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Social Return on Investment Analysis and Its Applicability to Community Preparedness Activities

Calculating Costs and Returns

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RESOURCES FOR THE FUTURE

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Abstract

Return on investment (ROI) analysis is a tool traditionally used in the private sector to evaluate and compare projects and investments. Over the past several decades, the use of ROI analysis has expanded to include a broader array of social and environmental benefits; this is termed social return on investment, or SROI. This paper examines the use of SROI analysis to examine investments in disaster preparedness. The paper outlines the basic methods and then discusses several challenges to using SROI in this context: the difficulty identifying all returns, especially spillover benefits; the challenge of separating attribution from contribution; the resources required to value nonmarket inputs and outcomes; the need to adequately address uncertainty; and the limitation of addressing distributional issues in SROI analysis.

Key Words: SROI, return on investment, preparedness

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Social Return on Investment Analysis and Its Applicability to Community Preparedness Activities: Calculating Costs and Returns

Carolyn Kousky, Brett Lingle, Liesel Ritchie, and Kathleen Tierney*

1. Introduction

Return on investment (ROI) is a tool traditionally used in the private sector to evaluate and compare projects and investments. Most simply, it is the net earnings from a project divided by project costs. Over the past several decades, the use of ROI analysis has expanded beyond standard business applications in the private sector to a range of public sector activities, such as policies and programs in conservation, poverty alleviation, health care, and education (e.g., Goldstein et al. 2008; Oriol et al. 2009; Stryckman et al. 2015). This expansion is driven in part by a desire to help make limited funds go further, an interest in identifying the biggest "bang for the buck," and pressure to demonstrate the benefits associated with investment decisions.

In the language of ROI, the returns are the monetized benefits of a project. For standard financial investments, returns are the earnings (net of costs). ROI is closely related to several other economic tools for comparing benefits and costs, such as cost-benefit analysis and cost-effectiveness analysis. In fact, all these approaches are essentially methods for systematically comparing the benefits and costs of a project; they differ in how the relationship between benefits and costs is reported. The expanding use of ROI analysis may be driven by the framework it provides for clearly comparing benefits and costs and assessing trade-offs. Essentially, ROI can be a disciplined form of priority setting and evaluation. ROI is generally used for one of three purposes:

1. to prioritize investments and allocate limited dollars ex ante;
2. to evaluate investments ex post; or
3. to reformulate investments to realize greater returns.

ROI can thus play a number of roles. It can help make decisions about where to invest limited dollars by identifying the project with greatest returns as a percentage of costs. It can be used to evaluate projects according to a profitability metric or to improve them to generate

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higher net returns. ROI presents information in one easy-to-understand metric; this is part of its appeal, but also, of course, this can prevent consideration of other important features of projects that are not inputs into the ROI calculation. ROI should thus be only one aspect of project evaluation and one consideration in decisionmaking. When broader social and environmental benefits are included, the analysis is often termed "social return on investment," or SROI. Several groups have worked to develop and standardize a SROI framework, including the Roberts Enterprise Development Fun and Social Value UK (formerly SROI Network) (e.g., Nicholls et al. 2012).

This paper provides an introduction and overview of the use of (S)ROI to evaluate investments in community preparedness. Preparedness generally refers to activities that improve readiness to respond to a disaster, and we focus here on community preparedness. This is a broad concept, and many activities can fall under its umbrella, but it is distinct from hazard mitigation, which typically involves specific investments undertaken to lower damages from an event. Although economic approaches such as cost-benefit analysis have been used to evaluate investments in bricks-and-mortar hazard mitigation, activities related to preparedness have only rarely been subjected to (S)ROI or other economic analyses. The paucity of analyses is due to several challenges: difficulty in identifying, quantifying, and monetizing all inputs and returns; challenges in considering outcomes that are reported in incommensurable metrics; limitations in separating contribution from attribution; hurdles in determining baselines; uncertainty over many benefits and costs; and lack of consideration of equity issues within most standard economic approaches.

This paper proceeds as follows. Section 2 provides an overview of ROI and SROI methods. The relationships among ROI and various other economic approaches and the reasons for choosing one over another are discussed in Section 3. In Section 4 we turn to the many challenges of using (S)ROI in a preparedness context. Section 5 concludes.

2. ROI Methodology

ROI is becoming increasingly popular for guiding investment decisions and garnering support for proposed activities. Funders have found it useful to have a tool that can be used to communicate and compare the benefits of their investments using a common metric. For example, when applied to conservation, it has been found that ROI-based planning can significantly change the location and targets of conservation investments and improve cost-effectiveness in the face of limited budgets (Boyd et al. 2015). This section reviews the standard

ROI methodology and then its expansion to address social programs, which could be a useful analog for considering ROI for investments in community preparedness.

2.1. Standard Approach

An ROI analysis typically has five steps:

1. Identify the investment, project, or policy being considered.
2. Identify the full range of costs and returns (benefits) from the project.
3. Quantify (and if possible, monetize) costs and returns.
4. Calculate the ROI metric, discounting future benefits or costs to present dollars.
5. Conduct a sensitivity analysis to determine the effects of any assumptions on outcomes.

