

MAKING BENEFIT ESTIMATION USEFUL: LESSONS FROM FLOOD CONTROL EXPERIENCE

Leonard Shabman

Professor
Virginia Tech
shabman@vt.edu

It is hereby recognized that the destructive floods upon the rivers of the United States, upsetting orderly processes and causing loss of life and property, including the erosion of lands, and impairing and obstructing of navigation, highways, railroads, and other channels of commerce between the States, constitute a menace to national welfare; that it is the sense of the Congress that flood control on navigable rivers or their tributaries is a proper activity of the Federal government in cooperation with the States, their political subdivisions, and localities thereof, that investigations and improvements of rivers and other waterways, including watersheds thereof, for flood control purposes are in the interest of the general welfare; that the Federal government should improve or participate in the improvement of navigable waters or their tributaries, including watersheds thereof, for flood control *if the benefits to whomsoever they may accrue are in excess of the estimated costs* and if the lives and social security of the people are otherwise adversely affected. [emphasis added] (Section 1, Flood Control Act of 1936.)

Economists often cite the emphasized phrase from the 1936 Flood Control Act as the initial expression of legislative support for economic benefits assessment as a guide for public decision making. In fact, flood control benefit assessment began in the middle of the 19th century. Since that time different benefit assessment techniques have been selected for their consistency with national flood control project financing policy and with the existing political rationale and support for flood control project construction. Recognition of the historical relationship among financing, political rationales for public sector involvement in flood risk management and the "technical matter" of benefit assessment provides lessons for future flood control benefit assessment and for the conduct of benefit assessment in other areas of public decision making.

FLOOD CONTROL BENEFITS BEFORE 1936

In the mid 19th century flood control benefits were associated with increased land prices and income potential. For example, following the Swamplands Acts in the last century, the construction of lower Mississippi River Valley levees were planned by local levee districts and the construction was paid for with taxes assessed on project beneficiaries (Harrison, 1961). That area's low and flat topography suggested that all properties would realize some minimum benefit; therefore one component of the beneficiary assessment was a per acre land tax. Second, it was asserted that lands of higher market price would receive greater financial benefits; therefore, an ad valorem general property tax was assessed against all property in the watershed. Third, a tax was assessed on cotton production on protected lands, presumably to capture a share of the enhanced income potential of the protected lands. The economic justification for a levee was established when there was cooperative formation of a levee district and when that district was able to secure local tax receipts sufficient to pay for project costs. A calculation of economic benefits in relation to costs was not part of a formal economic justification.

The 1913 experience with flood control for the Miami River Basin of western Ohio illustrates the use of land prices as a part of a more formal analytical protocol, although here too the assessment of benefits was motivated by the need for project cost recovery (Morgan, 1951). The Miami River Conservancy District needed to secure funds to pay for flood control works, but there were significant differences in expected benefits for affected landowners. As in the Lower Mississippi River Valley, the assertion was made that flood control project construction should lead to increased property prices. Land appraisers were employed to predict the increase in land prices with a flood control program in place. Using these predicted increases as a benefit measure, a project benefit-to-cost ratio of four-to-one was estimated. Based on this calculation the district required all benefitting landowners to pay 25 percent of the predicted increase in their land price toward the cost of project construction. However, the project would not move forward unless there was a local consensus on a cost distribution among

those paying the tax assessments. To achieve that consensus the District bargained with property owners over cost assignments. The appraiser's estimate of the land price increment was the starting point for a negotiation between individual project beneficiaries and the District, with the expectation that there would be adjustments in assessments.

Following the Miami River example, the Muskingum River Conservancy District, also in Ohio, began a process of project planning and land price increment benefit assessment for a flood control project in that basin (Jenkins, 1976). That effort was not completed before the onset of the Great Depression. With the National Industrial Recovery Act came the new federal work relief programs and the aid programs of the Public Works Administration. The Muskingum projects were built with federal funds and the construction was justified as a stimulus to national employment. Then with the 1936 and 1938 Flood Control Acts, significant financial responsibility for flood control planning and construction was shifted to the federal government.

While land price increment financing continued to be used for small scale non-federal levee and storm water control projects in some parts of the nation (and to pay the non-federal cost share of federally constructed projects), flood control benefit assessment for the new national flood control program came to rely upon another approach, avoided property damages, as a preferred benefit estimation method.

