FLOOD PROTECTION OPTIONS IN A POST-KATRINA WORLD

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Abstract
Flood protection is often presumed to be a public good and hence a government responsibility. Unfortunately, the full costs of publicly-funded flood control efforts are often obscured. Moreover, reliance on government protection can create false impressions that individual risks have been minimized, thus encouraging more personal and business investment in disaster-prone regions. Reimbursing these losses after a disaster perpetuates a cycle in which resources spent to protect communities from flood damage can instead increase vulnerability and create a climate of "moral hazard" where people fail to take appropriate actions to reduce risk. As New Orleans continues to rebuild from the damage of Hurricane Katrina, there is a need to consider comprehensive approaches that will provide decision makers at all levels with incentives to manage flood risk more effectively. This paper offers guidance for developing more rational, risk-based government policies for flood protection, approaches that could be less costly and place fewer people and their livelihoods at risk.

Key Words: flood protection, risk management, moral hazard, public-private partnerships, Hurricane Katrina

Introduction

On August 29, 2005, Hurricane Katrina made landfall in New Orleans. A hurricane-driven storm surge in Lake Pontchartrain entered the city's drainage canals and caused water levels to rise to more than two meters above Mean Gulf Level (MGL), a height never before reached. Multiple levee and floodwall failures as a result of overtopping and poor design and construction allowed water from Lake Pontchartrain and Lake Borgne to enter the city and cause widespread flooding. This was the costliest natural disaster in U.S. history with losses expected to exceed US$100 billion.

Over the past fifteen years, the cost of natural disasters, not only in the United States but around the world, has noticeably escalated. Comparing the inflation-adjusted economic losses due to natural disasters worldwide from 1950 to 2000 reveals huge increases, from US$53.6 billion in the 1950s to US$778.3 billion in the '90s. This decade has already seen US$420.6 billion in losses, principally due to the record losses in the 2004 and 2005 hurricane seasons.

The key driver of these rising numbers is increased development in hazard-prone areas, which puts more property and investment at risk (Mitchell and Thomas, 2001; Black, 2005). In the United States, although private insurance underwrites much of the cost of natural hazard events, an event's escalation to "disaster" status entails the federal government stepping in to provide assistance. Such aid amounts to de facto property and casualty insurance to which all U.S. taxpayers contribute. Unfortunately, the true costs of publicly funded disaster assistance are often disguised, and reliance on government protection can lead people to underestimate their risk. Arguably, this creates a climate of "moral hazard," where people are less likely to purchase insurance or take other mitigating actions on the assumption that someone else will cover their losses.

Despite their inadequacies in the face of Hurricane Katrina, U.S. flood protection and disaster assistance policies remain essentially unchanged today. Although the events of August 2005 cannot be undone, there are alternative approaches that would provide decision makers at all levels—from elected officials to individual homeowners—with incentives to base decisions on risk. This paper offers guidance for developing more rational government policies for flood protection—policies that could stop subsidizing risky behaviour.

The Mississippi River and New Orleans: A Short History of the Levees

Established by the French as a deep water port in 1718, New Orleans remains important today as a major international port and centre of oil and natural gas operations in the Gulf of Mexico. From its founding, New Orleans was subject to periodic flooding from the Mississippi River and hurricane-driven storm surge. Since most of the city lies just a meter or less above sea level, flooding also routinely occurs during the intense spring and summer rainfalls. As a result, for many years development was confined to the higher areas near the Mississippi River levees. However, in the latter part of the nineteenth century, development began to expand into the swampy areas closer to Lake Pontchartrain, necessitating construction of additional levees and a drainage system for the city's lower-lying areas. Further development of this land occurred after World War I and again following World War II, when the Lakeview, City Park, Fillmore, Gentilly, and Pontchartrain Park areas behind the lakefront emerged as desirable residential communities (Rogers, 2006).

The U.S. Army Corps of Engineers (USACE) became heavily involved with the city's drainage canals in 1955 following Congressional studies that later led to the authorization of the Lake Pontchartrain and Vicinity Hurricane Protection Project (LP&VHPP) in 1965. The LP&VHPP was still not complete when Hurricane Katrina struck in 2005.

As the many post-Katrina reports have shown (ILIT, 2006; IPET, 2007), the levees were not designed to withstand the effects of a highly likely hurricane, the crest of the levees was lower than required due to use of the wrong elevation datum, and construction and maintenance was often substandard. The Hurricane and Storm Damage Risk Reduction System (HSDRRS) which will provide a 100-year level of protection is scheduled to be completed by 2011. Although continued reliance on structural measures to ensure more reliable flood protection are understandable given New Orleans' history , they should not preclude re-evaluating the implications of employing this approach alone and whether it is the most effective strategy for reducing risk.