Once the investment, project, or policy has been clearly defined, the costs and returns from this investment need to be identified. A private firm might use cash flow accounting to evaluate its investment and consider only its own costs and returns. Costs, for example, would be the sum of all the outlays the firm makes in relation to the project. Evaluation of public projects, however, should consider the full range of costs and benefits to society as a whole. In practice, this may be limited to a political jurisdiction, region, or country, but the scope of ROI analyses should be broad enough to include those who will pay the majority of the costs and receive the majority of the benefits. These could differ from private sector costs and returns because of externalities, or costs and benefits imposed on others.

It should be noted that when ROI is applied outside the standard financial context, identification of costs and returns may not be straightforward. It may be challenging to link a particular intervention or investment to outputs and outcomes. Effects may be uncertain, and multiple factors other than the costs that are measured may contribute to a given outcome, raising questions of relative contribution versus attribution. We return to these issues in the specific area of preparedness in Section 4.

The third step in the ROI process is quantifying and, when possible, monetizing costs and returns. For costs, the appropriate measure is the opportunity cost of the investment, which is the value of those resources in their next-best use. For goods that are sold in perfectly competitive markets, the opportunity cost is simply the price, and for labor, the opportunity cost of workers' time is their wage.[1] For benefits, intangible returns should also be included. In Section 4.3 we discuss the process of monetizing nonmarket returns—an important step in ROI because decisionmakers may otherwise focus only on those costs and benefits that are easy to quantify and/or monetize (Tanner and Rentschler 2015). It is standard to not include transfers of wealth because the benefits of these are offset by the costs on someone else. For example, a public subsidy to a group to carry out a particular activity is a benefit to that group but a cost to the taxpayers who pay for it. That said, wealth redistribution could be an explicit objective of policy, highlighting the need for consideration of multiple criteria in decisionmaking. Finally, especially with respect to preparedness, there are likely to be returns for which quantification or monetization may not be possible, particularly under budget and time constraints, and yet such returns still need to be included in a broader analysis.

Fourth, to calculate the ROI metric, the returns and costs must be discounted to present values. Costs and benefits are discounted to present dollars because future funds are not worth as much as money today. There are two reasons for this. The first is that $1 today can be invested to yield $1 plus interest in the future. The second is reason is uncertainty about the future, which leads people to have a preference for current funds over future funds. For a private firm, the correct discount rate to use would be the interest rate the firm could get on its investment in its next-best use. The appropriate rate for public sector investments, particularly those with long time frames, has been a matter of debate, and much has been written on how to determine the appropriate social discount rate. When benefits accrue long into the future, the effect of the choice of a discount rate can be extremely influential on the magnitude of benefits calculated. The Office of Management and Budget (OMB 1992) has suggested the use of a real discount rate of 7 percent because this rate approximates the marginal pretax rate of return on an average private sector investment. Interest rates are much lower at present. In 2015, for example, the US Army Corps of Engineers (2015) used a discount rate of 3.375 percent, and for fiscal year 2016 used a rate of 3.125 percent.[2] Some scholars have argued that for projects that will last generations, a very low or declining discount rate may be most appropriate.

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[1] In cases of monopoly or unemployment or externalities, the price or wage in the market may not equal the opportunity cost because one component of it may simply be rents. Transfers of wealth from one entity to another are not true costs from the point of view of society as a whole.

[2] This is the interest rate from the US Department of the Treasury for average market yields on interest-bearing marketable securities in the United States with 15 or more years until maturity.

If we consider a simple project with one stream of benefits and one stream of costs and denote the returns in year *t* as R_t, the costs in year *t* as C_t, and the discount rate as *i*, then the ROI can be calculated as follows:

$$ROI = \frac{\sum_{t=0}^{T} {R_t}/{(1+i)^t}}{\sum_{t=0}^{T} {C_t}/{(1+i)^t}}$$

Note that returns are simply benefits minus costs, or net benefits. So the ROI can be thought of as (B – C) / C. Multiplying this by 100 gives the ROI metric as a percentage. A ROI of 100 percent would mean that the returns were 100 percent greater than (or twice) the costs. If benefits were exactly equal to costs, the ROI would be zero; there would be no net return to the project. Projects that have costs greater than benefits would have a negative ROI. Firms sometimes compute the average annual ROI by dividing the total ROI by the number of years of the investment, but this may not be as relevant for public sector preparedness projects.

The final step in an ROI analysis is to do a sensitivity analysis on assumptions made. One parameter for a sensitivity analysis is the choice of the discount rate (OMB guidance also suggests this). For example, a benefit-cost study of Federal Emergency Management Agency (FEMA) hazard mitigation grants used a discount rate of 2 percent but checked interest rates ranging from 0 to 7 percent in a sensitivity analysis (Multihazard Mitigation Council 2005). If estimating costs or returns involved uncertainties, discussed more in Section 4.4, a sensitivity analysis should be done on those as well.

As can be seen from this basic overview of the steps involved in undertaking an ROI analysis, to the extent such analyses require substantial data collection and valuation studies, they can be expensive and time consuming. One estimate suggests that the cost of ROI may be 1 to 10 percent of the entire project budget (ROI Institute 2015). Because of this added expense, it may not be desirable to undertake ROI studies of all projects and decisions.

