

CLIMATE POLICY

Using markets to adapt to climate change

Research shows if and when markets can help limit the harms from climate change

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Even under the most ambitious greenhouse gas emissions mitigation scenarios, climate change will continue to affect human well-being for generations, with the severity of these impacts differing across mitigation pathways. Adapting to climate change is thus a necessary complement to mitigation. Because individuals, businesses, and communities benefit directly from their adaptation choices, the incentives they face as individuals to adapt are generally stronger than the incentives they face to mitigate emissions. Yet evidence to date suggests that communities are not systematically adapting to recent climate changes (1). What can policy-makers do to facilitate adaptation? Here, we draw on a burgeoning field of economic research on climate adaptation to identify when and how markets can be a promising tool for effective and efficient adaptation.

Climate adaptation is any decision made in response to the climate—from choosing where to live or work to deciding which physical or financial assets to invest in. Adaptation involves not only large public infrastructure projects such as levees and seawalls but also decentralized individual actions. The latter have received less attention from policy-makers but will likely account for a large share of adaptation and have been well studied by economists (2). Examples include a family in New Delhi buying a fan to help stay cool on hot days, or a coastal Louisiana household moving inland to reduce exposure to storms and sea level rise.

Economic policy will shape how populations adapt. Such policies can be categorized on a spectrum from “command-and-control,” where policy-makers mandate specific behaviors, to “market-based,” where economic incentives drive agents to make their own choices. Market-based policies can range from “free markets” with no government participation, to market interventions that aim to align private incentives with social objectives. In practice, society relies on a mix of these strategies. For example, mandating that buildings comply with wildfire safety codes is a command-and-control policy, whereas allowing homeowner’s insurance rates to reflect wildfire risk is a market-based policy. Disclosure requirements are a middle ground, where governments require sellers in a market to disclose climate risk information to potential buyers. Effective adaptation will require a mix of these approaches, including sometimes relaxing or eliminating policies to allow markets to function more efficiently.

Climate change impacts are widespread, with different impacts on each region, industry, and individual. Well-functioning markets can shine in these conditions by using price signals to aggregate and disseminate information without relying on a central authority. Markets can also discipline spending decisions and mitigate perverse incentives that may arise from well-intentioned insurance subsidies, price controls, and post-disaster government spending. As a result, care-

fully designed and regulated markets can, in many cases, encourage the economy to adapt to the complex and widespread impacts of the current climate and future climate change.

But markets are not a panacea. They are enabled, supported, and constrained by government policies. In some cases, there is scope to improve markets—and their potential to enable adaptation—by relaxing policy constraints. In other cases, governments can help create markets that could spur innovation, facilitate risk sharing, or improve natural resource management. Governments can also encourage prices in existing markets to better reflect social costs and benefits. Finally, complementary or alternative policies may be better suited to address concerns around fairness and public goods. Here, we highlight opportunities to use markets for climate adaptation, including addressing failures in existing markets and building new markets. We also discuss cases where markets are insufficient and nonmarket policy tools may be more appropriate.

MAKE EXISTING MARKETS MORE EFFICIENT

Policy interventions can make markets function more efficiently—i.e., increase total benefits to society—by providing information to consumers and creating incentives to provide public goods. In other cases, reassessing potentially counterproductive controls on markets may help them better incentivize adaptation.

Public policy reform to ensure complete and transparent climate risk information is essential for markets to function properly and spur adaptation. Growing evidence shows that financial and real estate markets have historically mispriced climate risk. For example, properties facing high flood risk have been found to be overpriced and underinsured. Policies requiring real estate listings to disclose flood risk can improve market efficiency when they provide relevant, comprehensible, and financially material information early in the buying process (3).

Climate risk information is often a public good, suggesting that the public sector can play an important role in its provision. This can include supporting the creation of climate risk models, paying for their diffusion, and monitoring their quality. Recent advances in high-resolution climate datasets provide new and improved characterizations of climate risks, potentially enabling more efficient risk pricing in markets if this information is widely available. Policy-makers can ensure widespread access to the information that climate risk models provide, which may be undersupplied by private markets or cost-prohibitive for the most vulnerable consumers. The government also has a key role to play in supporting basic scientific research, which underpins these and other technologies that enable adaptation.

