Carbon Tax with Alternative Tax-Design Schemes for Ethiopia: A General Equilibrium Analysis

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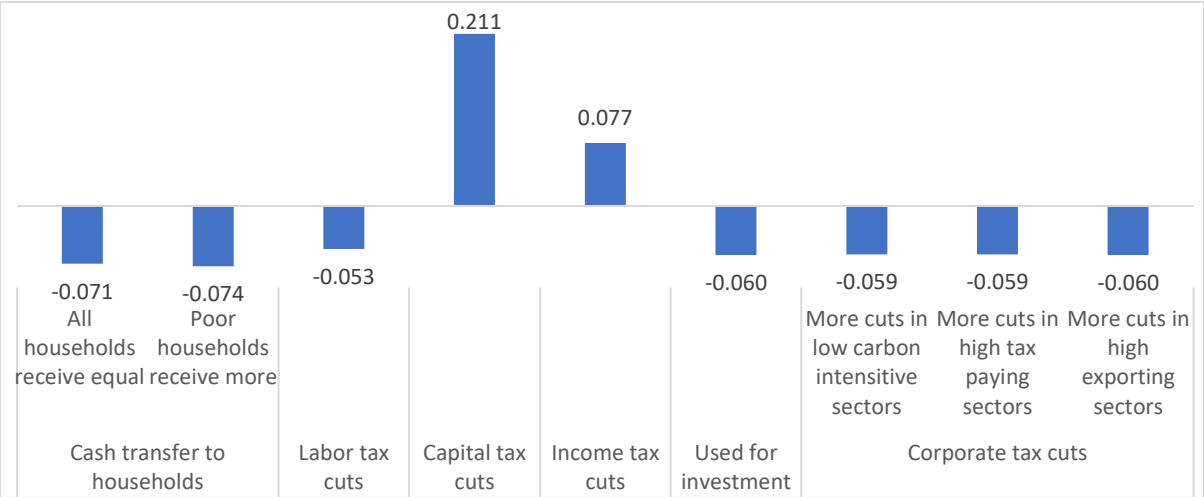
Overview: Ethiopia, a land-locked developing country in Sub-Saharan Africa, has set an ambitious target of reducing its greenhouse (GHG) emissions 68.8% below its projected emissions in 2030 as its nationally determined contribution (NDC) under the Paris Agreement (FDRC, 2021). The country has expressed a strong desire to participate in carbon market opportunities by introducing carbon pricing instruments, such as carbon tax, to achieve the NDC target. However, the economics of carbon tax is highly sensitive to its design architecture, particularly the schemes for recycling revenues generated from the carbon tax (Timilsina, 2022). Any country interested in implementing a carbon tax, therefore, should carefully analyze its economic impacts under alternative design architecture. The government's decision on the introduction of a carbon tax is also influenced by the distributional impacts of the carbon tax. A comparison of the economy-wide costs of a carbon tax across alternative tax design schemes would be highly helpful to policymakers. This study examines the macroeconomic effects, households income, and international trade effects of a hypothetical carbon tax in Ethiopia.

Methodology: We developed a multi-sector, static computable general equilibrium (CGE) model for the analysis. It explicitly represents the behavior of four economic agents: households, national government, enterprises, and the rest of the world. The model has 20 production sectors; each is represented through nested Constant Elasticity of Substitution functional forms. Households behavior is represented through a Stone-Geary utility function, which guarantees the minimal level of consumption of goods and services for households. There are five categories of households in the model distinguished by income quntile. The model first runs a baseline scenario. This is followed by simulations of a carbon tax with four alternative schemes for recycling tax revenues. The model follows the revenue-neutrality principle by not allowing government revenues to fall below the baseline level; if the total government revenue, including carbon tax revenue, exceeds the baseline level, the excess is recycled into the economy. The tax revenue recycling schemes include: (i) recycling the tax revenues as cash transfers to households, (ii) using it to lower existing capital, labor and income taxes, (iii) using it to invest in the economy and (iv) using it to cut existing corporate income taxes. Cash transfer and corporate tax cut scenario are futher divided to sub-scenarios depending on the critaria used to reallocate the carbon tax revenues for these purposes. We developed a social accounting matrix of Ethiopia for the year 2016 to calibrate the model parameters.

Results: We consider a hypothetical carbon tax of US$20/t$CO_2$. It would reduce about 7% of national CO_2 emissions from the baseline It would generate more than 5% of the additional revenues for the government. The emissions reductions and carbon tax revenues do not vary significantly across tax revenue recycling schemes. The economic impacts of the carbon tax (i.e., impacts on GDP) are presented in Figure 1. Our results show that carbon tax would increase GDP when the carbon tax revenue is recycled to cut either capital taxes or personal income taxes (i.e., the sum of capital and labor taxes). Whenever it causes GDP to fall, the loss in GDP would be the smallest when carbon tax revenue is used to cut existing labor taxes. The carbon tax is found to cause relatively higher economic costs (i.e., GDP loss) when the tax revenue is recycled to households as cash transfers. More interestingly, the GDP loss would be the highest when the tax revenue is recycled to households in such a way that poor households receive more cash transfers. It would raise the equity vs. efficiency dilemma while designing a carbon tax architecture. We also find that the economic impacts do not vary significantly across the criteria used (i.e., the sectoral emission intensity, corporate tax rates and export-intensity of sectoral outputs) to reallocate the carbon tax revenue to industries to cut their corporate income taxes. In terms of economic impacts, the ranking of carbon tax revenue recycling schemes is consistent with that reported in most of the existing studies synthesized in Timilsina (2022).

Figure 1. Economic impacts of a carbon tax under alternative tax-design schemes (% loss of GDP from the baseline)



Conclusions: Our study examines the economics of a carbon tax policy to reduce GHG emissions in a developing country, Ethiopia, in Sub-Saharan Africa. We considered nine alternative schemes for the carbon tax design architecture and compared their general equilibrium effects. The study finds that the economic impacts of carbon tax depend on how the tax revenues are utilized. A carbon tax in Ethiopia would increase GDP when the tax revenue is used to cut existing capital taxes or personal income taxes. On the other hand, the carbon tax would cause the highest loss of GDP when the carbon tax revenues are used as cash transfers to households. The levels of emission reductions do not vary significantly across the schemes to recycle carbon tax revenue. Our findings are consistent with those reported in the literature, although economic structures, income levels and energy supply mix are significantly different across the countries included in the existing studies.

References

Timilsina GR (2022). Carbon Taxes. Journal of Economic Literature. Forthcoming.

Federal Democratic Republic of Ethiopia (FDRE) (2021). Updated Nationally Determined Contribution. https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Ethiopia%20First/Ethiopia%27s%20updated%20NDC%20JULY%202021%20Submission_.pdf (Accessed on April 6, 2022).