2.2. Social ROI

The term social return on investment (SROI) has emerged to refer to studies that draw on the ROI methodology but take a broader view of returns, incorporating social benefits beyond project earnings, as well as investments that have no quantifiable financial earnings, only harder-to-value social improvements.[3] SROI has developed its own language and a standardized approach, which was first promoted by the Roberts Enterprise Development Fund. More recently, Social Value UK has advanced the practice and developed guidance. As with standard ROI, an SROI approach can be used to evaluate investments ex ante or ex post. A review of SROI studies found that about 65 percent were retrospective and 30 percent prospective, with the rest being a mix (Krlev et al. 2013).

Social Value UK has identified six steps that constitute an SROI analysis (Nicholls et al. 2012):

1. Establish the scope of the study and identify relevant stakeholders.
2. Map outcomes.
3. Find outcome data and value outcomes.
4. Try to identify attribution and establish impact of the project against a counterfactual.
5. Calculate the SROI.
6. Report, use, and verify the SROI metric.

Some of these steps are comparable to the standard ROI approach. For example, both kinds of analyses must begin by clearly identifying the project or investment (study scope). SROI, however, takes explicit account of stakeholders—that is, groups involved with or affected by the project. Standard ROI is considered a technical calculation carried out by economists. In contrast, SROI envisions a role for stakeholders in identifying returns, establishing outcomes, and then using and verifying the SROI metric. Practitioners and proponents of SROI say the inclusion of stakeholders is necessary to identify outputs and outcomes and that the process of conducting an SROI and taking into account stakeholders' views can be as important as the actual calculation of the SROI metric (Moody and Littlepage 2013).

As discussed further in Sections 4.1 and 4.2, with preparedness investments, identifying the full range of returns, as well as the relationship between the intervention under consideration and specific outputs, can be challenging. The SROI approach helps by again drawing on the expertise of stakeholders. For instance, SROI analysis often begins with an "impact map," which

[3] In some cases, an approach similar to SROI takes a broad view of returns but is still just referred to as ROI. For instance, the general framework has been applied in the fields of conservation (Boyd et al. 2015) and public health (Frank and Nason 2009).

is similar to logic models in evaluation research and theory-of-change approaches (Nicholls et al. 2012). This helps link interventions to outputs, as we discuss in Section 4.2

The actual SROI metric is often closer to a benefit-cost ratio than to the more standard financial approach of calculating returns as net of costs. Social Value UK guidelines state that either of these can be calculated, referring to the traditional ROI calculation as the “net SROI ratio” and the benefit-to-cost ratio as the “SROI ratio” (Nicholls et al. 2012). To truly mimic standard ROI analysis, it is net benefits that should be the numerator of the ratio.

Both ROI and SROI then seek to quantify and value costs and returns. The same challenges of valuation discussed above (and in detail in Section 4.3) apply in an SROI context as well. Perhaps surprisingly, a review of SROI studies found that despite being the driver of SROI, social benefits are often treated simply as a “residual category,” demonstrating the challenge of including hard-to-monetize benefits in an ROI framework (Krlev et al. 2013). Like all ROI approaches, SROI is only as good as the data that are used, and often, available data are not sophisticated or comprehensive enough for quantification and monetization of all returns (Moody and Littlepage 2013). Again, proponents argue that even in these cases, the process of defining values, objectives, costs, and benefits can be important in and of itself (Reinhard et al. 2014). Whether the ultimate result can be equated to an ROI analysis, however, is perhaps debatable.

3. Relating (S)ROI to Other Economic Approaches

ROI is closely related to a range of economic approaches, all of which, in different forms, compare the benefits and costs of a project. Many different types of economic metrics based on benefits and costs can be calculated, such as the benefit-cost ratio, the internal rate of return, the net present value, or the return on investment. This section discusses benefit-cost analysis and cost-effectiveness analysis, comparing them with ROI. Various reporting metrics are identified and discussed. The value of all these economic approaches is their ability to identify systematically and include in decisionmaking the full set of benefits and costs of a decision and to clarify trade-offs; this requires transparency in the analysis (Risk to Resilience Study Team 2009).

3.1. Benefit-Cost Analysis

Benefit-cost analysis (BCA) is a well-established and accepted method of public investment analysis for comparing the benefits and costs of a project investment or policy intervention. The benefits and costs are monetized and discounted to present values, and the benefit-to-cost ratio is then calculated and compared. When the ratio exceeds 1, benefits are greater than the costs of the project. The idealized approach recognizes the full range of benefits and costs to society. A general decision rule is to maximize net benefits when formulating a project and choosing project scale. BCA is thus a tool to measure the total change in individual well-being from a policy intervention, measured by economists as a person's "willingness to pay" for the policy (Kopp et al. 1997). This is explained further in Section 4.3.

BCA is most appropriate either when the objective is to determine whether a single project is worth undertaking (usually when B>C), or when a decisionmaker is attempting to choose among a limited number of alternative projects (usually ranked by the B/C ratio). Note that once benefits and costs are monetized, many metrics can be calculated. BCA usually compares benefits divided by costs, or B/C. A ROI analysis calculates (B—C)/C. When all benefits and costs are discounted to present dollars, B—C is called the net present value. Other metrics sometimes used to evaluate investments are the internal rate of return, or the interest rate at which the net present value equals zero, and the payback period, which is the length of time before benefits equal costs.