Assessing and Managing Flood Risk

A formal process of risk assessment and management can help illuminate and resolve whether and how the technical and institutional problems that contributed to the Hurricane Katrina disaster could have been addressed more effectively. Risk assessment can be defined by three questions (Kaplan and Garrick, 1981):

1. What can go wrong?
2. What is the likelihood that it could go wrong?
3. What are the consequences of failure?

Based on the findings of the post-Katrina assessments, a summary of the answers to these questions could be:

"In the event of a stronger than usual but not uncommon intensity hurricane, it is highly likely that the levees will be breached or otherwise fail in a number of locations, resulting in the deaths of hundreds to thousands of mostly poor people as well as billions of dollars in damage."

Risk management integrates the results of risk assessment with other information such as political, social, economic, and engineering considerations to arrive at decisions about the need and methods for risk reduction. Risk management seeks answers to a second set of questions (Haimes, 1991):

4. What can be done and what options are available?
5. What are the associated trade-offs in terms of costs, benefits, and risks?
6. How do current management decisions affect future options?

The answers to these three questions and how they could influence governance and decision making in and about New Orleans will occupy the remainder of this paper.

What can be done and what options are available?

Options for managing flood risk can be grouped into five general categories:

1. *Avoid the risk by locating somewhere else*. In the case of flood protection, living outside the flood-prone area is perhaps the wisest choice, though certainly not an option for many of the people who were already living in New Orleans in August 2005. However, as redevelopment occurs, residents could be encouraged to return to parts of the city with

a lower flood risk and to residences elevated above expected flood levels.

2. *Reduce the risk by taking countermeasures*. Typically, these might include advance warning and evacuation, flood-protection works such as levees and floodwalls, hazard-resistant structures, and rapid response and recovery mechanisms so that the city can recover quickly. Most of these components were thought to be in place in August 2005. However, the floodworks proved to cause the flooding rather than prevent it, and multiple avoidable problems at all levels of government delayed response and recovery operations.

3. *Spread the risk by choosing multiple redundant locations for certain protective measures*. For example, it would have been wise to locate at least some of the special generating capacity for the city's drainage pumps outside the flood zone[1]. Similarly, stockpiling emergency supplies where local community action groups could have accessed them might have helped alleviate the survivors' suffering more quickly.

4. *Transfer the risk through insurance or other related methods*. Insurance can be an effective risk management tool, but only when rates reflect true risk. The Federal Flood Insurance Program (FFIP) was established because the commercial insurance industry was unwilling to underwrite flood-hazard risk at rates that homeowners were willing to pay. Thus, flood losses were not covered and a government program attempted to fill the gap. Sutter (2008) suggests that subsidized risk pools such as the FFIP may actually increase risk because they disconnect locational decisions from their potential consequences. Catastrophe bonds are risk-linked, fixed-income securities that transfer a set of risks from a sponsor to investors and could be an option to supplement traditional insurance or reinsurance (Anderson and Suess, 2006). They are often structured as floating-rate corporate bonds with a fixed term (often three to five years) whose principal is forgiven if specified trigger conditions are met. If the catastrophe bond is not triggered by the hazard of concern, the principal is returned to the investor upon maturity. If, however, the bond is triggered, part or all of its assets will be made available to the sponsor to cover its liabilities. Insurers typically use catastrophe bonds as alternatives or supplements to traditional catastrophe reinsurance.

5. *Retain the risk*. In light of the preceding points, property owners, neighbourhoods, the City of New Orleans, or even the entire state of Louisiana may have no choice but to accept a portion of the consequences of the multiple hazards they face. Below a pre-determined level, the cost of a disaster event would be managed locally. Above a particular threshold, various forms of private involvement would come into play through insurance/reinsurance or catastrophe bonds. At a further trigger point, the cost of insurance compared to the likelihood of a very extreme event becomes overly burdensome and a decision to accept the consequences must be made. Although governmental bodies routinely make these decisions, they are made implicitly, leaving the general public with the impression that they are protected from all levels of catastrophe, when in fact, they are not.

What are the associated trade-offs in terms of all costs, benefits, and risks?

