Climate Change Mitigation Policies and Global Poverty

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Abstract

Mitigating the potential impacts of climate change is one of the leading environmental policy concerns of the 21st Century. However, there continues to be heated debate about the nature, content and, most importantly, about the impact of the policy actions needed to limit greenhouse gas emissions. One major contributing factor is the lack of systematic evidence on the impact of mitigation policy on the welfare of the poor in developing countries. This paper provides quantitative evidence on the poverty impacts of climate change mitigation polices. We consider a scenario whereby a carbon price of $27/tCO2eq is applied to all sectors in all Annex I regions along with a forest carbon sequestration subsidy to all regions. Using a novel economic-climate policy analysis framework, we assess the poverty impacts of the above policy scenario on seven socio-economic groups in 14 developing countries. In general, we find that such a policy scenario increases poverty in 11 out of the 14 countries in our sample. There are, however, differences when we decompose the scenario by policy drivers, including Annex I taxes on CO2 emissions, a tax on Annex I non-CO2 emissions coupled with a forest carbon sequestration subsidy in Annex I countries, and finally, a carbon forest sequestration subsidy in the non-Annex I countries, paid for by the rich countries.

More specifically, the non-fossil fuel GHG tax in Annex I countries boosts agricultural production and helps reduce poverty in countries where there are large concentration of the poor in the agricultural stratum. The fossil fuel tax in Annex I countries is, on average, poverty reducing in the sample of 14 developing countries considered here, but the magnitude of the impact is much smaller. A combination of both fossil fuel and non-fossil fuel GHG taxes in the Annex I region, is more effective at reducing poverty in developing countries. Our results show that a forest carbon sequestration subsidy in the developing countries leads to increased poverty and that happens to be the dominating sub-component of the policy package. There are two forces at work here. One is that such a subsidy bids land away from agriculture and brings substantial benefits to land owners. However, the elasticity of poverty to income changes to land is very small for most countries and this translates to smaller changes to poverty reduction. Furthermore, the subsidy bids land away from agriculture and leads to decline in output of the sector and hence factor income. For most countries, the latter effect seem to dominate and hence the worsening poverty. The second impact is that the inflow of the transfer creates a “Dutch disease” effect, which affects the manufacturing output negatively and reduces non-agricultural income substantially.

JEL classification: Q54, C68, F18, I32, R20, O13

Key Words: Climate Change, Mitigation Policies, Computable General Equilibrium, Developing Countries, Poverty Headcount

I. Introduction

Climate change is a global problem and will require the concerted effort of all governments to successfully address it (IPCC, 2007). Generating a global plan of action, however, is easier said than done. There continues to be heated debate about the nature, content and, most importantly, about the impact of the policy actions needed to limit greenhouse gas emissions. It would be difficult to generate global participation without clear evidence on the economic and distributional implications of climate change mitigation policies. This paper provides quantitative evidence on the poverty impacts of climate change mitigation polices.

Establishing a causal link between climate change mitigation policies and poverty presents a rather complex challenge. First, there are different types of mitigation policies and each has different impacts on production and consumption decisions in countries where the policies are implemented. For example, one mitigation strategy could focus on reducing the use of fertilizers in agriculture, while another policy could target income support in lieu of avoided deforestation. Both these policies affect production and consumption decisions of the household in very different ways. Second, as things stand, it is very likely that most of the mitigation policies are to be implanted in the developed world. This would mean that some of impacts of these policies will be mediated through international trade. Analyzing the transmission of changes in international prices to domestic prices and then linking to the results to poverty is the next level of difficulty in this exercise (de Janvry and Sadoulet, 2008). Lastly, the definition and measurement of poverty itself adds another level of complexity to the problem (Chen and Ravallion, 2001).

Climate change mitigation polices could affect poverty in developing countries either directly or indirectly. A good example of the direct channel is when farmers get paid for avoided deforestation. For example, payments for environmental services (PES) are direct transfers to the farmer and help increase income. Other things remaining the same, one would expect that such payments should help reduce poverty. The indirect channel operates through markets via changes in world prices, domestic prices and factor earnings.