ROI is usually used for projects that are akin to financial investments: some amount is being spent to generate a stream of future returns. BCA, on the other hand, is most frequently used to evaluate projects in which a clear outlay is spent to obtain a particular benefit. In the business community, ROI has sometimes been used to analyze only the financial returns from an investment, whereas broader analyses, in the spirit of SROI, are instead treated as BCA. In the end, the metrics are interpreted in slightly different ways and the semantics are different, but the general approach of needing to identify and value benefits (or returns) and report the result in relation to financial outlays is the same. Given the similarity between ROI and BCA, best practices from BCA should be applied to ROI analyses. Many agencies, both domestic and international, have provided such guidance (e.g., OMB 1992).

BCA, like other economic approaches, can be a useful framework for analysis, even when not all benefits and costs can be quantified or monetized, perhaps because of limited data availability. In this case, the BCA framework can be used to discuss benefits and costs of interventions and rank them; this was done, for example, in evaluating flood risk reduction measures in a country where data were scarce, using community consultation and engagement techniques to identify interventions, costs, and benefits (Risk to Resilience Study Team 2009).

Volumes have been written on BCA, including critiques of the approach. For a thorough accounting of these debates, the reader is referred to the many books and articles on the topic (e.g., Kelman 1981). One common concern with BCA is that it does not address equity; we discuss this issue in Section 4.5. Others argue that putting a monetary value on some variables, such as the environment or mortality risk, is morally inappropriate, and contend that policy goals involving rights that individuals possess, such as the right to breathe clean air, should not be subject to economic analysis. Finally, economists have debated whether and under what circumstances preference satisfaction and individual willingness-to-pay are measures of social well-being. These issues are beyond the scope of this paper but could apply to the types of ROI analyses on which this study focuses (see, e.g., Shabman and Stephenson 2000). Here, it is simply worth highlighting that BCA can be very a useful tool for assessing project outcomes and for choosing among alternative projects, even if it is not (or should not be) the exclusive criterion for decisionmaking.

Multiple BCAs of disaster risk reduction activities have been undertaken over the years. A recent paper reviewed many of these studies, finding (after excluding one high outlier) an average benefit-to-cost ratio of around 14 from the maximum ratios reported in the studies (Shreve and Kelman 2014). These studies have tended to focus on structural hazard mitigation measures, where the benefits are avoided damages. FEMA requires BCAs for hazard mitigation projects that are awarded grant dollars. To assist local governments in these calculations, FEMA has developed software for mitigation-related BCAs, as well as outreach materials. Benefits are largely the estimated reduction in losses or the prevention of future damages. The Corps of Engineers also requires BCAs for flood hazard reduction projects and has developed its own guidance and specific approach to estimating project benefits. The Multihazard Mitigation Council (2005) undertook a now well-known study to estimate the benefits and costs of FEMA mitigation grants targeted at earthquakes, flooding, and wind events between 1993 and 2005. The study found they were cost-effective and, on average across them all, had a benefit-to-cost ratio of 4:1. However, as that report notes, compared with mitigation projects, the costs and benefits of preparedness activities are much more difficult to calculate.

3.2. Cost-Effectiveness Analysis

Cost-effectiveness analysis (CEA) is distinct from BCA and ROI in that it does not monetize benefits. CEA is used when a clear benefit or target is desired, and the analysis evaluates the least expensive way to achieve it. CEA is thus useful when there is one quantifiable benefit, several policy options, and limited resources. It is also used when the benefit of a policy is hard to monetize but can be measured in other ways. In this case, a cost-effectiveness ratio can be calculated that compares costs to some measure of benefits. For example, when used by a conservation group, the benefits might be acres of land conserved; in a health setting they might be the number of illnesses avoided. The CEA analyst then calculates the number of acres conserved or illnesses avoided per dollar spent across different projects. CEA is most useful as an ex ante analysis to decide among different investments or policy options. It gives the decisionmaker an ability to identify those interventions that have the biggest "bang for the buck."

4. Challenges in Using (S)ROI to Assess Preparedness Activities

As stated, economic approaches have long been used to evaluate investments in hazard mitigation when the benefits, or returns, of a project are measured in monetary terms as future avoided damages. More recently, the value of lives saved, using value of a statistical life measures (see below) has sometimes been reported as well. Community preparedness activities have been less frequently subjected to such economic analysis, perhaps because of the greater challenges in doing so. To begin with, community preparedness activities can be less discrete and their scope harder to define: instead of a one-time investment (perhaps with predictable future operating and maintenance costs), community preparedness activities may be ongoing and evolving. A FEMA textbook defines preparedness as "preimpact activities that establish a state of readiness to respond to extreme events" (Lindell et al. 2006, p.244). Preparedness activities can include risk identification and mapping, education and outreach, training, planning, and equipping functions.

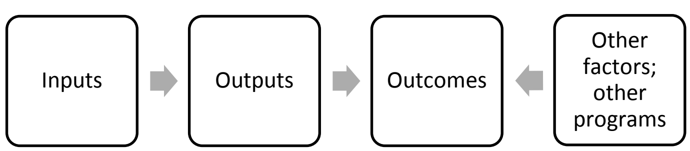
As we discuss in this section, it can be difficult to judge the results of such activities, particularly in the absence of an actual disaster event. Many of the outcomes that community preparedness activities seek to influence, such as the development of community-based planning and response networks, are influenced by so many factors it can be difficult to tease out for analysis the role of a specific preparedness initiative. Some of the benefits of preparedness, such as increased feelings of safety, are also challenging to quantify or value in monetary terms. It is likely that preparedness efforts will produce cobenefits in addition to those that are disaster related. For example, a preparedness network developed for disasters may branch out into other areas, such as crime awareness or environmental protection. Here again, such cobenefits may be difficult to capture and quantify. Finally, any estimates may be uncertain. And economic approaches do not explicitly address equity, yet distributional concerns can be critical to community preparedness. For example, vulnerable populations may need special attention or support to enhance their preparedness capabilities, over and above what other community residents may receive. Thus, some type of multicriteria decision analysis may be most appropriate (e.g, Keeney and Raiffa 1993).