Governments can use incentives, both direct investments and subsidies, to direct innovation toward socially valuable technologies that do not yet exist. Directing innovative efforts toward unsolved problems

with large potential social impact—such as improving soy and maize heat resistance—can bring social benefits (4). These benefits may be especially large when there are positive spillovers to others that the innovator does not capture.

Some markets' potential to aid adaptation can be hampered by existing government policy, including price controls and subsidies. Tariffs can constrain markets from delivering appropriate or sufficient adaptive actions and investments (5). Price controls and subsidies in insurance markets can also disincentivize adaptation. Subsidized federal crop insurance disincentivizes farmers from adapting their practices to extreme heat (6). If regulated homeowners' insurance rates do not fully reflect climate risks, real estate market participants will have lower incentives to live in lower-risk locations and to invest in risk reduction. Beyond policies manipulating prices, governments also disincentivize climate adaptation by building infrastructure in, and providing disaster relief to, climate-exposed areas. Removing these subsidies can encourage adaptation by putting the full cost of development on property owners (7).

BUILD MARKETS THAT ARE MISSING

A market is “missing” when a market delivering social benefits could exist but does not. Facilitating market formation is a powerful way to prepare key segments of the economy for climate change. Markets for new adaptive technologies, climate risks, and climate-affected natural resources may improve our readiness for climate change, yet are rare owing to coordination failures, high transaction costs, a lack of monitoring technologies, and low demand likely arising from market participants' limited understanding of emerging risks.

Markets for emerging adaptation technologies, such as climate-resilient staple-crop varieties, often face substantial barriers to development. A key challenge is a coordination failure: Innovators are hesitant to invest in research and development because they doubt a profitable market will emerge, while potential buyers—such as smallholder farmers—cannot credibly signal demand for an unproven product that does not yet exist. This leads to underinvestment in the innovation and distribution of these critical technologies. Advanced market commitments (AMCs) can partially address this failure by having a third-party guarantor commit to rewarding innovators if a new technology they create meets predefined performance and adoption standards. For example, researchers estimate that an AMC for a heat-resilient sorghum variety in East Africa could generate between \$850 million and \$2.5 billion in economic benefits, depending on adoption rates (8).

Markets for innovative financial products that allow for risk pooling and support public finances often do not exist, but can help economies recover from climate disasters more quickly. Example innovations that have helped to address these missing markets include catastrophe bonds that transfer risk to capital markets, securities that diversify balance

sheets and reduce aggregate exposure to climate risks, and parametric insurance that releases funds when an event of prespecified intensity occurs. One success is the Caribbean Catastrophe Risk Insurance Facility (CCRIF), which enables 23 Caribbean and Central American countries to pool their tropical cyclone risk. When a disaster strikes, the CCRIF makes rapid payouts to member governments to finance government operations and immediate relief efforts. Research has shown theoretically that such financial innovations can help reduce the welfare cost of tropical cyclones (9). Multicountry risk pooling mechanisms have been developed for Pacific Island nations and for African Union states. Similar markets in other regions where they do not yet exist can help promote macroeconomic stability in the presence of climate risk.

Similar ideas can work on an individual level, where credit and insurance markets are often missing. For instance, a randomized trial in Bangladesh provided farmers with guaranteed access to credit if their area flooded and found that these farmers were less severely affected when flooding occurred (10). This provision of credit was also profitable for the microfinance institution involved, suggesting that businesses could sustainably develop post-disaster credit markets, creating benefits without external subsidies.

Markets can also facilitate natural resource management by directing resources to their highest-value use, often delivering the greatest benefits during climate extremes (11). Such markets might, for example, enable trade in water rights or allow one party to pay another to conserve an ecosystem. Currently, these markets can be missing because of high transaction costs, unclear or incomplete property rights, difficulties with monitoring and verifying trades, and political constraints.

Governments can help markets form and function by intervening to ease these frictions, going beyond their traditional role guaranteeing property rights and enforcing contracts. In a water market, for example, transaction costs sometimes include assessments that evaluate how water transfers would affect third parties through

changes in flow. A market creator can bear the upfront cost to streamline and standardize these assessments, then recoup those costs through fees paid by market participants. In other examples, new remote-sensing technologies can be used to quantify and track environmental assets that are relevant to climate change adaptation—such as monitoring fish populations migrating in warming oceans and quantifying soil carbon storage—enabling transactions that might otherwise be prohibitively costly. Markets may form around such transactions if integrating these technologies is not onerous.