The foregoing suggests that the poverty impacts of climate change mitigation policy depend on a number of factors that potentially vary by country and by region within a specific country. For example, consider a scenario whereby Annex I mitigation policy leads to an increase in the international price of say, an agricultural commodity. How such a price increase translates to poverty depends, for example, on the transmission of prices to domestic markets. That is to say, the change in world prices might differ from local prices (Gardner and Baffs, 2003). Integration of domestic markets will also play a major role. For example, Nicita (2004) shows that that the transmission of higher food prices from the US border to rural communities across Mexico diminishes sharply as one move away from the border region towards the south of that country. At the micro level, a price change might have differing impact depending on status of the household in both product and factor markets. Net sellers of output and labor will probably see an increase in their income from a price rise. In some cases, this income rise might just be enough to cover the consumption impact of a price increase (Swinnen, 2010;Ferreira-Filho and Horridge, 2006). These issues highlight the difficulty in making *a priori* determinations about the poverty impacts of mitigation policies. Thus we are led to the need for an empirical investigation with a tool that is both economy-wide and global in nature.

The paper is organized as follows. Section two will briefly summarize the empirical literature. Section three discusses the method, model and policy scenario that is to be implemented. Section four will highlight the patter of international trade of the 14 developing countries in our dataset. Discussion of the results of the different experiments is presented in section five. Section six concludes the paper.

II. A brief review of the empirical literature

The Kyoto Protocol has designed a number of mechanisms that allows countries to meet the agreed upon targets for GHG emission reductions. The Clean Development Mechanism (CDM), for example, allows a country to invest in emission reducing projects in developing countries. While it is not the ultimate purpose of the CDM to reduce poverty, the transfer of income, technology and ideas could have a lasting effect on developing countries. Gong, Bull, and Baylis (2010) made a review of the first CDM project in China and report a positive and successful result. The authors report that about 55 % the targeted 4000 hectares of the degraded lands were reforested. This relative success has led to the flow of the promised financial flows to the farmers. There were no desire on the part of the authors to test the impact of the project on poverty but these financial flows could be seen as augmenting income of the participating households (Hertel and Rosch, 2010).

Pagiola et al (2004) present one of the very few papers that discuss the poverty implications of payments for environmental services (PES) in Latin America. They argued that there are three basic questions that need to be answered to better enhance the poverty reducing impacts of PES : (a) who are the participants and how large is that group , (b) what type of obstacles prevent the poor from participating in the PES, and (c) what is the impact on participants in the PES (Pagiola et al ,2004). They contend that existing PES arrangements do not always address these issues and as a result the authors remain skeptical about the poverty reducing impact of PES in general. To be effective in reducing poverty, the authors argued, PES should be well targeted to meet local needs.

Antle and Stoorvogel (2008) explored the impact of payments for agricultural soil carbon sequestration on poverty in Kenya, Peru and Senegal. The general message coming out of their case studies is that, while carbon contracts increase aggregate income in rural areas, their impact on poverty is relatively muted. As a result, the authors conclude that payments of environmental services may not always lead to poverty reduction; indeed these payments are most likely to succeed when such transfers are combined with the necessary economic policy and institutional arrangements.

In addition to the above “direct” impacts, climate change mitigation polices affect poverty thorough changes in production and consumption decision of economic agents. For example, the Intergovernmental Panel on Climate Change Report (IPCC, 2001) identifies a likely range of impacts from -0.2% to -2.0% of GDP to meet Kyoto emission targets. Climate mitigation policy could also have an impact on income distribution. In general, the literature shows that in developed countries, carbon tax is regressive, unless complementary policies are introduced to reduce the impacts of the policy on lower income groups (Grainger and Kolstad, 2009; Kerkhof et al, 2008). The impact of the mitigation policy on income distribution depends, for example, on both the magnitude of the tax and the energy intensity of the economy (Hamilton and Cameron, 1994; Symons et al, 1991). OECD (1995) highlights the role of factor mobility and the degree to which impacts result in unemployment i.e. those already in lower income groups are less able to find jobs easily after a shock.

Jorgenson et al (2010) provide a point of departure from the literature that tries to evaluate the costs of climate policies. They use a fully intertemporal model that allows them to measure welfare of any household over time. Added to this is the fact that the model has disaggregated data on households, which differ by region, family size, residence and head of household gender and race. They used this model to assess the welfare impact of a cap and trade system in the US i.e. they imposed emissions limits on greenhouse gases (GHG) of 167 giga-tonnes of carbon dioxide equivalent (GtCO2-e) and 203 (GtCO2-e) over the period 2012-2050.They report that such a policy scenario will have a regressive impact on welfare but they also found that the magnitude of the impact to be rather small.