4.1. Identifying Returns

For many preparedness activities, identifying the full range of specific returns to a project or policy can be challenging. For a standard ROI analysis of hazard mitigation projects, expected avoided damages and lives saved are typically the returns, and these can be (and have been) valued using standard approaches. As discussed next, the contribution of preparedness activities to these standard benefits can be hard to isolate and evaluate. In addition, as noted earlier, community preparedness activities such as information provision, training, and community engagement can produce cobenefits, including indirect or spillover benefits. Note that the returns are not outputs of a project, such as number of people who attend a community preparedness meeting, but the things of value that result from that meeting. These outcomes could be wide ranging, depending on the project, but include things such as reduced anxiety, faster recovery, or returns unrelated to disasters, such as networking that facilitates performance during noncrisis situations.

To identify potential returns ex ante, ROI analysis could draw on methods from evaluation research, particularly the use of logic models. A logic model is a visual representation of the relationships in a system—for example, a program or initiative. It maps the inputs to the activities that are undertaken and the changes that are expected to result from those activities. Development of a logic model serves a purpose by identifying the goals of a project or program, as well as the intended benefits and potentially unintended consequences. As shown in Figure 1, a basic logic model identifies inputs, or the resources used to accomplish the program, as well as the outputs, which are the activities that are accomplished, and the outcomes, or the “so what”—the benefits of the intervention. Outcomes are typically influenced by many other factors in addition to the inputs, as discussed next.

Figure 1. Stylized Logic Model



Using a logic model can form the basis of a ROI analysis. The “inputs” in a logic model, which are valued, are the “costs” in an ROI framework. The “returns” for ROI analysis will be in some way related to the “outcomes.” For instance, a return may be a direct outcome, the part of the outcome that is attributable only to the intervention, or an input into a return. A logic model also identifies the assumptions underlying the project, as well as other factors that may influence outcomes, which can be useful for isolating the returns directly attributable to the project, program, or initiative under study. As with SROI approaches, stakeholder feedback is important in the development of logic models.

A distinction needs to be made here between ex ante and ex post analysis. When evaluating an investment after the fact, it may be easier to identify the full suite of outcomes, particularly cobenefits, as well as unexpected costs. Ahead of time, however, it can be very difficult to predict what outcomes and costs will materialize from an intervention beyond the primary purpose governing the project. For example, in one study, after collaborations among health care organizations for disaster preparedness were established, representatives from those groups were able to identify that those collaborations had yielded additional benefits, such as improving operations in nonemergency settings (Priest and Stryckman 2015). It was only after the project had been completed that researchers were able to interview stakeholders and use a content analysis of those interviews to identify cobenefits—additional returns—from the project.

4.2. Baselines and Contribution versus Attribution

Once all outcomes have been identified, it is necessary to isolate what portion of them can be attributed to the preparedness measure being evaluated and which may be the result of other processes. For ROI analyses to be valid, it is important to determine that outcomes are the result of programmatic activities and not produced by factors independent of the intervention in question. That is, a causal link between the activity and the return is needed. How this can best be accomplished varies, depending on whether an ex ante or ex post ROI analysis is desired.

For ex ante analysis, this can be best accomplished by linking ROI to a theory-of-change or logic model, as is discussed in the preceding section. In developing such a model, close attention must be paid to establishing a baseline, or a projection of outcomes in the absence of the intervention to compare with outcomes in the presence of the intervention. No matter which of the many different approaches is used to develop a plausible baseline, all assumptions should be stated clearly. For example, one common approach is to use historical data on impact metrics to project their “without intervention” values. When data are not available, expert opinion may be used to construct a baseline. Context, thresholds, and antecedent conditions are all important to consider.

For an ex post analysis, various methods can help attribute a particular outcome to a specific investment. The old adage that correlation is not causation guides these studies. The gold standard for attributing an outcome to a specific input is a randomized control trial. In many cases, however, the use of such methods is not possible. Quasi-experimental methods can be a useful second-best approach. These are research designs that exploit variations in policies or programs that can plausibly be presumed to be akin to random assignment (perhaps conditional on some observable variables). These approaches compare an entity experiencing the intervention—the treatment group—with a control entity that did not but that is otherwise similar. For instance, perhaps a policy was adopted in one community but not in another that is similar in many respects. Or perhaps the time at which a policy was adopted is plausibly random such that outcomes before and after can be compared. When quasi-experimental methods are not workable, a range of econometric and statistical approaches can be employed in an effort to isolate effects. When no quantitative options are viable, obtaining information from stakeholders can help to identify benefits attributable to a program. This may be especially important for complex systems in which it can be very difficult to isolate effects (Krlev et al. 2013).

