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Adaptation in first- and second-best worlds

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Mitigation policies have traditionally been evaluated from the perspective of first-best worlds that have perfect foresight and full and immediate policy implementation. Adaptation assessments typically consider second-best worlds that incorporate the realities of market imperfections, institutional and informational constraints, delayed policy implementation, and other issues. As mitigation analyses increasingly consider the potential effectiveness of policies implemented under second-best world assumptions, it strikes us that their use of first-best and second-best benchmarks is becoming increasingly valuable. It also strikes us that adding the perspective of first-best worlds to adaptation analyses would do the same by providing comparable baselines for national and international assessments integrating the costs and benefits of adaptation and mitigation policies. In addition, adaptation analyses under first-best world assumptions could provide valuable information to policymakers on what *could* be achieved under ideal conditions. It would be very informative for science and policy to understand the benefits, trade-offs, human and financial resource requirements, and residual damages under first-best and second-best assumptions about the rate, extent, and timing of implementation of climate policies.

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Introduction

Global and national estimates of the extent to which adaptation and mitigation polices could reduce current and projected climate change impacts, the trade-offs between adaptation and mitigation, and the potential costs and benefits of these policies often start from different underlying assumptions. Many models evaluating policies designed to reduce greenhouse gas emissions, particularly integrated assessment models, commonly assume perfect foresight and full and immediate policy implementation. These are 'first-best world' analyses assuming a hypothetical situation where a policy works essentially perfectly; that is, such analyses do not take account of the realities of constraints to policy formulation (such as possible consequences or environmental considerations), market imperfections, institutional and informational constraints, delayed policy implementation, social preferences, and other issues [1••,2•].

Evaluations of adaptation policies, by way of contrast, typically have not explicitly explored their possible effectiveness under ideal conditions. Instead, most analyses of adaptation projects and programs (whether autonomous or planned) start from existing constraints to their formulation and implementation, including the realities not included in first-best world analyses. That is, they work in what economists term a 'second-best' world where progress is often slow, erratic, and the result of hindsight (e.g., impacts experienced), with considerable imperfections in information, institutions, political will, and adaptive management [1••,2•]. These imperfections are part of the constraints and barriers to adaptation.

These mismatches in assumptions and direction of analyses have consequences for national and international assessments of the extent to which mitigation and adaptation can be mutually reinforcing in preparing for and managing the risks of climate change. Evaluating trade-offs between mitigation and adaptation becomes difficult, if not misleading, or even impossible, when research results are based on different and perhaps incompatible assumptions. It follows that comparisons of effectiveness, human and financial resource requirements, and the rate, extent, and timing of implementation may provide misleading or irrelevant information for policy action.

1st vs. 2nd best worlds

Creating first-best benchmarks has a long history in economic thought. Economists continue to conduct positive analyses of this policy or that in economic environments *first* under the assumption of perfectly competitive product and input markets — even though perfectly competitive markets are few and very far between. The critical insight is that these analyses produce solid intuitions of what might happen and why. This is why analyses conducted under different second-best environments come second — to see if the results would be different from a world of perfect efficiency, and to use the underlying intuition to explain, without resorting to equations or high-level analytics, why this result could actually make sense and why it might be correct. Whether

it is interesting or important is another matter. Results of analyses of the effectiveness of a particular policy or program in reducing the severity or likelihood of an impact can be quite different in first-best or alternative second-best worlds. But the questions are — by how much and why?

In mitigation, there is growing interest in exploring climate policies under second-best conditions that evaluate policies under constraints on the availability of needed technologies, the timing and efficacy of mitigation policies, the degree of countries' participation in international mitigation agreements, and the degree to which adaptation at any temporal and/or spatial scale can reduce the consequences of residual impacts. These studies typically indicate that market imperfections can have a pronounced effect on the costs of mitigation [3•,4–6] and their net values in terms of currency or simply reduced risk. Because there is never a unique second-best policy mix, however, these studies spend little time comparing themselves to each other, instead comparing themselves to first-best benchmarks. This allows the authors to begin to explore the relative costs of the modeled imperfections *and* the economic values of even partial amelioration of these imperfections, including using metrics that account for uncertainty and attitudes toward risk (e.g., [7,8]).

An adaptation first-best world is one with perfect conditions for designing and implementing a policy; that is, there are no weaknesses in the underlying determinants of adaptive capacity that constrain design, implementation, effectiveness, or monitoring (e.g., no economic, social, institutional, or technological conditions and no lack of political constrain development or deployment of adaptation).

The value of the perspective of 1st and 2nd best worlds

There is significant potential value in providing policy-makers with analyses evaluating the costs and benefits of adaptation and mitigation in internally consistent first-best and second-best worlds, including:

- More realistic assessments of the success of mitigation policies in second-best worlds. Such assessments would further understanding of the severity of possible impacts of climate change (e.g., what will need to be adapted to);
- Joint analyses of adaptation and mitigation, including highlighting the possibility that investment in one may make the other more productive (i.e., they complement one another in the strict economic sense). Such analyses should be based on the commonality of many factors that characterize second-best adaptation and mitigation worlds; and
- Adaptation baselines for future analyses based on descriptions of adaptation first-best worlds. These baselines can provide decision-makers with information on what adaptation could achieve under ideal situations, help prioritize which constraints and limits may be more important to address, and provide additional information on the full range of options achievable with particular policies.

More realistic assessments of the success of mitigation policies in second-best worlds are needed to further understanding of the severity of impacts to which future societies will need to prepare for, respond to, and recover from. If the assumptions underlying analyses of climate policy through integrated assessment models are unrealistic (in their portrayal of implementation efficacies), they can lead to overly optimistic projections of the magnitude and extent of reduction of greenhouse gases. In these cases, current generations will underinvest in adaptation *and* future generations will pick up the bill because they will have to do more.

Factors that define second-best environments for adaptation and mitigation show considerable overlap, including limited knowledge of what polices and measures are needed where and when (which includes understanding not just climate change projections, but also how development will interact with climate change risks), the unavailability of necessary human and financial resources (i.e., imperfect capital markets and government process that do not appropriately discount for projects and programs that complement private investment), the unavailability of appropriate technologies, and limited political will to implement policies. These factors can also interact: benefits and costs of adaptation options (expressed as reduced risk, simple benefit-cost ratios, etc.) depend on mitigation trajectories and the magnitude and extent of climate change. At the same time, the application of adaptive potential affects the benefits and costs of mitigation policies. It follows, as noted above, that adaptation and mitigation can complement one another in the sense of more investment in one makes the other more productive, especially in a policy world that recognizes the need to iterate as we learn and not one that uses uncertainty as an obstacle to do nothing. These and other overlaps indicate that joint evaluations are possible and extremely valuable, but only if these evaluations work with and through common sets of assumptions, comparing themselves with other integrated evaluations as well as against the relative first-best benchmarks.

Taking existing inefficiencies and constraints as the starting points for adaptation assessments limits the information provided to decision-makers and policy-makers about the full range of options that could achieve particular policy goals. Explicit descriptions of adaptation