While the literature documenting the distributional impacts of climate policy in developed countries is growing, there is lack of systematic evidence that links policies implemented in Annex I countries to poverty in developing countries. Much of the recent work examines the impact of Annex I policies on international trade and does not venture to document how such shifts in trade patterns affect wellbeing of the poor in developing countries. It is usually left to the imagination of the reader to figure out how international price changes translate to changes in welfare of the poor in developing countries. One exception is the literature on the global impacts of biofuels. Projections of cost minimizing mitigation policies over the coming century suggest a large role for biofuels in the optimal mix of GHG reducing measures (Rose et al, 2009). Therefore, it is worth reviewing the literature on the global impacts of biofuels policies and their potential impacts on poverty in developing countries.

The study by McDonald et al (2006) is one of the earlier papers to employ the GTAP data base for analyzing the effects of substituting a biomass (switch-grass) for crude oil in petroleum production in the U.S. The results from a direct substitution of switch-grass for crude oil revealed an increase in world price for cereals, but decline in world price of other crops, livestock, and crude oil. Banse et al. (2007) expanded the initial GTAP-E model to analyze the impact of the EU biofuel policy on agricultural markets. Biofuels were introduced in the production structure as a substitution between vegetable oil, crude oil, petroleum products, and ethanol composite. A land supply curve was developed as a relationship between land supply and land rents. This supply curve was used to control for land conversion and land abandonment following the policy shock. Their analysis showed that the target of the EU biofuel policy will not be reached by year 2010 and that the increase in demand for biofuel feedstock will result in a larger agricultural trade deficit.

Birur et al (2008) used a biofuel focused version of GTAP-E to assess the impact of bio-fuel production on world agricultural markets. Their experiments focused on six main drivers of the biofuel boom: the hike in crude oil prices, replacement of MTBE (Methyl Tertiary Butyl Ether) by ethanol as a gasoline additive in the US, and subsidies for ethanol and biodiesel in the US and EU. Their results seem to suggest that with higher crude oil prices, biofuels could be a substituted for petroleum products. They found that the biofuel boom has led to higher demand for feedstocks in the three major producing regions; United States, Brazil and EU. As a result there is change in acreage towards corn in the US, oilseeds in EU, and sugarcane in Brazil, affecting the land area under paddy and wheat in all the regions.

In sum, mitigation policies have the potential to significantly change the workings of international agricultural markets, and consequently, affect the welfare of the poor in the developing world. This important issue has been recognized. However, most of the empirical literature that employs CGE models focuses mainly on the impact of biofuels on poverty. For example, Arndt et al (2008) used a CGE model for Mozambique and report that biofuel investments boost economic growth (by 0.6 percent) and reduce the incidence of poverty by six percentage points. Cororaton et al (2010) combined the World Bank's global CGE model with a global poverty model and report that, in the international market, biofuels lead to higher prices for basic agricultural commodities which translate to higher food prices. Domestically, expansion of biofuels increases the returns to unskilled rural labor. The result of these changes is to increase poverty in South Asia and sub-Saharan Africa but there is poverty decline in East Asia and Latin America regions following expansion of biofuels.

III. Method, data, and policy scenario

The questions we have raised in the previous section will require an understanding not only how climate change mitigation policies affect both domestic and international but also how these changes affect the welfare of developing countries. General equilibrium models come in handy for the type of question we are trying to address. We will combine the modified version of the standard GTAP (called GTAP-AEZ-GHG) with the recently developed poverty module that is inserted in the general equilibrium model to allow for micro-simulation.

The GTAP-AEZ-GHG model used in this paper is comparative static, general equilibrium global trade model (Golub et al. 2010). The model incorporates detailed non-CO2 GHG and CO2 emissions mapped directly to countries and economic sectors, and a forest carbon stock database (Rose et al, 2009). The forestry component of the model is calibrated to outputs from an updated version of the partial equilibrium global forestry model of Sohngen and Mendelsohn (2007). The model has two unique features that make it ideal for the purpose at hand. First, land a heterogeneous endowment that is divided into 18 agro-ecological zones (AEZs). There are six classes of crop growing periods and three climatic zones giving 18 types of land. As a result, each AEZ differs in terms of its suitability for production of crops, forestry and livestock. Second, emissions in the GTAP-AEZ-GHG model are tied to some specific input use or output of a sector. For example, the model allows three types of responses from agricultural production following some type of mitigation policy. These are: input use, primary factor use and output level adjustments (Golub et al, 2010).