A benefit/cost (B/C) analysis would determine that $X in capital outlays and $Y for annual operating and maintenance expenses would generate $Z in benefits. If the net present value of the annualized equivalent of Z is greater than X + Y, the project has a favourable cost-benefit structure and is justified. However, this analytical procedure makes no effort to determine a relative value for the project or to distinguish between who bears the costs and who reaps the benefits. For example, although all U.S. taxpayers underwrite a portion of the federal share of the costs of flood control, the benefits accrue locally. Although often labelled National Economic Development benefits, they are usually targeted to a more local audience. The equity of U.S. federal water development and flood control policy has been debated for years and will not be resolved in this paper. However, from the standpoint of managing risk equitably, much better alignment of who benefits and who pays is certainly possible. Efficiency as well as equity considerations dictate that the incremental costs are charged to those who stand to gain. To date, there

[1] For reasons of economy, the screw pumps used for dewatering were designed to operate on 25Hz, 3,000 volt electric current which could not be provided by local utilities.

has been little serious discussion of the extent and the means by which market discipline can be brought to bear on this aspect of flood protection

What is the impact of current flood management practices on future development options?

New Orleans, subject to both river flooding and hurricane storm surge, has seen the almost continuous installation of floodworks during the past two-hundred years . Historical decisions to encourage the growth of New Orleans as a major city and build flood works to enable that growth have precluded other approaches. Once the size of the population and the value of the constructed environment achieved certain thresholds, there was little to do but to continue investing in large protective flood control structures. However, as demonstrated by Hurricane Katrina, these large investments were not sufficient to avoid disaster. Rebuilding the levees and then rebuilding the city—absent other changes to land use, cost allocation, and other factors—will only perpetuate this cycle.

The Case Before Us: The Options for New Orleans

Levees, because of their broad flood protection mission, are often thought to be classic public goods and therefore the responsibility of the public sector to construct and maintain. But the discussion of public goods has recently become more complex (and more interesting) for two reasons. First, it is recognized that many local public goods have a spatial ambit: excludability ceases to be an overwhelming problem and benefits are capitalized (priced) in land markets. As such, there are market signals that private developers can (and often do) respond to when providing local public goods and facilities (Foldvary, 1994). Second, public authorities in the U.S. have started looking to private capital markets to fund projects through various arrangements known collectively as Public Private Partnerships (PPP or P3) that had, in most of the twentieth century, been publicly financed.

Figure 1 presents four hypothetical scenarios for levee ownership and maintenance. Quadrant I depicts the status quo, but even without major changes in property ownership or responsibilities, new finance options can and should be considered.

		Levees	
		Publicly Owned and Operated	Privately Owned and Operated
Local Communities	Conventional Governance and Planning	I	III
	Private Governance and Planning	II	IV

Figure 1: Taxonomy of Allocations of Responsibility Between Public and Private Governance

One of these involves the previously described catastrophe bonds that could be issued by the levee authorities or other joint powers umbrella organizations to offset the risk of levee failure. Catastrophe bonds are essentially forms of self-insurance and could bring some market discipline to levee reconstruction and maintenance. For example, market participants' willingness to purchase levee catastrophe bonds would indicate the degree to which people believed the land "protected" by the levees was viable for private development. If people chose not to purchase these bonds, the cost of public subsidy to support development would be transparent and the policy implications of subsidy at least open to debate.

Quadrant II represents an arrangement that retains the suggested modifications to public levee finance discussed above, but also involves private communities in decision making.

There were more than 295,700 private community associations in the United States in 2007 which included 23.8 million housing units that were home to 58.8 million people (Community Associations Institute, 2007). These associations are essentially private local governments, delivering a variety of common services, facilities, and areas. They also have the contractual power to assess fees that amount to private taxation.

Along with the increasing numbers of private communities, there are as many as fifteen hundred Business Improvement Districts (BIDs) in North America, (Nelson, McKenzie, and Norcross, 2008; Brooks, 2008). BIDs refer to geographically defined zones empowered to assess and collect taxes and fees from area businesses. In return, the BID provides various services, including

sanitation, street cleaning, street improvements, security, and area marketing. The model is flexible and could include other services, depending on local conditions.

Developers of planned communities fund local infrastructure construction mostly within these communities and, in return, have achieved land design flexibilities and savings. Local governments benefit from cost savings whenever infrastructure is privatized, but they also impose exactions and impact fees on developers for any public infrastructure those governments provide (Ben-Joseph, 2004; Altshuler and Gomez-Ibanez, 2003). Explicit transacting for augmented levee services would be no different and arguably, with closer links between services, costs and benefits, there would be greater interest and involvement from residents and neighbourhoods with the performance of the infrastructure and the institutional entity charged with its maintenance.

Quadrant III introduces private levee ownership and management combined with conventional governance and planning. Private levee finance could be modelled on private highway finance. Unlike the situation discussed for Quadrant I, a proprietary organization could operate and maintain the levees if there were a contracted flow of rent payments as has been accomplished to some degree in Great Britain (Halcrow, 2009). In the Broadlands case, a private consortium received a 20-year concession to maintain and improve 240 km of coastal flood defence works in exchange for payment of an annual fee. Ownership of the facilities and liability for their failure remains with the government. Private insurers could also get directly involved; they or their surrogates could own and manage the levees, and they would offer to insure protected properties on terms over which they have some control.