FLOOD CONTROL BENEFITS AFTER 1936

Until the 1930s federal flood control activity was confined to the lower Mississippi Valley and the Sacramento River of California. Even in these areas non-federal interests were responsible for one-third of construction costs and the provision of the lands, easements, and rights-of-way needed for project construction. Following a series of great floods in the 1930s, and in the midst of the depression, the 1936 Flood Control Act defined flooding as nationally significant problem warranting federal involvement. With the 1938 Flood Control Act, the federal government assumed the responsibility of paying for most flood control project costs. This federal financial responsibility remained unchanged until 1986. A 1975 study estimated that non-federal costs were 17 percent of the total flood control costs for U.S. Army Corps of Engineers' projects (U. S. Water Resources Council, 1975).

The 1936 Act declared that the effect on the nation's welfare from extensive flooding was unacceptable. This declaration came in the midst of fundamental changes in

engineering and planning philosophy. Upstream storage reservoirs became the favored flood control strategy (replacing the traditional "levees only" approach) shifting management attention to the hydrology of whole river systems (Barry, 1997). The progressive era view of scientific management also captured the imagination of depression era government planners. These planners saw themselves as technical experts who could choose the best projects through careful and consistently applied evaluation (Wengert, 1981). Not surprisingly, the 1936 Act reflected what the planners on the National Resources Planning Board had argued in 1934: "In the interests of the national welfare there must be national control of all the running waters of the United States, from the desert trickle that may make an acre or two productive to the rushing flood waters of the Mississippi" (National Resources Planning Board, 1934). It was at this time that the federal agencies adopted the damages-avoided method for flood control benefit assessment.

A damages-avoided benefit assessment first defines the expected monetary consequences of a flood event. For commercial and residential land uses damages were defined as the cost of replacing and repairing real property that could be harmed by different flood events. For agricultural land uses, damages were the forgone income (lost sales and/or increased production costs) attributed to a flood event. Once estimated, the damages for each possible flood event were multiplied by the probability of each flood occurring. By summing probability weighted damages over all possible floods, a total damage estimate is achieved. Subtracting estimated damages with the project from estimated damages without the project yielded an avoided damages benefit estimate.

The damages-avoided technique was logically related to the changed policy environment of the post-1936 period. The 1936 Act had declared that flood damage reduction would promote general economic prosperity and the damages-avoided technique directly measured damage reduction. The avoided-damages technique promised a uniform approach to benefit analysis within the federal project construction program so that budget authorities could compare the merits of competing projects. Even though the land increment financing method had been grounded in the assertion that flood damages affected land prices, the avoided damages method could be universally applied by the federal agencies and was not subject to the lack of consistency that might occur with land price assessments made across different areas, by different assessors and in different land market conditions.

The avoided damages method was logically derived from watershed hydrologic (probability) analysis that was already required for the design of water storage structures. However, early in its development the results from the damages-avoided method were inconsistent as a result of inconsistent application (White, 1936). With continued application, the damages-avoided technique was improved and the resulting benefit measures became more uniform across projects. Areas of improvement have been in probability estimation for flood flows and methods of valuing property and contents of buildings expected to be damaged.

The damages-avoided technique was adopted but economists were troubled by its narrow focus on property damages. The 1936 Act had clearly called for a broader definition of the benefits and costs of flood protection projects. At the same time the economics profession of the 1930s, under the influence of the scientific management movement, wanted to expand the scope of benefit and cost assessment. These planners were encouraged by A.C. Pigou's book the "*Economics of Welfare*" in which he introduced the terms social benefits and social costs and encouraged economists and planners to define and measure such benefits and costs as a guide for decision making. One depression era agency—the National Resources Committee—argued that a comprehensive benefit-cost analysis would take account of "social benefits as well as economic benefits, general benefits as well as special benefits, potential benefits as well as existing benefits—all types of benefits and costs should be evaluated on a consistent and comparable basis" (Maass, 1970). However, it was decades later (but only for the period from 1972 to 1982) that analysts were allowed to measure benefits in such broad categories using the independent criteria of national economic development, environmental quality, regional economic development, and social well being (U. S. Water Resources Council, 1972).

The narrow focus of avoided damages does not mean that the project selection process also was narrowly focused. In the budgeting process and in the Congress benefits measured by avoided damages were expected to exceed project costs before a project would be considered for funding. However, demonstration of positive net benefits only was a threshold to be crossed for a project to be included in the portfolio of projects eligible for funding. Once the minimum threshold was crossed social, political and environmental criteria were employed to select particular projects for funding. Benefits assessment was useful to the agencies because it gave them a reason to resist local political pressures for federal flood control assistance—they could say a project did not pass the nationally required net benefits test. However, once a

project became eligible for consideration the benefits assessment, as had been the case for locally funded projects before 1936, was the start and not the end of a financial negotiation that determined whether a project would be built.