Creating new markets and actualizing these benefits will require leadership from governments and coordination between researchers, market participants, and market managers. Careful market design, especially regarding the initial allocation of property rights, can help reduce political opposition to environmental markets.



A house near Cle Elum, Washington, was able to survive a wildfire on 14 August 2012. Prior removal of trees and brush from the home's perimeter made this outcome more likely.

WHERE MARKETS ARE INSUFFICIENT

Issues associated with politics, incomplete property rights, the absence of contractual commitments, and social conflict can create obstacles that cannot be addressed by markets alone. When these political economy considerations dominate, governments may need to take a more active role in facilitating adaptation, including through regulation, direct investment, and institution building.

Large public investments, such as seawalls and levees, may sometimes be the best approach to adaptation. These projects should prioritize careful cost-benefit analysis and consider how they will alter private incentives. Whereas markets discipline investments by ensuring balance between costs and benefits, direct government investments may not have such guardrails. For example, recent analyses have found that the net present value of some levees and seawalls may not exceed construction costs (12), and that levees can induce negative spillovers, create moral hazard, and dampen adaptation incentives (13). However, if private investment responds positively to government-provided protection and the government underprovides protection, one equilibrium can involve low government protection and low investment. Coordinating on a more desirable equilibrium with high protection and high investment could require a “big push” with upfront government investment in protection (14).

To effectively manage adaptation, society will likely need to create or modify institutions, and in many instances, only governments will possess the authority to do so. Internationally, we may need institutions for researching and governing behavioral adaptations such as climate migration and conflict. Technological solutions such as solar radiation management also need international coordination and governance. Domestically, governments should build in program evaluations when experimenting with new adaptation policies and ensure that program design reflects the best available evidence.

Market incentives that reward the most profitable ideas may not result in innovation with the greatest social value. For example, recent work suggests that private agricultural innovation is more often directed toward large, developed countries than lower-income countries (15). Using public funds to spur appropriate agricultural innovation for developing countries may be a promising model for adaptation.

Markets alone will not always ensure equity. In such cases, government intervention in markets to protect marginalized groups may therefore be justified. For example, insurance prices that fully reflect risks may lead to unequal consequences that disproportionately burden disadvantaged groups if they live in high-risk areas. One potential consequence is that low-income individuals or businesses could be priced out and no longer able to afford insurance. To address this, some governments subsidize insurance rates or provide insurance in locations where private insurers refuse to offer coverage, such as the Fair Access to Insurance Requirements (FAIR) plans for homeowners in many US states.

At the same time, subsidized insurance can introduce moral hazard, disincentivizing homeowners from undertaking protective investments or migrating to lower-risk areas. Subsidies for protective investments, such as hurricane- or wildfire-resistant building upgrades in the US Gulf states and the western US, respectively, can help to offset these distortions. Likewise, allowing property owners to use fire insurance claim payments to buy new homes elsewhere, as the California legislature explored after the 2018 wildfire season, can counteract existing disincentives to move out of harm's way.

Finally, governments can help actors make privately beneficial decisions by intervening in markets where imperfect or asymmetric information can lead to insufficient adaptation. Insurance mandates and building standards can help coordinate adaptation. Oversight and penalties for predatory practices by insurers and contractors can help protect individuals—who are unlikely to experience more than one or two large insurance claim events in their lifetimes—against exploitation.

Adaptation choices today, from building seawalls to designing

new markets for natural resources, have long-run implications and financial stakes in the trillions of dollars. A rapidly evolving body of research can help guide decision-makers and encourage experimentation in the climate adaptation policy space. Policies that harness the power of markets while addressing their limitations have potential to reduce damages from inevitable climate change. As risks evolve, adaptive policies that are robust to uncertainty and a wide range of possible outcomes are particularly valuable. Without thoughtful policy, society may underinvest in adaptation, and investments may be made in the wrong locations or solutions. The stakes are tremendous and the obstacles daunting, but careful research shines a light on promising paths to a better-adapted future. □

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