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Sea Level Rise, Government Policy, and Economic Efficiency

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Sea level rise (SLR) is likely to be one of the impacts of global climate change that has significant effects on human welfare. Recent attempts to legislate the rate of SLR used by state agencies in planning have fueled widespread debate in North Carolina about the use of science in setting public policy for land use and infrastructure choices in coastal areas. This article addresses the economic rationales for policy interventions as adaptive responses to SLR. A reasonable and very general definition of adaptation is actions by individuals or systems to avoid, withstand, or take advantage of current and projected climate changes and impacts.

This article proceeds from a conventional public economics paradigm: If for some reason markets systematically produce inefficient outcomes, then some kind of policy intervention may be beneficial. A focus on incentives is particularly useful in discussing adaptation to climate change, since much of the academic and policy discussion has focused on the role of planning and ignored the role played by market processes. Accelerating rates of SLR in the future will cause individuals and private institutions to change their assessment of the likely costs and benefits of alternative courses of action. Public policy should anticipate and incorporate these responses rather than

assuming that only publicly planned responses will take place.

The economic framework for looking at adaptation to sea level rise begins with the changes in conditions caused by SLR and other climate-influenced phenomena, and the impacts of those changed conditions on housing, recreation, and other goods and services produced in coastal areas. According to most scientific predictions, these are likely to include accelerating rates of erosion, greater flooding and wave damage during storms, and increased variability in hydrological conditions. These risks will be consequential long in advance of when sea level actually rises above existing property during non-storm times, and they are expected to have predominantly negative effects on individual property owners and on key elements of infrastructure in coastal areas. Efficient adaptation should not be focused on eliminating these negative effects, but rather should minimize the sum of expected damages and the cost of adaptive actions and policies.

Market Failure

Many of the public decisions that are central to adaptive responses involve goods which economists term “natural monopolies.” These are things like electricity generation or

transportation infrastructure that, by virtue of significant economies of scale, are more efficiently provided by a single entity. Such goods will either be directly provided by government (as in the vast majority of transportation infrastructure) or be significantly regulated (as in electricity transmission or gas pipelines). Government will therefore have a direct role in siting, construction, and maintenance decisions that will influence the explicit and implicit prices affecting private decisions. In one very visible contemporary example, North Carolina and the federal government will need to make decisions about what kind of road, bridge, and ferry network should be chosen for North Carolina's Outer Banks, along with what costly activities should be undertaken to either protect or rebuild those networks in the future. These choices will directly affect the transportation cost and time needs for both residents and visitors, and therefore have significant effects on location and business decisions.

Individual and collective adaptive responses are likely to give rise to spillover effects that impose costs on individuals not targeted by those responses. This provides an additional rationale for policy intervention. For example, managing inlet formation to maintain road and marine transportation links can significantly affect future flooding and erosion risks in other locations. Adaptation to SLR is therefore likely to expand and change the remedies chosen by political and bureaucratic processes to address these spillovers. Direct regulation, incentive-based policies, or redefinition of property rights are common examples of such remedies.

An additional potentially significant source of market failure is incomplete information. If we accept peer-reviewed science as the best available source of information about risk, then much of the market is currently not acting on those predictions. While information about

future behavior is always imperfect, this is a case where the divergence between "expert" and "non-expert" opinion is particularly pronounced. Recent legislation passed by the North Carolina General Assembly forbidding the use of any non-zero predictions about SLR in state planning and policy formation provides an example of how deeply this divide runs.

Government Failure

Government failure is a complementary line of argument for why explicit public policy on SLR could contribute to efficient adaptation responses. The federal government has consistently provided substantial resources ex-post to help those whose property and businesses have been damaged by natural disasters, even when the probability of that damage occurring was foreseeable. This creates a situation of "moral hazard" in which those subject to damage have distorted incentives to engage in protective behaviors (such as improved building construction, greater use of property insurance, or relocation). The National Flood Insurance Program (NFIP) is the clearest example of a policy response to this phenomenon. It is a de facto mandatory program for anyone purchasing a home through conventional mortgage financing, and has resulted in property owners financing a significant amount of disaster-contingent payouts. In addition, communities that participate have been required to impose building standards that lower the risk of damage from flood events.

The NFIP provides partial remedies to both government failure and incomplete information, and thus is an interesting template for policies to address SLR. It removes some of the moral hazard that results from expectations about disaster relief by shifting the cost to the affected parties. It also addresses information failure. People do not gather enough information to understand the benefits of insurance and of protective behavior. Thus, the NFIP's de facto

purchase requirement and its institution of more stringent flood-resistance requirements for new construction arguably bring about outcomes closer to what would be observed if market participants were fully informed.

Flood, Fortify, or Flee: A Question of Timing

SLR is not a discontinuous proposition:

residents of coastal communities do not remain unaffected until the day the water rises into their living rooms. Indeed, by the time sea level rises to the point where everyday water levels are over currently developed areas, those areas will be uninhabited. Climate change generally, and sea level rise in particular, can be expected to increase risk levels from flooding and erosion over time.