FLOOD CONTROL BENEFITS TODAY

By mid century, professional economists had developed the theoretical case for defining the only acceptable benefit measure as a project beneficiary's "willingness to pay" (Marglin, 1967; Eckstein, 1958; McKean, 1958). However, economic analysts were frustrated as flood control investment projects were being selected by political bargaining rather than by application of economists' analytical tools (Haveman, 1988; Howe, 1971). Then in the 1970s economist critics of flood control projects were joined by environmental interest groups and federal budget administrators. The political support base for the construction program rapidly withered away. From 1976 to 1986 there were no appropriations for new federal flood control project construction. It was in that context that, in 1972, the federal agencies accepted landowners willingness to pay as the basis for flood control benefit analysis (U.S. Water Resources Council, 1972). However, the agencies retained avoided damages as the preferred flood control benefit measurement technique, declaring it to be an acceptable willingness to pay measure. The logic was that landowner's willingness to pay for flood protection would at least equal the damages they would no longer incur.

Critics cited problems with avoided-damages as a measure of landowners' willingness to pay for flood protection. For example, the approach considers only the physical property losses associated with flooding and people may be willing to pay to avoid the anxiety of living with a flood threat (Blocker and Rochford, 1986). Concurrently economists were developing alternative ways to measure willingness to pay for many environmental and public sector services (Freeman, 1979) and these new tools could be used in lieu of avoided damages. The contingent valuation method was tested but there were perceived difficulties in application (Thunberg and Shabman, 1991; Shabman and Stephenson, 1996). Land price analysis had been used for flood control benefit assessment decades earlier, but as a starting point for a negotiation over financing. Contemporary access to computerized land records, combined with developments in statistical inference procedures, suggested that analysis of land market prices might overcome the problems of variability in assessors' judgments about market values. Furthermore, new theoretical insights suggested how land price analysis could yield a willingness to pay estimate (Freeman, 1979; Driscoll, *et al*, 1994). However, studies

also documented that land market traders might not appreciate the nature of flood risk, often over-estimating flood hazard immediately after a flood event and underestimating the hazard if there had not been a flood in recent years. In addition, the land market may not reflect high damage, but low probability, events. Therefore, willingness to pay estimates derived from land price studies may vary with the time at which the analysis is conducted (Shabman and Stephenson, 1996).

Alternative ways to measure willingness to pay did not replace the avoided damages technique for flood control project benefit evaluation. Avoided damages estimates do approximate one dimension of willingness to pay and the estimates are easily and consistently made within the limited analytical resources of the agencies. Also the estimate has an intuitive appeal to budget decision makers. However, another explanation for the continued use of avoided damages to measure willingness to pay is that the theoretical argument for adopting the willingness to pay standard was never uniformly accepted or understood. Recall that the 1970's adoption of willingness to pay coincided with the decline of the federal flood control project construction program. At that time both budget authorities (especially during the Carter presidency) and environmental opponents of the construction program were convinced that a willingness to pay test would reduce the likelihood of project justification. The willingness to pay standard was supported because it conformed with the desire to reign in the program and not because economists' theoretical logic was clear or compelling. Additional evidence for this strong assertion is provided by the recent experience of applying a willingness to pay test to the analysis of the benefits of floodplain evacuation.

FLOOD CONTROL BENEFITS TOMORROW

The 1990's will be characterized by issues of floodplain evacuation and renewed emphasis on local (non-federal) beneficiary financing. These changes will again call for a shift in benefit assessment approaches. Opposition to federally funded water control structures that permit floodplain occupancy continues and new project construction is limited to local levee and channel projects that protect existing economic activity. As will be noted below, the non-federal share of the costs for these local protection projects has been increased. National policy toward floodplains now seeks to restore the flooding regimes to advance environmental values of these riparian areas. Floodplain occupancy is now treated as a risky activity where the costs of risk taking should be borne by the floodplain occupant through federally managed flood insurance (created in 1966). For purposes of this discussion it is worth reviewing the emerging

debate over how to calculate the economic benefits of evacuation.

