

Does Subsidized Beach Protection Change Land Use?

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Summer storms with names like *Bertha* and *Fran* have, once again, drawn attention to the problem of storm damage in beachfront areas. The US Army Corps of Engineers ("Corps") shore protection program provides subsidized erosion and storm damage control projects to communities that meet Corps program criteria. Because the federal government generally pays 50% to 65% of the cost of such projects, beach enhancement is much less expensive for land owners in communities that participate in the Corps program than it would otherwise be. As a result, the program has been criticized for subsidizing development in beachfront areas with high risks of storm damage.

Two issues have been at the heart of the debate over the federal role in attenuating storm exposure risks for private land owners. One is disagreement about how much private development is actually induced by government programs. A seemingly sound argument offered by critics is that public funding significantly increases the amount of improved property located in harm's way along coastal shorelines, and that the counterproductive effect is to raise, rather than to lower, storm damage costs. An opposing view is that most shoreline development is driven by factors other than federal spending on beach enhancement, and that when such outlays do play a role, they provide benefits by shifting activity from unprotected to protected beaches, thereby decreasing the average risk of development. Actually, federal protection projects' effects on shoreline development can be quite complicated. The subsidy has numerous strings attached, and the projects are likely to have more complex locational effects than simply moving development from inland areas to Corps-protected beaches.

A second issue involves evaluating the benefits ultimately generated by various programs designed to reduce economic losses from storm damage. Critics argue, as explained below, that any type of government-induced development could theoretically *increase* expected storm damage losses in protected shore

areas. The actual effect of moving beach development to protected areas, however, depends on whether the induced development is prompted by programs (such as the Corps program) that *reduce* risk from storm damage, or by programs (such as flood insurance) that *spread* risk without actually reducing it.

Two questions therefore have to be considered. One is empirical: what is the ultimate effect of Corps beach enhancement projects on patterns of beachfront development? The other is conceptual: how should induced development be evaluated for policy purposes?¹

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The Complexity of Net Effects

Despite the generous federal subsidy, a Corps beach enhancement project is not without cost to the affected land owners. Communities that participate in federal shore protection projects must agree to provide substantial public access to protected beaches, and Corps planning often requires construction of rather high dunes that may block views of a beach. A locality must therefore weigh the benefits of the federal subsidy against the accompanying land use restrictions. The fact that many shoreline communities have chosen *not* to participate in subsidized Corps projects suggests that the costs of these restrictions are potentially significant; the "net subsidy" enjoyed by private land owners is probably less than meets the eye. In effect, the land use restrictions that accompany federal beach protection activities may make properties at protected beaches safer, but also less attractive in some important dimensions. This dichotomy can have offsetting effects on beachfront development.

Another complication is that shore protection projects can have several different effects on the location of

shoreline development. Critics of Corps programs argue that protected beaches attract additional development to areas highly susceptible to storm damage. But this criticism is based on an implicit assumption that any new development occurring in areas protected by Corps projects comes from areas with less exposure to storms. It is, of course, quite possible that protecting part of the shoreline shifts development to the protected sector from unprotected beaches that remain very susceptible to storm damage. Relocation of development from high risk beaches to Corps-protected areas could

well reduce the average risk of storm damage. Thus, shore protection is capable of generating as complex a pattern of locational effects as are other public policy initiatives, including zoning, housing and building codes, or spatially defined public expenditure programs.

Finally, Corps beachfront protection plans are not the only federal programs that affect shoreline development. Most notable among other programs is flood insurance, through which land owners have benefited from premium rates that were, until recently, federally subsidized.

Putting the Effects in Perspective

The analyst's task is to assess the effect of Corps shore protection activities, while taking into account the wide range of factors that might affect beachfront development. These factors include broad economic variables (which affect the demand for recreation services and the risk of storm damage) and the presence of government programs, including flood insurance (which spread economic losses caused by storms). The crucial question is how much shoreline development we can attribute to Corps programs, after

considering the effects of other factors that affect development in beach areas.

