Cost-Benefit Methodology

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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 a cost-benefit analysis 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 571 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 the effect sizes depending on the research methodology. For example if a research study does not have random assignment the effect sizes are discounted by 25 or 50 percent, depending on the methodology used.[2]

In their meta-analysis WSIPP categorized these studies into more than 50 types of programs 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.

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[1] S. Aos, M. Miller, E. Drake, *Evidence-Based Public Policy Options to Reduce Future Prison Construction, Criminal Justice Costs and Crime Rates,* (Olympia: Washington State Institute of Public Policy, 2006).

[2] For example, if a rigorous quasi-experimental design is used and the study showed a 10 percent effect size, WSIPP would discount that effect size to 7.5 percent.

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 how the effect diminishes over time.

For this analysis recidivism was estimated for 10 years following the program. This was done by examining recidivism patterns of those released from prison and those on probation in 1997. Due to data constraints only felonies were measured over this 10 year period. It was also assumed that the programs were less effective over time, with a decay rate of 2.5 percent. This means that if a program is initially 10 percent effective in year one, the effectiveness would decrease to 9.75 percent in year two. The effect size is multiplied by the actual recidivism of similar offenders to estimate the number of crimes avoided.

Avoided Felony Convictions from Drug Courts (100 Participants)									
Crime Change	Year	Crime Type							All
		Homicide	Sex	Robbery	Assault	Property	Drug	Other	
-11.7%	1	0.00	0.02	0.07	0.05	0.63	1.03	0.33	2.13
-11.4%	2	0.00	0.03	0.03	0.03	0.34	0.66	0.29	1.39
-11.1%	3	0.01	0.01	0.02	0.05	0.25	0.55	0.19	1.08
-10.8%	4	0.00	0.01	0.02	0.04	0.21	0.49	0.12	0.88
-10.6%	5	0.00	0.01	0.01	0.03	0.22	0.36	0.10	0.73
-10.3%	6	0.00	0.01	0.02	0.03	0.16	0.33	0.07	0.62
-10.1%	7	0.00	0.01	0.01	0.03	0.16	0.27	0.07	0.55
-9.8%	8	0.00	0.01	0.01	0.03	0.13	0.29	0.07	0.54
-9.6%	9	0.00	0.01	0.02	0.02	0.13	0.27	0.07	0.52
-9.3%	10	0.00	0.00	0.02	0.02	0.11	0.18	0.07	0.41
	All	0.01	0.13	0.22	0.33	2.34	4.43	1.37	8.83

Table 1

Table 1 shows an example of using the effect size from the meta-analysis and estimating the avoided felonies from 100 drug court participants. Table 1 is estimated by looking at the recidivism patterns of similar offenders. In Oregon, most drug court participants would be on probation for a drug or property crime if they were not in drug court. The recidivism numbers used are for drug and property offenders who were on probation in 1997.[3] It is assumed that drug courts are equally effective at reducing all crime types. So table 1 estimates that for every 100 offenders who participate in drug courts there are 8.8 felony convictions avoided over a 10 year period. Most of the convictions are for drug, property and other crimes, but there is a non-zero probability that 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 not consistently report back to the state agency on what specific programs were funded with that money.

[3] If the avoided convictions from sex-offender treatment in prison were estimated the recidivism table would be of sex-offenders released from prison in 1997. The conviction distribution will vary depending on what offender population is evaluated.

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 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 tax payer 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 seven broad crime types to capture these differences.[6]

Taxpayer and Victimization Costs of Crime in 2008 Inflation Adjusted Dollars

	Taxpayer Costs						
	Homicide	Rape	Robbery	Aggravated Assault	Property	Drug	Other
Arrest (per arrest)	$35,937	$7,310	$7,310	$7,310	$6,098	$6,098	$6,098
Conviction (per conviction)	$174,861	$7,772	$2,081	$2,081	$2,081	$2,081	$2,081
Probation (annual cost)	$2,895	$2,895	$2,895	$2,895	$2,895	$2,895	$2,895
Post-Prison Supervision (annual cost)	$3,301	$3,301	$3,301	$3,301	$3,301	$3,301	$3,301
Dept. of Corrections (annual cost)	$28,433	$28,433	$28,433	$28,433	$28,433	$28,433	$28,433
Jail (annual cost)	$41,331	$41,331	$41,331	$41,331	$41,331	$41,331	$41,331
	Victimization Costs						
Out of Pocket (per victimization)	$1,528,962	$7,571	$3,414	$2,301	$1,839	n/a	n/a
Quality of Life (per victimization)	$2,835,260	$120,833	$8,461	$11,579	$207	n/a	n/a

Table 2

Cost of an arrest

The cost of an arrest is estimated by the 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 from 1994 to 2003. 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 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

[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).

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 2007, Washington had the lowest number of police officers per 1,000 population of any state, Oregon 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 both state's property crime rates well above the national average. 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. These explanatory variables seem to capture the work performed by the courts. 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 the 2001 to 2003 and 2003 to 2005 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 the cost of a conviction for Washington was used.

Cost of incarceration
The cost used for incarceration is calculated from budget data obtained from DOC staff. The DOC budget for direct care costs for the 2007 to 2009 biennium was divided by the average daily population to compute an average cost per day. The cost of probation and post-prison supervision was also obtained from staff at DOC and is an average cost per day for the 2007 to 2009 biennium.

Cost of local jail
The cost of jail was obtained from the *OSSA Survey of SB 1145 Costs for FY 2005*. All 33 jails in Oregon received a survey asking for the total costs and the average daily population. Out of the 33 jails, 27 responded. Of the 27 jails that responded their total expenditures were added up and then divided by their average daily population to calculate an average 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.[10]

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[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.
[10] T. Miller, M. Cohen, and B. Wiersema, *Victim Costs and Consequences: A New Look,* Research Report, Washington DC: National Institute of Justice, 1996.