The Multihazard Mitigation Council study on the costs and benefits of hazard mitigation struggled with this issue of attribution when it came to process grants—specifically those associated with FEMA’s Project Impact. The study attempted to link a process grant to “subsequent action” and concluded that the “best way to determine the change in the probability [that mitigation will occur] might be to survey decision makers who are responsible for implementing mitigation actions” (Multihazard Mitigation Council 2005, p.42). This approach may be best for many preparedness and engagement activities aimed at improving community resilience. Note, though, that many of these efforts are not just about changing the probability of mitigation, but also about building trust and social capital or improving understanding even absent behavioral change. These projects are especially hard to document and value, as discussed next.

4.3. Valuation

Although the framework of ROI and other economic approaches has been used in cases in which full quantification and then monetization is not possible, converting all benefits and costs into a common, quantified denominator, usually dollars, is an aspiration of the particular approach. This section first discusses the standard approaches for estimating avoided damages, the primary benefit from disaster risk reduction that has been quantified to date, and then turns to discussing how methods of nonmarket valuation can be applied to monetize benefits that are not priced and traded in markets. The last subsection discusses alternatives to valuation when these methods are not deemed appropriate or feasible.

First, however, it is worth emphasizing the difference between quantification and monetization. Many outcomes can be quantified, such as number of people trained or degree of protection provided by a levee, but these are not the ultimate benefits that should be monetized for inclusion in economic analyses. Only the ultimate benefits that people value should be monetized. This issue has been discussed in research on the ROI from conservation investments (Boyd and Krupnick 2009). In hazard mitigation, it may not be the level of levee protection or wetland acres preserved, both of which are quantifiable, that are directly valued, but reduced flooding and flood-related losses. To get monetary valuation estimates from the methods discussed in Section 4.3.2, below, it is necessary to focus on the endpoints—here, lowered exposure to flood risk—and not the inputs that produce that result.

4.3.1. Estimating Avoided Damages

Multiple economic analyses have estimated avoided damages as the primary benefit of a project. This includes all BCAs for FEMA mitigation grants as well as Corps of Engineers hazard and exposure reduction projects. Most BCAs of hazard mitigation measures use loss modeling to estimate damages with and without a mitigation measure in place; the difference, or avoided damages, is the benefit. FEMA HAZUS software, for example, can be used for this purpose. This approach was employed in the Multihazard Mitigation Council study for estimating avoided damages, and the study team then used benefit transfer (a technique discussed in Section 4.3.2) for benefits for which it could not estimate values through the model. More sophisticated models are used by catastrophe modeling firms and in some academic research (see Grossi and Kunreuther 2005).

All these models generally have three modules: the hazard module (such as flood depths of various return frequencies); the exposure module, which is usually information on the capital stock or population at risk; and a vulnerability module that relates the hazard to damage (such as earthquake fragility and flood depth-damage curves) or life loss at each exposure unit. The results are then combined to calculate the expected loss. The models can be used to estimate the benefits of mitigation measures by calculating the expected damages with and without those measures. All models are probabilistic and are often used to calculate summary measures, such as annual average loss or exceedence probability curves, which give the probability that losses of a certain amount would be exceeded. Of course, all models are only as good as their components, and often there is considerable uncertainty in multiple relationships being modeled, part of which is attributable to inadequacies in disaster damage databases.

Avoided damages can be estimated for certain preparedness activities that are expected to result in behavioral changes that lower losses. This often necessitates making hard-to-justify assumptions about the extent to which a particular preparedness measure would translate into such actions. For example, in estimating avoided damages associated with improved early warning, assumptions must be made about how much the warnings will reduce losses; sensitivity analyses can help provide plausible bounds (Pappenberger et al. 2015).

4.3.2. Nonmarket Valuation

Preparedness measures may not just be inputs into reducing negative disaster impacts but also can produce a range of other benefits. These could include such outcomes as reduced feelings of anxiety or heightened perceptions of safety; faster recovery times; reductions in intangible disaster costs, such as loss of personal heirlooms; reduced trauma; reduced damage to the environment; better post-disaster health and mental health outcomes; improved community cohesion; improved sheltering and provision of temporary housing; and better communication among community members that creates spillover benefits in other domains. There could also be nonmarket inputs, such as volunteer time. How to value volunteers' time might take into account whether volunteering is replacing remunerative work or leisure and the benefits people may obtain from volunteering (Arvidson et al. 2013). For benefits and inputs like these that are not priced in a market, economists have devised many methods for monetization, collectively referred to as nonmarket valuation (e.g., Freeman 2003). The purpose of these approaches is to put all benefits in a common metric—dollars—allowing them to be aggregated and compared. Indeed, this is usually the motivation for undertaking a ROI or other economic analysis to begin with, as opposed to using other evaluation approaches and decision criteria.

These methods are designed to estimate people's willingness-to-pay (WTP), which is the amount they would pay to be equally happy with the policy or program as without. Over the years, critics have raised questions about whether WTP captures well-being, whether individual welfare can be simply summed across people to arrive at some measure of overall social welfare, and whether valuation tools truly capture WTP. Of necessity, we put aside these questions here, but they remain important.