To address this question, we have assembled panel data from forty-two beach communities selected to provide variation, both over time and among localities, in: beachfront economic development, demand for beachfront services, exposure to storm damage, and the scope of federal involvement in attenuating the economic losses, either through federal flood insurance or through Corps projects. The time period covered, from 1960 to 1992, yields thirty-three observations for each community.

The data allow for the observation of economic development within a given community, and among different communities, before and after the provision of

sample. The average annual rate of growth in housing units in the thirty communities that had Corps activity at some time during the 1960 – 1992 period was 4.1%, while the growth rate in the twelve communities where the Corps was not active was 3.8%.

The somewhat more rapid rate of development at beaches with Corps programs could be a sign of induced development, but it could also reflect the criteria used in selecting projects. Approval for Corps projects depends, in part, on potential damage avoided, a condition that depends on improvements already in place. Shore protection projects are thus likely to be found in areas with considerable past development, such as areas that have experienced rapid growth.

face depends both on the actual risk of property damage and on the out-of-pocket costs that those who own storm-damaged property ultimately pay. The model shows shoreline development to be affected by broad economic factors that affect the demand for recreation services, by the risk of storm damage, by government programs (such as shore protection projects) that reduce the risks of storm damage, and by programs (such as flood insurance and disaster relief) that reduce the out-of-pocket cost that these risks impose on property owners.

Our analysis shows that government programs that lower the economic losses from storms can induce development in beachfront areas. We also find that reducing losses for individual property owners can have the result of increasing aggregate losses. This seemingly paradoxical result is not surprising; lowering economic losses from storms lowers the cost of potentially risky investments in beachfront areas, thereby increasing the volume of such financial commitments.

But the model shows that it matters a great deal *how* the government lowers these risks. Such programs as shore protection projects provide real reductions in the cost of making investments in beachfront areas by lowering the “physical risks” of property damage. In contrast, such programs as subsidized flood insurance lower the costs to individuals of making risky shoreline investments, but do not lower the risks themselves.

The distinction is important. When government programs reduce risk, greater investment in beachfront areas occurs because the social costs of risk are actually lower, so economic well-being is enhanced. But when government programs shift risk without reducing it, the social costs of risk are not reduced; the effect is to encourage more investment in risky areas than would normally be supported by the competitive market.

Measuring the Economic Effects

Based on this theoretical framework, we can formulate and estimate a statistical model that explains variations in economic development among different communities, both in a given year and over time. In estimating this model, we draw on several sources of published and

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flood insurance and/or shore protection projects. Our sample includes localities where the Corps was active for the entire period, others where the Corps had no authorization to act, and others where the Corps gained authorization at various points between 1960 and 1992.

Some Simple Comparisons

There is clear evidence that beachfront communities, from Maine to Texas, have experienced considerably higher rates of residential development than have inland locations. In the forty-two beachfront communities that constitute our sample, the average annual rate of growth in housing units over the 1960 – 1992 period was 3.9%, a figure more than 50% above the 2.4% figure that represents the approximate nationwide average. Such a comparison, however, reveals little about the effects of shore protection activity. Development in all beach areas, not just those protected by Corps projects, may have been more rapid than development in inland areas for a variety of reasons.

A different picture emerges if we compare growth rates among different beachfront communities within our

We also calculated rates of growth in particular communities before and after Corps projects. The comparisons indicate that the average rate of growth in housing units during periods when there were Corps-approved projects was only 3.7%, compared to 4.9% for years when there were no Corps activities. This result appears to run counter to the hypothesis that Corps projects cause rapid economic growth, although it could also reflect the possibility that these projects were undertaken *following* periods of rapid growth.

The problem with these simple comparisons is that they are hard to interpret. Clearly, we need more careful empirical analysis to determine what causal effect, if any, federal shore protection activities have on induced economic development.

A Theoretical Model

The starting point for such analysis is a theoretical model, in which development of beachfront areas is determined by the demand for beach services and the costs of providing those services; the latter depend, in part, on expected damages. The economic cost of expected storm damage that individual property owners

unpublished data that help us to measure economic development, and to measure the factors that influence development.

