crime convictions, other felony convictions, misdemeanors and all other non-criminal filings. The model was estimated using a log-log form and was for both adult and juvenile convictions.

The cost of a conviction was also estimated using data from Oregon. Expenditure data for court operating costs was obtained from the Oregon Judicial Department. A pooled cross-sectional regression analysis was performed for two biennia. Felony convictions were calculated by adding felony convictions from DOC and the Oregon Youth Authority. Complete data on county district attorney costs were not available. An estimate of the total district attorney budget was made using data from 18 of the 36 counties. It is estimated that the county's district attorney's budget is about 25 percent of the total court operating expenditures. Adding this amount to state spending on courts provides an estimate for the cost of a conviction.⁹ Again because of state similarities and data limitations in Oregon the cost of a conviction for Washington was used.

Cost of incarceration

The cost used for incarceration is estimated from budget data obtained from DOC staff as well as conversations with the Legislative Fiscal Office (LFO). DOC has traditionally used a standard cost per day that is calculated by using the budget for direct care costs divided by the average daily population. However this cost is not applicable when estimating the costs or savings of incremental or marginal changes to the prison system. For very small changes to the prison population the marginal cost is much smaller than the standard cost per day that has traditionally been used. In 2011, while the Legislature was in session, much work was done by the CJC, DOC and LFO to estimate the marginal cost of the state's prison system. This was done by examining DOC's budget and how much savings could be realized from marginal changes in the prison population. The costs or savings will vary depending on the size of the impact to the prison system. The estimates shown in table 2 reflect the costs or savings from temporary beds. If a policy or program has an impact that can close a prison the savings will be larger.

The cost of probation and post-prison supervision was also obtained from staff at DOC and is an average cost per day for the 2011 to 2013 biennium. These are the costs per day that the state pays to counties for each supervised offender and vary by the type of offenders and level of supervision.

⁸ The cost-benefit calculation was nearly the same using the cost of an arrest estimate with Oregon data and using the estimate from the Washington State Institute of Public Policy.

⁹ The cost of conviction was similar using Oregon data. Due to difficulties gathering county budget data on District Attorney's the Washington estimates seemed more reliable.

Cost of local jail

The cost of jail was obtained from DOC staff and is estimated from the 2011-2013 cost per day that is reimbursed to counties for offenders with felony local control sentences.¹⁰ This cost is similar to the average cost per day calculated by DOC. To estimate a marginal cost we multiplied DOC's ratio of marginal cost to average cost by the average cost of the jails to estimate a marginal jail cost.

Victimization costs

Taxpayer costs are not the only costs incurred from crime. Victimization costs are also a substantial cost and in some cases are much larger than taxpayer costs. Victimization costs include lost property, lost productivity, mental health, social services, medical care and quality of life. A prominent national study has conducted thorough research to estimate these costs.¹¹

This study breaks victimization costs into two parts, monetary and quality of life. Monetary costs include medical, mental health care, lost property expenses, and reduction in future earnings of crime victims. Quality of life costs place a dollar value on pain and suffering of crime victims using jury awards for pain and suffering and lost quality of life. An estimate of these costs is included in table 2.

Use of resources

Now that tax payer costs and victimization costs have been estimated, the units used with each crime avoided needs to be calculated. For example, if a robbery takes place there is clearly a victim. The robbery will only involve the cost to the victim if the crime is not reported or if no arrest is made. The crime will involve taxpayer costs once an arrest is made. If an arrest is made but there is no conviction, only the taxpayer costs for an arrest are incurred. Table 3 estimates the probability of an arrest and conviction for each crime category.¹³ This information can then be used to calculate for each avoided crime how much of each resource is used. For example if a program avoids one property crime, the benefit would be the victimization costs, plus 0.11 multiplied by the cost of an arrest, plus 0.08 multiplied by the cost of a conviction, plus 0.08 multiplied by the discounted cost of incarceration and post-prison supervision or the cost of probation, depending on the sentence. It is important to know the probability of each resource being used in order to calculate the cost to the system.