The two standard approaches for estimating WTP are revealed preference and stated preference. Revealed preference approaches infer WTP based on choices people make in other markets, whereas stated preference approaches try to use well-designed surveys to elicit WTP directly from individuals or groups. Hedonic analysis, one of many revealed preference methods, is based on observed choices for multi-attribute goods, such as homes. Statistical methods are used to isolate the contribution of different characteristics to the overall price, such as the number of bedrooms or proximity of the home to open space. For example, hedonic studies have quantified the lesser amount by which flood-prone properties sell on average (see, e.g., Carbone et al. 2006; Bin et al. 2008; Kousky 2010; Bin and Landry 2013). Another revealed preference technique, referred to as the travel cost method, estimates how much people spend to visit a site, such as a national park, as a measure of how much they value having the park. This approach includes valuing people’s time as well as direct expenditures on gas, airfare, and other costs associated with that activity.

The most common stated preference method is contingent valuation (CV), which is often used by environmental economists to estimate the value people place on environmental goods and services that are otherwise extremely difficult to monetize, such as the value people get from knowing that a species exists (Portney 1994). CV often employs survey research methods, and over the decades a rigorous approach to CV has been developed to improve such surveys. For example, the way questions are asked, the order in which they are presented, the background information provided, and the broader context can all influence how people respond to survey questions. In addition, because people often say one thing in surveys and do another, survey responses may not truly reflect the choices people would actually make. Studies have been carefully designed to minimize these and other potential problems and to minimize bias in responses.

Developing original valuation studies of any type, however, can be very costly and time consuming. To avoid the costs of launching new studies, analysts sometimes employ an approach called benefit transfer. This technique is used to estimate benefits in one situation by adapting or “plugging in” an estimate of benefits from another that is thought to be analogous. When this method is used, it is best practice to pick a study that has been undertaken of a similar kind of policy, in a similar location, and/or with a similar study population. When cases are not similar, an approach called value function transfer is sometimes used (Ready and Narud 2005). This approach uses a type of meta-analysis to link values to characteristics of the site or population studied. Once these relationships are established, they can be used to estimate values for different contexts. Of course, meta-analysis cannot be used unless many studies of a particular type of benefit have been undertaken.

Benefits transfer can introduce large errors because of its extensive use of assumptions, but it may be the only approach for monetization if resources are insufficient to carry out an original study. Still, great care should be taken in applying numbers from studies on one topic or in one arena to another. For instance, the Multihazard Mitigation Council report for process grants did not have access to studies on process-related community-based activities, and so it reported estimates from other domains. This approach did yield estimates of benefits, but raises questions. The council used estimates of the value of radon testing and communicating landfill risk to estimate benefits for providing disaster warnings, yet the benefits in each of these cases could be quite different, raising questions about whether the study's results are at all meaningful (Multihazard Mitigation Council 2005).

FEMA has gone one step further with benefit transfer for the environmental benefits of open space by simply specifying a unit value for green space benefits to be used in its mandated BCAs. Since conducting individual nonmarket valuation studies for the value of open space preservation can be costly and time consuming, FEMA has developed guidance for the inclusion of these environmental benefits in benefit-cost analyses undertaken for using mitigation grants for property acquisition ("buy-outs"). As stated in FEMA Mitigation Policy FP-108-024-01, for projects with benefit-cost ratios of 0.75 or greater using traditional benefits (e.g., avoided damages), FEMA's BCA Toolkit automatically includes environmental benefits based on the size of the property. The policy states that total environmental benefits from open space are $7,853 per acre per year; for riparian lands, the benefits are $37,493 per acre per year (the greater value for riparian lands is due to greater recreational and erosion control values, among other things). FEMA does not attempt to adjust the numbers based on aspects of the specific property, its location, or the surrounding population. This makes such estimates unreliable, and the values calculated cannot reflect the "true" value of open space in any particular setting.

To apply ROI or BCA to preparedness activities that reduce fatality risk from disasters, a value for the improvements in mortality probabilities is needed. The value of any individual life is clearly infinite; people would pay all they have available to save their own lives or those of loved ones. This is not what economists attempt to value. Rather, they seek to value the benefit of small reductions in the probability of mortality. This is called the value per statistical life (VSL), which can be thought of as the amount someone would pay to reduce mortality risk. Like other nonmarket benefits, VSL is estimated through either revealed preference or stated preference approaches (Robinson 2007). A common revealed preference method is to compare wages across jobs with different mortality risks. These studies seek to measure how much more people need to be compensated to take a riskier job. Another technique is to look at how much people pay for products that increase safety. Air bags, smoke detectors, and other products all reduce the probability of death from various causes, and economists examine how much people are willing to pay for these. Estimates are then used to compute an implicit average value per life saved.

Federal agencies regularly use VSL estimates in program evaluation. The US Office of Management and Budget notes that most studies of VSL range from $1 million to $10 million (OMB 1992); federal agencies tend to use values within this range. For example, the Environmental Protection Agency recommends using a VSL of $7.4 million (2006 USD) in all cost-benefit analyses of new environmental policies.[4] The Food and Drug Administration uses a $5 million VSL estimate, and the Department of Transportation uses $3 million. Behavioral research has shown that people do not treat all mortality risks the same—the context may matter for someone's WTP for a reduction in mortality risk. It may thus be prudent to use VSL estimates from studies closely related to the subject of the ROI analysis—in this case, community preparedness. Because appropriate data may not be available or can be costly and time consuming to acquire, a benefits transfer approach is almost always used for VSL, with an average consensus value being used within specific agencies, as previously noted. VSL estimates can also vary by the income and age of individuals, but any such adjustments are highly controversial on both technical and ethical grounds.