Several issues arise in measuring economic activity in a beachfront community. One is defining the geographic unit of analysis. For example, analyzing the economic effects of government storm risk management programs at the level of a county that happens to have one shoreline border could easily cause us to miss the beachfront effects. To minimize this problem, we have defined communities in our sample at the sub-county level, specifically at the level of *urban places*. Thus, each beachfront community in the sample consists of an urban place where economic activity is concentrated near to, and/or is dependent upon, a local beach area.

Other issues arise because of the highly seasonal character of the demand for beach services. In principle, economic activity in shoreline areas should be measured during the summer peak, but the data for urban places, including beachfront communities, are in many cases collected in the winter or spring. There are, however, some measures of community economic development that are less affected by seasonal peaks. One is the annual measure of building permits issued during the previous year. Another involves housing stock data which, albeit collected in the spring, are also less affected by the summer peak problem than are other data series. Our selected measure of new beachfront development is the number of new housing units authorized, as indicated by building permits issued during a given year. The building permit data include units in both single-family and multi-family structures.

Demand for Recreation Services

If patterns of beachfront development are similar to those analyzed in the general literature on small area economic growth models, the primary determinants of local development will be total income and employment in the economy. In terms of our coastal development model, changes in regional income and employment are predicted to shift the demand for beach services, raising their price and stimulating development at all beach locations, if the likelihood of storm damage exposure,

and the presence/absence of federal flood insurance and shore protection projects, are held constant. Consistent with this literature, it is plausible to assume that the demand for beachfront recreation depends on aggregate income growth in areas closer to a particular beach area. Put another way, we assume that high growth in Atlanta, or even Albany, has a more substantial effect on demand for Florida beach services than does growth in San Francisco or Portland.

Thus, we assume that demand for recreation services in the beachfront areas from our sample depends on overall income and employment in metropolitan areas east of the Mississippi River. The proximity weights are estimated based on travel cost, and on the availability of recreation opportunities at other beach areas. Changes in income and employment in large cities near a particular beach shift the demand for recreational services at that beach.

Exposure to Storm Damage

Another implication of our model is that exposure to storm damage should affect development in beachfront areas. Though it is difficult to measure such exposure precisely, we were able to construct two crude measures of storm intensity for use with our sample. The first is an index of the strength of any hurricane-force tropical storm that reached a landfall, in a particular year, in the county where the studied beachfront community is located. The other is an index of storm damage to the beachfront area (available for specified areas during periods when they had authorized Corps projects). Each storm damage index is subject to measurement error. The first index ignores potential damage from storms that are not hurricanes, and it implicitly equates wind speed of the storm to damage inflicted; the second does not measure damage in areas lacking Corps activity.

Federal Flood Insurance

Although we have no direct measure of the subsidy value of disaster relief, the effects of federal flood insurance on beachfront development are captured by the inclusion of two measures of flood insurance. First, we can identify years when the community participated in

the National Flood Insurance program. Second, we can observe whether and when a completed flood insurance map became available in a given community. The data for coding these variables were compiled by the Federal Emergency Management Agency (FEMA).

The two flood insurance variables correspond to different regimes of federal flood insurance. When it was first established in 1968, the federal insurance was made available at subsidized rates. Subsequent changes in the program were intended to remove (or, at least, reduce) this subsidy. Program officials achieved this end administratively by requiring communities to participate in federal flood insurance in two phases. In the initial, or emergency, phase, a limited amount of flood insurance was provided on a subsidized basis, pending the area's submission of a flood plain management plan and its completion of a FEMA map. Upon completing the map, a community was required to enter the regular phase of the flood insurance program, which provided broader coverage than the emergency program, but at premiums designed to correspond more closely to actuarially-based costs. Hence, observations with flood insurance but no FEMA map represent situations in which communities benefited from subsidized flood insurance, while observations with both flood insurance and the map represent situations in which flood insurance was available under less favorable terms.

Shore Protection Projects

Finally, we have included variables that measure both the presence and the scope of federal shore protection activities. These variables include the following measures: tons of sand used in beach nourishment each year, total cost of nourishment in 1994 dollars each year, the year when the project was initially authorized, years in which the project authorization was modified, and years in which a Corps project was active in the community. We use several alternative measures of Corps activity because our intent is to discover if any one, or a combination, of these variables has a positive effect on our measure of economic activity that would reflect development induced by the Corps project.