Quadrant IV offers the most radical departure from current conditions. Private levee providers would negotiate with private governments (homeowners associations), developers, or consortia thereof. The latter owe their existence and their economic prospects to reliable levees giving them a real stake in the performance of levees that abut their communities.

This case is intriguing because private entities are on both sides of the negotiating table: community property owners on one side and infrastructure contractors on the other. The analyses of Tiebout (1956), Nelson (2004), and Fischel (2004) all support a hypothesis that some New Orleans communities might be better off providing their own flood protection because well-conceived investments can add value to the neighbourhood and property owners' involvement can help ensure a good result. If these communities were able to raise the funds to contract on their own for levee maintenance, why should they be prohibited from doing so? They would be free to add additional value to their land, and the wealth created could more than cover the associated private costs.

Conclusion

Public provision of "public goods" need not crowd out private provision which raises the question of which of the four quadrants is best. Answering this question requires that learning through trial and error must occur, and failures must be tolerated. Appropriate contractual norms and arrangements are likely to emerge only in a more open regulatory setting. Regardless of the arrangement, the idea of land owners financing their own flood control benefits is well-established as Misczynski (1978) reports: "The earliest special assessment occurred in the Romney Marsh case of 1250, in which a local ordinance allowed authorities to assess residents for repairs made to sea walls. Assessments were in proportion to the acreage benefited. Thus the practice of estimating benefits by rule-of-thumb proxy has deep roots." But can the political will be mustered to allow some open-endedness and tolerance for trial and error?

Generally speaking, and in the absence of a serious commitment to reform, the answer is "no." Lease deals for turnpikes and highways have been discussed in U.S. states, but the challenge of finding arrangements that are both attractive to investors and politically acceptable have hindered these efforts. A private-private arrangement for flood protection would also have an uphill battle—like the continuing controversy with respect to highways and other "public" infrastructure in the U.S.—but probably would be more intense given the potential for catastrophic human and economic losses. As Katrina so aptly demonstrated, flood control is not child's

play. But trusted institutions with decades of experience make mistakes and maintaining the status quo will not eliminate existing serious problems.

Negotiating appropriate levels of protection tied to engineering and management solutions requires technical expertise that can raise the transaction costs to such a level that the arrangement is no longer financially attractive. From the perspective of a private services provider, dealing with an uninformed customer is not desirable. Questions of whether such an arrangement adequately protects the public interest, which party is liable for what, and the reasonableness of the fee structure are all issues that have arisen in recent discussions of the private provision of transportation infrastructure (Ortiz, Buxbaum, and Little, 2008). Attitudes in the United States remain deeply conflicted in this regard. Although many brand the public sector as inefficient at best, and lazy, corrupt, and stupid at worst, there is an identifiable bias toward public provision of vital services when safety and security are at stake. The creation of the Transportation Security Administration in the aftermath of the 9/11 attacks is a case in point. However, the long-time federal presence in New Orleans as the de facto provider of flood protection—but one with little or no input into local planning or public finance decisions—complicates the development of workable alternative solutions. As has been discussed throughout this paper, an effective flood protection system entails more than just the physical floodworks. If the USACE is to play the major role in flood protection, then perhaps they should have more input into the non-engineering decisions that also affect flood risk. On the other hand, if the USACE is to function only as a turn-key contractor for flood protection, they (and by extension, all U.S. taxpayers) should be reimbursed by local beneficiaries of the services they provide and the value thus added.

The challenge for New Orleans and the United States as well, is whether there is sufficient will to explore options that extend beyond the national socialization of local risk to better align the costs of flood protection with those who receive its benefits.

This paper has suggested that there are alternatives to the status quo in funding and financing flood protection. Public and private responsibilities can be divided in various ways. As New Orleans rebuilds from the damage of Katrina, local and national policy makers are attempting to ensure the levees are rebuilt better and stronger. While such efforts to ensure more reliable flood protection are certainly understandable given the region's history, they should not preclude serious consideration of the implications of excessive reliance on business-as-usual practice. Openness to approaches that pay attention to institutions and associated incentives can provide decision makers at all levels—from elected officials to individual homeowners—with opportunities to manage flood risk more effectively.

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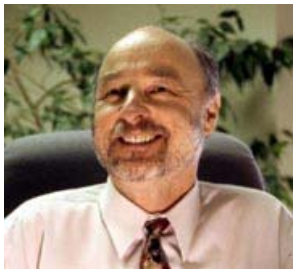

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