Policy Effectiveness Assessment of China's Optimal Adaptation and Mitigation

By Hongbo Duan and Shouyang Wang

To limit the global warming-rise below 2 degrees Celsius by the end of this century (relative to the pre-industrial level) arrives at a consensus worldwide; and during the COP 21 of the United Unions Framework Convention on Climate Change (UNFCCC) in 2015, this target has been formally and legally included in the Paris Agreement. To date, the global average temperature has increased by over 0.8°, which implies that the achievement of this goal may be full of challenges (Parry, 2009; Peters et al., 2013); and the implementation of Intended Nationally Determined Contributions (INDCs) mitigation plan of Paris Agreement is hardly enough to keep temperature from exceeding the critical threshold (Reis et al., 2016). In this circumstance, it is of great necessity to start adaptation actions and cope with the climate residual damages that are not avoided by mitigation.

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With respect to the world, the specific countries or regions may suffer more acutely from the global warming impacts, owing to the significant differences in location, climate adaptation capability as well as vulnerability (Baker et al., 2012), implying that adaptation may be even more promising at the regional level (Lesnikowski, et al., 2015; Araos et al., 2016). In this circumstance, we attempt to develop a framework of regional integrated assessment model, coupling with both adaptation and mitigation mechanism, to systematically examine the effectiveness of China's optimal adaptation, and portrait the relative adaptation cost curve; in particular, we explore the influence of induced optimal mitigation, given the 2-degree warming-rise target, on the benefit-cost effectiveness of adaptation.

This research is conducted by employing the regional 3E-integrated assessment model, CE3METL, in which we implement both adaptation and mitigation as well as all the empirical simulations (Duan et al., 2013), and the global 3E-integrated assessment model, E3METL, which mainly provides the emission trajectories for the rest of the world and the references of the global average radiative forcing change and warming rise (Duan et al., 2015). To fulfill the proposed ends, we design several policy simulation scenarios in addition to the reference scenario, i.e., the optimal adaptation scenario, the mitigation scenario under the Paris agreement and the policy mix of both adaptation and mitigation.

On average, optimal adaptation in China could avoid 28% of climate-related damages, with the highest damage-reducing rate reaching 66%. It is worth noting that adaptation alone is far from enough to hedge against all the possible climate change risks, and our result supports that even though no adaptation restrictions are considered, the protection level resulting from adaptation is far from 100%. Similarly, mitigation alone cannot avoid all the climate damages as well; in addition, the effectiveness of mitigation is significantly lower than that of adaptation, implying that in the short term, it remains true that adaptation is more effective than mitigation in response to climate damage reduction at the regional level, particularly for China. What needs to be emphasized is that the given Paris Agreement climate target, i.e., keeping the global temperature-rise from exceeding 2 degrees, is actually much stricter than the INDC plans, which should be largely responsible for the high mitigation cost and low short-term effectiveness. It can therefore be inferred that the policy effectiveness of mitigation would be greatly strengthened if the INDC plans were set to be the target.

Given the higher mitigation costs under the strict 2-degree warming control target, climate change costs in the presence of mitigation is significantly higher than that in the optimal adaptation case, in which adaptation gains the highest effectiveness in avoiding climate damages, and the ratio of benefits to costs increases prominently after 2050, and by 2100, this ratio approaches 2 (Figure 1). In the short run, mitigation may be an expensive way of avoiding adverse climate effects; however, its policy effectiveness would be significantly enhanced as time

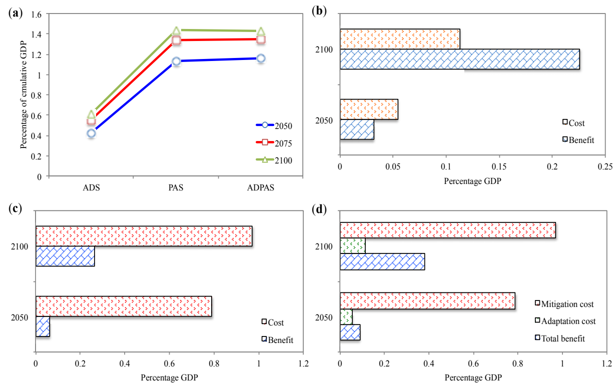

Figure 1. Cumulative costs of climate change across various scenarios (a) and ratios of cumulative benefits to costs (b-d), corresponding to the adaptation scenario, the mitigation scenario and the portfolio scenario, respectively (we choose two time periods, i.e., 2010-2050 and 2010-2100, to accumulate the variables, with the discount rate assumed to be 5%)

progresses, owing to the inertia of the carbon cycle and climate system, the time-consuming process of economic restructuring and energy technology development and switching. As noted by de Bruin et al. (2009), the damage-avoiding benefit of adaptation remains much higher than that of mitigation, even in 2130, and after that, mitigation starts to reduce the bulk of damages. This implies that to successfully and earlier attain the point of effectiveness (i.e., the point at which the policy benefit begins to exceed the relative cost), earlier mitigation-related investment is urgently required.

An important finding is that the effectiveness of a policy mix of adaptation and mitigation in response to avoid climate damages appears not to be '1+1= or >2'. Actually, the policy benefits under the portfolio scenario are far lower than the sum under both the mitigation and adaptation scenarios but are still higher than any single policy scenario (Figure). Thus, there exists a negative interaction effect between mitigation and adaptation, owing to the crowding-out effect of investment. In contrast, the negative effect associated with mitigation intervention will be offset to a large extent by the increasing damage-reducing benefit. As a consequence, the portfolio policy is still the best option to cope with the climate damage risks.

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