Estimated Probability of Arrest and Conviction							
	2009 Adjusted Offenses	2009 Adjusted Arrests	% of Re-reported Crime	Estimated Crime	Prob of Arrest	Estimated Convictions	Prob of Conviction
Homicide	100	91	100%	100	91%	116	116%
Rape/Other Sex	2,690	607	31%	8,763	7%	1,565	18%
Robbery	2,513	1,169	66%	3,831	31%	782	20%
Aggravated Assault	5,790	3,225	57%	10,122	32%	2,279	23%
Property Total	50,247	8,774	62%	80,570	11%	6,241	8%
Burglary	19,726	2,658	50%	39,373	7%	1,305	n/a
Larceny	18,837	4,840	69%	27,499	18%	3,452	n/a
Auto Theft	11,684	1,276	85%	13,698	9%	n/a	n/a

Table 3¹²

¹⁰ Local control sentences of less than a year that are served in the local jail.

¹¹ K. E. McCollister, M. T. French, & H. Fang (2010). The Cost of Crime to Society: New Crime-Specific Estimates for Policy and Program Evaluation. *Drug and Alcohol Dependence*, 108(1), 98-109.

¹² The probability of a conviction for murder is greater than one because many murders are committed by conspiring offenders with a single victim.

¹³ The probability of a conviction is calculated using a mix of Oregon data and Washington data.

It is also necessary to know what happens once an offender has been convicted. Table 4 shows what percentage of felony offenders go to prison, local jails or probation and how long they stay at each.¹⁴ Using the data in tables 2 to 4, total cost avoidance for each avoided felony conviction can be estimated.

Felony Sentences 2008-2009										
Crime	Sentence Type			Prison			Local Control			Probation
	Prison	Local Control	Probation	Sentence Length (months)	Post-Pris. Supervision	Time Served Credit	Sentence Length (months)	Post-Pris. Supervision	Time Served Credit	Sentence Length (months)
Homicide	96%	0%	4%	356.4	11.2	8.2	0	24	0.0	36.0
Rape, Sex Offense	83%	4%	13%	88.0	87.5	3.4	3.58	24	0.6	61.6
Robbery	79%	2%	19%	60.8	29.5	2.5	3.26	24	0.0	35.1
Assault	65%	5%	30%	50.2	25.9	2.3	4.97	24	1.3	37.1
Property	66%	4%	30%	26.4	15.7	1.4	3.92	24	2.6	29.5
Other	25%	16%	59%	32.4	24.4	1.6	2.9	24	0.9	23.5

Table 4

Benefit calculation

With estimates for the costs of each resource used and how much of that resource each offender uses it is possible to estimate the monetary benefits to taxpayers and victims of programs that reduce crime. Table 5 shows the benefits of avoiding one felony conviction. If a program is able to avoid one robbery conviction, taxpayers would avoid an estimated \$73,673 in costs and victims would avoid \$20,658 in costs.

Taxpayer and Victimization Costs of one Felony Conviction						
	Taxpayer Costs					
	Homicide	Rape	Robbery	Aggravated Assault	Property	Other
Arrest	\$701	\$701	\$1,047	\$991	\$985	\$985
Conviction	\$152,378	\$18,770	\$9,865	\$4,877	\$201	\$201
Probation	\$313	\$1,580	\$1,326	\$2,214	\$1,791	\$2,816
Post-Prison Supervision	\$1,489	\$17,944	\$6,574	\$4,931	\$3,254	\$1,872
Dept. of Corrections	\$265,053	\$77,005	\$52,236	\$36,115	\$19,814	\$9,169
Jail	\$10,230	\$3,918	\$2,625	\$2,346	\$1,519	\$1,329
Total Taxpayer	\$430,163	\$119,917	\$73,673	\$51,476	\$27,564	\$16,372
	Victimization Costs					
Out of Pocket	\$662,368	\$19,478	\$8,236	\$19,374	\$9,046	\$0
Quality of Life	\$7,581,805	\$694,869	\$12,422	\$29,919	\$0	\$0
Total Tax and Victim	\$8,674,335	\$834,264	\$94,331	\$100,769	\$36,610	\$16,372

Table 5

Each estimate in table 5 is calculated using the estimated costs and how an offender moves through the system. For example, it costs the same to arrest an offender for a robbery or an assault but robbery arrests are less likely to end in a conviction so the cost per felony conviction of a robbery arrest is higher. Put another way, on average it takes more robbery arrests to get a conviction than it does for an assault.