The Federal Emergency Management Agency (FEMA) pays for the evacuation of properties from flood-prone areas whenever FEMA expects that continued occupancy of the floodplain will result in flood insurance claims in excess of the premiums paid (Shabman *et al*, 1997). As part of that calculation, FEMA uses avoided damages (costs they would not need to indemnify if evacuation occurred) as its benefit measure for evacuation. The FEMA analysis is a financial calculation that addresses that agency's responsibility of assuring the long term actuarial soundness of the flood insurance program.

The interest in evacuation has created an expectation that the federal agencies which traditionally have constructed water control projects will now develop evacuation projects. However, those agencies evaluation guidelines for evacuation projects correctly—from an economic theory standpoint—prohibit using damages avoided as a benefit measure. The theoretical logic is that land buyers and sellers aversion to flood damages is reflected in lower prices for flood prone-land. It is true that when the flood prone-land is purchased for an evacuation project flood damages no longer occur, however the avoided damages are already reflected in the depressed land price. Therefore to count avoided damages as a benefit from evacuation would constitute double counting of the benefits. Instead, the benefits from evacuation are peoples' willingness to pay for the new land use on the previously occupied flood-prone land (for example, for new recreational opportunities). By adhering to the willingness to pay standard, while FEMA doesn't, the federal construction agencies have been accused of resisting the current national policy goals that are served by evacuation (Administration Floodplain Management Task Force, 1994; also see: Water Resources Development Act of 1996). This strong pressure to use a damages-avoided benefit measure for evacuation, in contradiction to the willingness to pay test, is evidence that the economists' favored measurement standard will be ignored since that standard no longer conforms with the new national attention to floodplain evacuation.

Ironically, while federal agencies are being pressured to accept damages-avoided measures for all activities, the usefulness of avoided damage estimates are being questioned by non-federal interests. In 1986, when Congress ended the ten-year hiatus on construction of flood control projects, it imposed new non-federal cost-sharing requirements on project beneficiaries. These beneficiaries were expected to pay as much as 50% of the total project cost. Non-federal interests have found avoided damages estimates to be of little use when trying

to raise the revenues needed to pay the non-federal share of flood control projects. Local community support for flood protection works (or floodplain evacuation) often rests on the perceived community effects (Shabman and Stephenson, 1992 and Shabman and Stephenson, 1994). Therefore, non-federal governments want assessments of a project's local economic development and fiscal consequences to help them assess the potential support for community-wide tax levies to pay the non-federal cost share. These are not willingness to pay concepts. These same local governments may also be interested in whether expected land price changes may support special assessments on directly benefitting landowners. This interest in land price assessments brings flood control benefit analysis full circle to the type of analysis that was done as long ago as the 1850's. A renewed interest in land price analysis as a benefit measure should not be surprising. That interest reinforces the central theme of this historical story – that the political rationales for the flood control program and the financing requirements have defined what is considered useful valuation analysis for decision makers.

IMPLICATIONS FOR ECONOMIC ANALYSTS

Until the 1970s flood control benefit assessment methods were selected for how well they informed and supported decision making needs. For a brief time in the 1980s a benefit assessment standard of willingness to pay, rooted in received economic theory, was universally accepted because it served a policy agenda that included reducing flood control project construction activity. Therefore, there was a coincidence of what economists deemed the “correct” measure of benefits and what the policy making process was able to use in its decision making. However, now the willingness to pay test is being challenged as an appropriate benefit measurement standard because it does not support the new national emphasis on floodplain evacuation. At the same time the information needs of non-federal interests who are now required to pay a significant share of project costs are not served by the federal agencies' evaluation procedures.

This history illustrates the challenge to economic analysts who are torn between conducting professionally respectable studies and providing information that is of certain and immediate utility to decision makers. Only by coincidence will there be a close correspondence between the benefit analysis dictated of contemporary economic theory and the information demands of public policy. One response might be to assert that benefits measured according to the dictates of economic theory should be given more weight by decision makers, even if they now are given limited consideration. With this perspective the economist analyst will continue to develop the theory and

tools of willingness to pay benefit assessment and advocate the resulting information as a useful (if not sole) guide for decision making. An alternative response by economists would be to evaluate the nuances of the decision to be made and then develop analysis that will provide information that will clearly assist in making that decision. Such analysis still can draw upon the economic theory and tools to assure that professional quality of the analyses (Shabman, 1984; Shabman, 1985; Shabman and Stephenson, 1996).

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Leonard Shabman is Professor of Environmental and Resource Economics, and Director of the Virginia Water Resources Research Center at Virginia Tech.