4.3.3. Alternatives to Nonmarket Valuation

As seen from the discussion above, sometimes valuation may be neither feasible nor desirable. Funds may not be available to do original valuation research, and related studies to use in benefits transfer analyses may be scarce. Some benefits are inherently challenging to value, even with well-developed nonmarket valuation techniques. And sometimes stakeholders simply prefer not to value some benefits. For example, a stakeholder may be opposed to valuation because the mere act of assigning a monetary benefit to some outcomes could cause those outcomes to decline in value. Valuation can conflict with the idea that individuals or groups have a right to certain benefits, and valuation methods may be subject to technical error or unacceptable levels of uncertainty (Kelman 1981).

[4] "Frequently Asked Questions on Mortality Risk Reduction," US Environmental Protection Agency, last updated January 21, 2016, http://yosemite.epa.gov/EE%5Cepa%5Ceed.nsf/webpages/MortalityRiskValuation.html.

Furthermore, the traditional use of an ROI approach gives a single metric, perhaps suggesting a degree of objectivity that is not supported by the underlying data and methods. When assumptions are questionable or not transparent and made merely in the interest of getting to a valuation estimate, study outcomes can become controversial. For instance, a Department of Energy study on the benefits and costs of weatherization became politicized and debated when it was found that some assumptions were implausible and if changed would have altered the results of the analysis (Porter 2015).

Several alternatives to complete and full monetization exist. Some studies quantify benefits but do not monetize them. For instance, one ROI study of habitat restoration calculated the number of bird and plant species per dollar spent on restoration and treated this as the ROI ratio (Goldstein et al. 2008). Another approach when benefits or costs are not quantifiable is to estimate how large they would need to be to reverse the outcome of the economic analysis and see whether that value is plausible. Finally, it is possible to combine qualitative and quantitative approaches. For example, one study started with a shared learning exercise to identify potential risks, quantified what was possible, and then qualitatively discussed issues where quantification was not feasible (Risk to Resilience Study Team 2009). As often stated by practitioners of SROI, it is worth recognizing that simply identifying the returns—even if not monetized—can be an important contribution of ROI thinking.

4.4. Dealing with Uncertainty

Any economic study has uncertainties, which can arise from a number of factors, including limited data availability or an incomplete understanding of relationships among variables. To the extent possible, uncertainties should be explicitly examined and reported, not ignored. Transparency allows users to make their own judgments about the results of the study. In the disaster setting, all estimates should be probabilistic and should be expressed in expected value or distributional terms. As discussed earlier, this requires assuming a probability distribution for disaster occurrence, which can be based on historical data and/or modeling. When necessary, expert judgment can be used to elicit subjective probability distributions (Cooke 1991). For each uncertain parameter, sensitivity analysis can be done, including analyses that vary the discount rate, the life of an investment, or particular aspects of benefits and costs. For multiple uncertain parameters, a Monte Carlo approach can be taken; any dependencies among the uncertain parameters should be considered and accounted for in the analysis.

4.5. Equity

Economic approaches generally do not address distributional issues within the evaluation framework; these effects must be considered separately. The purpose of evaluation methods such as BCA and ROI is to determine whether a particular policy or project will make society as a whole better off. In evaluating policy from a societal perspective, costs and benefits are summed across individuals and groups without regard to differences in income, race, age, or any other distinguishing characteristics. However, the question of which groups within a society are bearing the costs and which are reaping the benefits of a given policy is relevant to most social decisions and may determine whether a policy is ethically or politically acceptable. Many community preparedness activities, for example, may be explicitly targeted at underserved or at-risk populations when aiding these groups is deemed a critical part of building resilience. In addition, estimates of economic benefits can have equity implications. Benefits are often estimated as an individual's willingness-to-pay, but this can be problematic, since willingness-to-pay can be closely tied to ability-to-pay; it is thus a metric that can favor the affluent. Economic approaches should therefore be used in conjunction with other decisionmaking criteria related to distributional effects.

5. Conclusion

Economic analyses such as (S)ROI have a number of appealing characteristics. ROI analysis produces an easy-to-interpret metric that can be used to prioritize investments and allocate limited funds, to evaluate investments that have already been made, and to improve projects to generate greater returns. Increasingly, ROI is becoming a useful framework to communicate about project and investment decisions and garner support for programs.

Despite the many economic analyses of hazard mitigation investments, few studies have attempted to quantify or value the benefits of community preparedness measures—especially those that occur over long periods and involve a wide range of organizations, populations, or approaches. This paper identified some of the many challenges that could hinder greater adoption of (S)ROI studies of preparedness: the difficulty of identifying all inputs and returns; the uncertainty surrounding baselines; the need to separate attribution from contribution; the time and cost of conducting original nonmarket valuation studies; the uncertainty surrounding estimates; and the lack of an explicit focus on equity. These are not insurmountable challenges. However, those involved with managing and implementing projects, programs, and initiatives will need to decide how much time and funding to invest in conducting a well-done (S)ROI study. At times, attempting to conduct credible analyses may not be worth the investment. Any approach in the preparedness domain may benefit from an explicit SROI methodology (as opposed to standard ROI), possibly coupled with other evaluation approaches. Stakeholder engagement can help identify inputs and returns, and a logic model developed with stakeholders can guide analyses that distinguish between attribution and contribution. Such hybrid approaches appear promising for future work.

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