¹⁴ Different felony sentencing tables are used depending on the program being estimated. Table 4 is for non-sex offenders released from prison and most closely matches the offenders in the re-entry program. Probationers sentencing distribution will be different than those released from prison. For example a drug court will likely have less benefit from avoiding a conviction since they will be more likely to receive probation and have a shorter length of stay than an offender who is released from prison.

The final step in calculating the benefit of an avoided crime is to calculate the present value of benefits. The costs of crime, or the benefit of avoiding crime, are not all measured in the same time period. Some of the avoided crime occurs immediately and some do not happen until years in the future. When a crime is avoided in the first year the victimization cost is avoided immediately. However, if the offender is ultimately convicted and serves a prison sentence, the costs of incarceration and post-prison supervision occur in future years. An example of this is if an assault is avoided, the benefit of avoiding a victimization and an arrest would likely happen immediately. A potential conviction will take longer but likely be fairly close to the crime. However, if a prison sentence is avoided many of those benefits would not happen until years in the future. In Oregon a conviction of assault in the first degree would end in a prison sentence of 90 months or more. In this case many of the taxpayer benefits are not realized until years in the future. The standard economic technique to put future benefits in terms of today's dollars is to calculate the present value. The present value of benefits can be calculated using equation 1.

$$(1) PVBen_{ro} = \sum_{t=1}^{N_{ro}} \frac{Ben_{ro}}{(1 + Dis)^{t-1}}$$

where,

$PVBen_{ro}$ is the present value benefit or avoided cost for resource r for offender type o for time periods 1 to the number of periods for resource r and offense o .¹⁵

Ben_{ro} is the benefit or avoided cost for resource r for offense o measured in 2011 inflation adjusted dollars.¹⁶

Dis is the discount rate. It is used to discount future benefits into the current time period. For this analysis it is assumed to be 0.03.¹⁷

N_{ro} is the time period associated with the resource and offense.

Putting all of the above steps together provides an estimate for the benefits of programs that reduce crime. Combining this with the cost of programs yields a benefit cost ratio. This estimates the return of investing one dollar in a program in terms of benefits of avoiding victimization and taxpayer costs.

Re-entry program example

The first step in calculating the benefits of a program is to estimate if the program is effective at reducing recidivism. This can be done by conducting an evaluation of the program or using a meta-analysis. In 2011, the CJC did an outcome evaluation of re-entry programs and found that they reduced recidivism by 27 percent. This means that if 50 percent of offenders recidivate without a re-entry program, the recidivism rate would be expected to drop to 37 percent for offenders who enter a re-entry program.

The next step is to examine the recidivism patterns of offenders who are similar to re-entry program participants. The felony crimes committed by these offenders are put into six categories, four person crimes, property crimes, and other crimes. It is assumed that each of these crime types is reduced by 27 percent. This provides an estimate of how many felony convictions are expected to be avoided because of the re-entry program. Table 1 estimates that for every re-entry program participants 0.36 felony convictions are avoided.

The next step is to estimate the dollar value of those avoided felony convictions to taxpayers and victims. Using the methodology described above the avoided felony convictions provide a benefit to taxpayers of \$8,631 and avoided costs to victims of \$14,388 for a total benefit of \$23,019.

¹⁵ For example r could represent an arrests and o could be an assault.

¹⁶ All costs are converted to 2008 dollars using the consumer price index.

¹⁷ Three percent is a standard discount rate for most cost-benefit analysis.

The final step is to estimate the cost of a re-entry program. Using budget data from the amount spent on re-entry programs and the number of participants the estimated costs of the program was \$3,419 per participant. Dividing the benefit by the costs gives a benefit-cost ratio of \$6.73. This means that for every dollar invested in re-entry programs \$6.73 is avoided in taxpayer and victimization costs. Breaking this down further shows that for every dollar invested in re-entry programs \$2.52 is avoided in taxpayer costs and \$4.21 is avoided in victimization costs.

This same type of analysis can be done for any program that has an estimated cost and effect size. This analysis, although not described in this report, has been done for juvenile and prevention programs as well. The same methodology described above can be used for any program that has a known cost and know crime reduction.