Coastal areas are full of people who do not think that the risks of SLR are sufficient to make them move next week or next year. If the central predictions about SLR are correct, however, then there will certainly be some time in the future when high risks of flood and erosion damage, or eventual inundation, are viewed as not worth the risks. Whether that time is half a century or four hundred years into the future is uncertain. Individual residents and business owners will make the decision to leave when the benefits of owning property on the coast no longer outweigh the perceived costs of staying. This transition will depend on the cost, effectiveness, and decision rules for risk reducing actions in the present and near-term future.

Risk associated with remaining on the coast can be reduced by actions taken both individually and collectively. Individual actions include greater setbacks and elevation for buildings, improved construction, and increased insurance market participation. They also include updated decision rules on when to remain on the coast during storm and flood risks, and when to evacuate. Collective actions are likely to produce more significant risk-reduction impacts. Hard structures that hold

back waves and currents reduce risk in the short run, as does beach nourishment. Making energy and water infrastructure more robust to extreme climatic events reduces the cost of living on the coast. Similarly, investments in transportation infrastructure are particularly important to individuals' location decisions.

Certainty vs. Adaptive Management

A particularly difficult issue for efficient adaptation is setting expectations about public expenditures and policies. Markets tend to work best when everybody knows what government policies and expenditure will be. Clear signals about shoreline engineering, transportation infrastructure, and insurance programs will tend to allow efficient ex-ante decisions by individual residents and business owners.

When there is significant uncertainty about underlying future circumstances – which is most definitely the case for SLR – there is a substantial value in updating and changing policy to take advantage of improved knowledge. However, a fundamental tension exists between the advantages of clear public policy commitments made at a given point in time versus the flexibility to alter policies as conditions change. This tension exists for all policies that affect economic decisions; but it is particularly acute in the case of climate change because uncertainties about the timing and level of localized climatic effects are so large. In theory, this can be partially resolved by making policy contingent on specific thresholds. For example, North Carolina could commit to keeping existing coastal road links open until sea level reached some pre-announced level, or until some threshold amount of expenditure were required to keep it open. However, there is little, if any, precedent for successful implementation of these sorts of long-term commitments by governments, and such contingent thresholds are likely to be greeted with significant skepticism by residents and by markets.

Compensation, Incentives, and Baselines

Ideally, the expected risks from accelerating SLR and other climate stressors will be reflected in local decision-making about water and sewer infrastructure, landfill siting, etc. In addition, state and federal decisions about transportation infrastructure will be particularly critical in coastal areas. Simply put, increased climatic risks could mean that more expensive, climate-resistant infrastructure is optimal; or it could mean that reducing these expenditures and living with higher risk levels is the more efficient course of action. The costs and benefits of alternative choices will depend on climatic, geological, and socioeconomic factors that vary from location to location.

Resource transfers that improve transportation infrastructure or subsidize hazard insurance may achieve outcomes that provide substantial benefits to coastal residents. However, because they work to alter prices – the real cost of transportation or of hedging catastrophic risk – such transfers can have the unwanted effect of incentivizing individuals to not take appropriate precautionary steps. For example, beefed-up and elevated roads and bridges reduce the real cost of living in coastal areas, and therefore tend to encourage investment in property and enterprises that depend on road access. The economic ideal for compensation is that it not affect incentives. If individuals receive financial transfers instead of direct or indirect price reductions, then they make more efficient location and investment decisions. However, the public good nature of infrastructure generally renders reaching that ideal outcome unattainable via individual investments. Be that as it may, policy makers should nonetheless pay attention to situations in which well-meaning policies designed to help unfortunate individuals and communities affected by SLR-related risks may create incentives for continuing maladaptive behavior.

This brings up one issue where both science and policy matter. If state or federal programs offer compensation – for example, in the form of buyouts or partial relocation expenses for people whose homes become unsafe because of increased climate-related risk – then the question of baselines becomes important. Someone who bought a home or business in a coastal location in 1992 could not reasonably be expected to have anticipated increased risks from global climate change. However, people making those kinds of decisions in 2012 could be expected to be aware of these risks. Such individuals could also be reasonably expected to be aware that these risks would have lowered market prices for the homes or businesses that they have purchased. Thus, there is a strong case that 1992 buyers should be eligible for compensatory resource transfers while 2012 buyers should not. Establishing some sort of clear signal about how policy will regard reasonable knowledge about risk as a function of time is an important, if institutionally difficult, task in a fair and efficient governmental response to SLR and allied climate risks.

Summary

Sea level rise will likely significantly alter the underlying costs and benefits of living and working in coastal areas, and will do so in a difficult-to-predict and highly variable way. Adaptive responses will come from individual and collective responses to changing incentives. The public sector will be a key determinant of these incentives through its choices about infrastructure investments, risk management policies, and programs to compensate citizens for unfortunate outcomes. This review suggests that public sector policies are essential, but also difficult to craft in an environment of uncertainty and complex dynamic relationships between public and private decisions.