Poverty analysis is supported by a special poverty module which has been added to GTAP –AEZ-GHG model following the approach of Hertel et al (2011). Our sample of focus countries comprises 14 countries that come from Africa, Asia and Latin America. These countries were selected based on data availability and the overlap with the GTAP database. While the selection of countries is not random, it does encompass a wide range of developing countries with greatly differing patterns of poverty (Hertel et al, 2011). Within each country, poverty is broken down into socio-economic strata based on primary source of income (95 percent or more of income from the following sources): Agricultural self-employed (farm income), Non-Agricultural (non-agricultural self-employment earnings), Urban Labor (urban household, wage labor income), Rural Labor (rural household, wage labor income), Transfer payment dependent, Urban Diverse, and Rural Diverse (Hertel et al, 2004).

The poverty module utilizes a micro-simulation for representative households at the poverty line in each socio-economic stratum to determine changes in the national poverty headcount. We use the World Bank's $1/day Purchasing Power Parity definition of poverty to ensure comparability across countries (Chen and Ravallion, 2001). Each household maximizes utility obtained from an estimated AIDADS demand system (Cranfield et al, 2003; Rimmer and Powell, 1996). This gives us a new consumption bundle and a new level of utility following any changes in goods prices and factor incomes. The AIDADS demand system is for our purpose at hand due its ability to characterize consumer behavior at low income levels. For example, for each commodity AIDADS provides estimates of both the subsistence quantities of consumption and the propensity of households at subsistence level to spend an additional income on goods and services (Hertel et al, 2011).

The analysis reported here is based on the following equation which computes the percentage change in poverty headcount in a region r, $\widehat{H}_r$:

$$\widehat{H}_r = \sum_s \beta_{rs} \cdot \varepsilon_{rs} \cdot \sum_j \alpha^p_{rsj} \left(\widehat{W}_{rj} - \hat{y}_r\right) + \varepsilon_r \hat{T}_r - \varepsilon_r (\hat{C}^p_j - \hat{y}_r) \qquad (1)$$

Here, β_{rs} *and* α^p_{rsj} represent the contribution of a stratum, s, to national poverty in region r, and the share of income obtained from factor j in that stratum, for a household in the neighborhood of the poverty line. The parameter ε_{rs} is the stratum-specific poverty elasticity, which has also been computed from the household survey data and which describes how a given percentage change in household income at the poverty line translates into poverty reduction in that stratum. The first group of terms in (1) represents the "earnings effect" where changes in wages ($\widehat{W}$) are measured relative to national income (*y*). The second term ($\hat{T}_r$) is the "tax replacement effect" which arises from our assumption that any policy change must be fiscally neutral. This is achieved by adjusting the tax on primary factors of production (income tax). The third term identifies the "spending effect" i.e. the change in cost of living at the poverty line – once again measured relative to national income (Hertel et al, 2011).

In terms of policy scenarios, we consider a climate change mitigation policy whereby a carbon price of \$27/tCO2eq is applied to all sectors in all Annex I regions along with a sequestration subsidy to both Annex I and non-annex regions. The sequestration subsidy for non-Annex I regions is paid for by Annex II regions (Annex I without Russia) and the payment is tied to the level of abatement reported by non-annex regions. The rationale for this policy choice is that under the United Nations Framework Convention on Climate Change (UNFCCC), non-Annex I countries have no mitigation obligations. In addition, Annex II regions are expected to provide the necessary financial resources if non annex countries voluntarily undertake mitigation activities.

We will decompose the above policy package into three sub categories, the first two of which are implemented only in Annex I countries. The components are: (a) Annex I fossil fuel policy; (b) Annex I non-fossil fuel policy including sequestration subsidy, and (c) sequestration subsidy in non-Annex regions. This decomposition exercise provides better insights into the major policy drivers behind the results. We make use of the sophisticated "subtotal" numerical integration technique of Harrison, Horridge and Pearson (2000) in which the combined policy effect is precisely partitioned among the three policy components.

IV. International Trade Patterns of Focus Countries

The strength of the trade link of the countries in our dataset with Annex I regions will play a prominent role in determining both the direction and magnitude of the impact of Annex I climate change mitigation policies. In this section we will provide a brief overview of the trade patterns of developing countries vis-à-vis Annex I regions.