Elasticity Effects

Our analysis of the relationship between factors that influence economic development along coastal shorelines, and our measure of beachfront development, produced several interesting findings. First, there is strong evidence that higher demand for recreation services has been an important force in stimulating development in beachfront communities. We have found the estimated *elasticity* of new housing starts, with respect to employment, to be on the order of 0.20 in both versions (linear and logarithmic) of the model. This estimate implies that a 10% rise in weighted employment in eastern US metropolitan areas generates a 2% rise in new residential construction in Florida beachfront communities.

Effects of Shore Protection Projects

The estimated effects of beach protection projects are mixed, but overall we find that the variables that measure the level of Corps beach protection activity in a community are neither statistically significant nor economically important. We tested several alternative variables that could reflect the intensity of Corps activity in a beach area. For example, adding variables that measure the presence and scope of Corps programs in a community does not improve our ability, in one version of the model, to explain variations in economic development. In the other version, we find that these variables are statistically significant, but their measured effects are so small that they are not economically important. Because

federal program. Second, providing subsidized flood insurance has encouraged development in these areas. Shore protection projects, however, are found to have little or no effect on development.²

These findings have several implications. One is that subsidized flood insurance may have stimulated more development in coastal areas than would be regarded as economically efficient. Another is that the main effect of shore protection activities has been not to place additional property in harm's way, but rather to reduce the economic costs of storms for individuals in communities that would have experienced significant economic development in any event.

The latter result suggests that there may be confusion over the link between development and shoreline protection. No doubt, many beachfront areas have experienced substantial development following implementation of Corps beachfront protection. But development appears to have been driven mainly by economic growth inland and the availability of federal flood insurance; it would have taken place without the Corps projects. An observation that development may follow the implementation of federal activity does not prove causality. ■

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Storm Damage, Insurance Effects

We find that the damage index, which measures actual storm damage in Corps-protected areas, has a negative and generally significant (not created by random events) effect on building permits. This result does not hold, however, for the index that measures only the physical intensity of storms that reach landfall (which ignores the dollar amount of damages, as well as the effects of smaller but nonetheless costly storms).

Our results also indicate that flood insurance has stimulated beachfront development. The estimated effect of initial participation in the federal program is substantial and statistically significant, indicating that a community's approval for National Flood Insurance creates a strong positive effect on residential development. The results contrast with those reported in a 1982 General Accounting Office study, whose authors found flood insurance to have only a small effect on development. In some versions of our model, we find that building permits were roughly 50% higher in communities participating in the flood insurance program than they would otherwise have been.

such factors as storm damage, flood insurance availability, and the demand for beach services are found to be both significant and of economic interest, the failure of Corps activity variables to significantly affect measured outcomes leads us to conclude that federal action has done little or nothing to stimulate added development in the protected beach communities within our sample.

Summary and Conclusions

Damage caused by coastal storms has prompted debate about the federal government's role in managing the economic risks associated with natural hazards. There has been disagreement on whether federal risk management programs induce development in areas that are prone to damage from coastal storms, as well as on the economic effects of such induced development. The results based on an analysis of our data point to several conclusions regarding the causes of economic development in coastal areas. First, economic growth inland has shifted demand for beach recreation, and thus has been a significant stimulus to development in beach areas, apart from any

Notes

1. This article is based on the monograph *Shore Protection and Beach Erosion Control Study: Economic Effects of Induced Development in Corps-Protected Beachfront Communities*, TWR Report 95-PS-1 (February 1995). The research was supported by the US Army Corps of Engineers, and aided by staff at the Corps headquarters and its New York, Norfolk, Atlanta, Wilmington, and Jacksonville offices. Research assistance by Theresa K. Allman and Ethan Wade of the George Washington University is appreciated. David C. Ling of the University of Florida and Dean H. Gatzlaff of Florida State University provided valuable data.
2. This finding is broadly consistent with a 1992 assessment by the US General Accounting Office.

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