IMPLICATION OF FOREST CARBON OFFSET FOR ENERGY INVESTMENTS AND CLIMATE CHANGE MITIGATION COST

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Overview

The availability of Forest Carbon Offsets (FCO) will make reaching net-zero cheaper, as the necessary changes to the energy and production system will be smaller. The trade-off between offsetting through nature-based solutions (nature-based climate engineering) and decarbonizing the economy (mitigation) in the short term comes with long-term implications for the future costs of carbon-free technology, and for the level of confidence we have about reaching and maintaining our emissions target. Moreover, ecological systems, such as forests, have been and will be strongly impacted by climate change. Extreme heat, heavy precipitations, drought and fire events have already increased tree mortality around the world, increasing the risk associated with relying on forest carbon offset to manage anthropogenic carbon fluxes. Additionally, forests are also subject to the continuous risk deriving from human impacts. If the afforested land is not continually and expensively monitored, the risk of suffering from deforestation and or degradation due to "livelihood-hunting" of local people is to be added to the permanence and reliability issues of FCO. This issue is particularly relevant if considering that the majority of the economically feasible afforestation/reforestation projects are located in low-income rural areas, where alternative economic opportunities are scarce.

Looking at the climate change policy scenario, while carbon tax and other climate protection measures aim to increase the relative price of fossil fuels to move the market's interest away from them, FCO allows for a cheap shortcut to avoid a systemic change. In doing so, perverse incentives for moral hazard are created, which will allow companies to postpone, if not avoid entirely, investing in mitigation. The system's belief of being able to use a large-scale deployment of forest carbon offsets (afforestation/reforestation, REDD+, and improved forest management) will trigger a hubristic expectation of its ability to reduce climate change, and thus being unprepared in case of unexpected events.

With this work, we investigate the sensitivity of investment in R&D and deployment of green energy technology, as well as of the use of fossil fuel, to the quantity of accessible FCO deriving from afforestation/reforestation. Moreover, we will calculate the cost the society would incur in case of a not-accounted partial loss of these FCO.

Methods

To understand the implications for the mitigation strategy of using FCO, we employ the WITCH model, an IAM (i.e. integrated assessment model) which is particularly suited for our purpose as it is based on double modelling of the energy sector, including both a bottom-up and a top-down mechanism. In the WITCH model, the cost for solar and wind energy is decreasing with the cumulative installed capacity thanks to a learning-by-doing curve, while the cost for back-stop technologies is subject to a two-factor learning curve given by both the installed capacity and the investment in R&D that acts through a learning-by-researching channel. Moreover, the level of investment and technology deployment is chosen to maximize societal welfare (that is a function of consumption and population).

In this framework, the cost of implementing green technology in the future is function of the current investment decisions and the deployment of technology. These choices are influenced by the expectations regarding the carbon budget available, which can be expanded by making FCO available, or shrank by not allowing FCO. If the system overestimates the quantity or the permanence of these offsets, it will find itself in a situation where the quantity of R&D investment and green technologies deployment are sub-optimal with respect to the actual carbon budget. This would require a sharp re-adjustment of the investment strategy, which, however, will not be able to take advantage of the lower costs that would have followed from the correct foresight of the actual carbon budget. On the other side, fossil fuel will behave in the opposite way, as a higher carbon budget, driven up by the FCO use, make the room for more emissions.

We run the model under different scenarios of the share (i.e. 0%, 20%, 40%, 60%, 80%, 100%) of total FCO (from afforestation) available for the energy sector to perform a sensitivity analysis of investment in R&D and in energy sectors (renewables, fossil fuels, and carbon capture and storage). Moreover, we run the model with and without perfect foresight of deterioration of FCO, and we calculate the differences in the policy cost in case of implementing a buffer strategy and the case of necessary re-adjustment of investment strategies due to forecasted offset loss. While to run the model we use GAMS, all the post-processing analyses are performed in R.

Results

Preliminary results show that on average an increase of 20% of the available FCO from afforestation decrease the cumulative deployment of carbon capture and storage and renewable energy by 0.5% each, and the investment in R&D by 0.6%. On the other side, it increases the investment in the cumulative deployment of fossil fuel by 1.2%, and the investment in the extraction of natural resources sector by 2.8%. These results are not sensitive to the reference level from which FCO from afforestation is increased. This implies that there is no significant difference in investment response whether the 20% difference in available FCO occurs e.g. from 0% to 20% or from 80% to 100%.

The sensitivity of mitigation measures to the share of FCO available to the energy sectors is behind the societal cost deriving from an unexpected loss of some of the FCO. Modelling results suggest that if we account for only 80% of available FCO from the initial year (2020), the world GDP in 2150 will be T$7611.76. However, if we account for 100% of FCO until we realize in 2050 that 20% of them were lost, and then adjust our investments accordingly, the GDP will be T$7606.97. This implies a loss of GDP of T$4.77. The expected final results of this work will provide the sensitivity of the cost deriving from different overestimations of FCO and different correction year. We will also explore how these results will change if we include offsets deriving not only from reforestation, but also from REDD+ and improved forest management.

Conclusions

This analysis shows and quantifies the adverse incentives of FCO for green energy investments, as well as the risk of relying on uncertain nature-based solutions to tame climate change. While we recognize the role of carbon credits in driving investment toward reforestation and forest conservation, we believe it is worthy to underline the economic risks related to this strategy. In fact, while the environmental risks have been extensively discussed in the literature, the economic implications are an aspect that is been often overlooked.

Moreover, we are not hoping to cut the funds that are now flowing toward reforestation and forest conservation. But, rather, we hope this effort will not be used as an alternative strategy to real mitigation but as a means to its end. The moral call towards ecosystem restoration and protection should be followed regardless of its implication for carbon fluxes. Restoring the forest landscape around the world has, indeed, other benefits such as the increase in biodiversity, improvement of air and water quality, as well as the rehabilitation of cultural and religious spaces for indigenous and local communities.

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