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.[12] 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 0.07 multiplied by the cost of an arrest, plus 0.04 multiplied by the cost of a conviction, plus 0.04 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

	2004 Offenses	2004 Arrests	% of Reported Crime	Estimated Crime	Prob of Arrest	Estimated Convictions	Prob of Conviction
Homicide	99	132	100%	99	133%	94	94%
Rape/Other Sex	7,611	1,974	36%	21,260	9%	1,471	7%
Robbery	2,802	1,433	61%	4,586	31%	633	14%
Aggravated Assault	6,665	3,372	64%	10,382	32%	2,468	24%
Property Subtotal	169,470	32,867	38%	451,249	7%	18,825	4%
Burglary	30,501	3,977	53%	57,549	7%	n/a	n/a
Larceny	119,903	25,614	32%	371,217	7%	n/a	n/a
Auto Theft	19,066	3,276	85%	22,483	15%	n/a	n/a

Table 3[11]

Felony Sentences 2006-2007

	Sentence Type			Prison			Local Control			Probation
Crime	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	90%	0%	10%	247.6	26.1	9.1	3.3	n/a	1.8	14.3
Rape, Sex Off	63%	2%	35%	86.1	23.6	2.8	3.8	23.6	2.9	22.4
Robbery	58%	5%	36%	62.8	21.8	3.0	3.1	21.8	1.3	18.7
Assault	33%	3%	64%	41.4	23.1	2.7	3.0	23.1	1.3	25.4
Property	30%	5%	65%	21.7	17.2	1.1	2.8	17.2	1.1	19.3
Drugs	7%	11%	82%	19.0	23.8	1.4	2.4	23.8	0.6	18.9
Other	23%	14%	64%	27.4	22.6	1.7	3.0	22.6	0.9	19.9

Table 4

[11] The probability of an arrest for murder is greater than one because many murders are committed by conspiring offenders with a single victim.

[12] 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 percent of felony offenders go to prison, local jails or probation and how long they are at each.[13] Using the data in tables 2 to 4 total cost avoidance for each avoided felony conviction can be estimated.

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 $107,705 in costs and victims would avoid $48,930 in costs.

Taxpayer and Victimization Costs of one Felony Conviction in 2008 Inflation Adjusted Dollars

	Taxpayer Costs						
	Homicide	Rape	Robbery	Aggravated Assault	Property	Drug	Other
Arrest	$50,735	$9,807	$16,540	$9,989	$10,647	$15,020	$10,647
Conviction	$174,861	$7,772	$2,081	$2,081	$2,081	$2,081	$2,081
Probation	$633	$2,870	$2,678	$5,647	$4,843	$6,840	$5,451
Post-Prison Supervision	$5,346	$4,154	$4,376	$3,286	$2,871	$1,786	$5,215
Dept. of Corrections	$377,217	$110,599	$75,408	$28,258	$13,981	$2,905	$13,115
Jail	$28,207	$6,269	$6,622	$3,416	$1,681	$1,216	$2,811
Total Taxpayer	$636,998	$141,471	$107,705	$52,676	$36,105	$29,847	$39,320
	Victimization Costs						
Out of Pocket	$1,573,931	$58,478	$14,067	$5,990	$22,962	n/a	n/a
Quality of Life	$2,918,650	$933,349	$34,863	$30,143	$2,588	n/a	n/a
Total Tax and Victim	$5,129,579	$1,133,298	$156,635	$88,810	$61,655	$29,847	$39,320

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.

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 be 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 an assault I conviction 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.

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

[13] Different felony sentencing tables are used depending on the program being estimated. Probationers sentencing distribution will be different than those released from prison. For example a cognitive program in prison will likely have greater benefit from avoiding a conviction since they will be more likely to go to prison and for a longer length of stay than a probationer who is convicted of a felony.

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*.[14]

Ben_{ro} is the benefit or avoided cost for resource *r* for offense *o* measured in 2008 inflation adjusted dollars.[15]

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.[16]

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 cost-benefit estimate. This estimates the return of investing one dollar in a program in terms of benefits of avoiding victimization and taxpayer costs.

Drug court 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 and evaluation of the program or using a meta-analysis. For this example we will assume that drug courts are 12 percent effective at reducing recidivism. This means that if 50 percent of offenders recidivate without a drug court, the recidivism rate would be expected to drop to 44 percent for drug court participants.

The next step is to examine the recidivism patterns of offenders who are similar to drug court participants. The felony crimes committed by these offenders is put into seven categories, four person crimes, property crimes, drug crimes and other crimes. It is assumed that each of these crime types is reduced by 12 percent. This provides an estimate of how many felony convictions are expected to be avoided because of the drug court. Table 1 estimates that for every 100 drug court participants almost nine 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 conviction provide a benefit to taxpayers of $353,000 and avoided costs to victims of $243,000 for a total benefit of $596,000.

The final step is to estimate the costs of drug courts. Using the work done by ECONorthwest the estimated costs of drug courts was $1,600 per participant or $160,000 for 100 participants. Dividing the benefit by the costs gives a benefit-cost ratio of $3.73. This means that for every dollar invested in drug courts $3.73 is avoided in taxpayer and victimization costs. Breaking this down further shows that for every dollar invested in drug courts $2.21 is avoided in taxpayer costs and $1.52 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.

[14] For example *r* could represent an arrests and *o* could be an assault.
[15] All costs are converted to 2008 dollars using the consumer price index.
[16] Three percent is a standard discount rate for most cost-benefit analysis.