Tables 1a and 1b report the average trade specialization indices covering the period 1975 to 2002 for the focus countries and aggregated commodities. Trade specialization is calculated as: (X-M)/(X+M) where X stands for exports and M for imports, both in value terms. The index attains a minimum value of -1 for a country that imports but does not export a particular commodity and +1 for a country which is specialized as an exporter of a particular commodity. We start our discussion with trade structure of agricultural commodities and the first block of columns in Table 1a shows the figures. The first thing we note is that only 6 out of the 14 countries in our sample have maintained their net export status of agricultural commodities over time. In addition, the index values of these net exporting countries have declined over time, probably suggesting that countries have reduced their dependence on agriculture for export. Malawi, Vietnam, and Thailand are the only countries who have maintained an index value higher than 0.6 over three decades. Countries like Brazil, Colombia and Indonesia seem to have reduced their dependence on agricultural exports substantially. Zambia and Chile both have moved from net importer at the beginning of the period to being net exporter by the end the period. Peru, Venezuela and Bangladesh are net importers of agricultural commodities. Philippines is the only country in our sample that has moved from being net exporter at the beginning of the period to a net importer status by the turn of the century.

Turning to trade in livestock, we see that only four countries have maintained their net export status over time. Brazil is the only country which has over time become more specialized in livestock trade. Thailand has more or less maintained the same level of specialization while the net exporter status of both Indonesia and Vietnam has declined substantially over time. Close to half of the countries in the data are however, net importers of livestock commodities.

Table 1b focuses on trade specialization in non-agricultural commodities. The first set of blocks report the figures for fossil fuel commodities. It comes as no surprise that only few countries are net exporters of fossil fuels and that the specialization indices are much higher for these commodities. Countries like Venezuela, Mexico, Indonesia, and Vietnam have maintained their strong net export status over three decades while most of the countries in the dataset are strong net importers. Colombia has moved from net importer to net exporter of these commodities over time while the exact opposite is true for Peru. The second set of blocks of Table 1b also reports trade in textiles and related commodities. We note the following points. First, the specialization indices for these goods are a lot smaller compared to the other commodities reported in Table 1a, which implies that there is little complete specialization for such types of goods. Second, Bangladesh and Thailand have both maintained their net export status of these goods over time and have the highest specialization indices with in the group. Venezuela, Chile, and Mozambique are strong net importers. The specialization indices for these countries, however, have declined (in absolute terms) over the years.

The final block of Table 1b reports trade specialization indices for manufactured goods. Perhaps not surprisingly, 9 out of the 14 countries in our focus countries are net importers of manufactured goods and have been so for over three decades. The only two countries that have maintained their net export status, albeit with very small specialization indices, are Chile and Zambia (mainly because the mining sector is included with the other manufacturing aggregation). Mexico and Indonesia have moved from net importer at the beginning of the sample period to net exporter status by 2002.

Focusing next on bilateral trade with Annex I regions, Tables 1d and 1e show the share of each of the focus country's total trade that is specifically with the Annex I region. Most of the focus countries rely on Annex I market as a destination for more than two-thirds of their exports of agricultural commodities. Bangladesh and Thailand are the exception to this observation in the sense that export share to Annex I is less than half of total exports for Vietnam and much lower (19 percent) for Bangladesh. There is, however, greater variation when it comes to sourcing of agricultural imports from Annex I region. Not surprisingly, African countries import little of agricultural commodities from Annex I region while for East Asian and some Latin American countries, Annex I is the source of close to half of imports of these commodities. Any change in the direction of Annex I agricultural trade will therefore have significant effect on countries like Philippines, Thailand and Venezuela who import more than fifty percent of their agricultural goods from that region. Even greater reliance on Annex I region both as import source and export destination is exhibited for the manufacturing sector. The last two columns of Tables 1c and 1d provide the necessary data that goes with this story. For example, with the exception of Colombia and Mozambique, more than fifty percent of exports of light manufacturing are destined to Annex I markets. A similar story holds for exports of heavy manufacturing. On the import side also, Annex I is the major supplier of manufactured goods, with slight regional variations. For example, African countries source less than forty percent of their imports of manufactured goods from Annex I region, while East Asian countries are much more dependent for that market (between 56 and 68 percent of total imports).

V. Results and Discussion

Our presentation of the results will proceed as follows. For each policy simulation, we will first present the macroeconomic effects. We believe it is important to consider the macroeconomic impact of the shocks and consider the distribution of the shocks across macroeconomic aggregates, factor earnings, and the cost of living. Then we will proceed to discuss the poverty effects of the policy. With four experiments, seven strata, and 14 developing countries, there are over 500 poverty changes results following the implementation of the above policy package. A summary statistic is needed. For that, we will borrow what Hertel et al (2007) have called the "sign consistency" statistic (SC henceforth) of poverty impacts of each policy. This statistic takes the ratio of the average change to the average absolute value of changes. This statistic lives in the [-1, 1] range. For example, if the impact of a given policy on a specific stratum of the population gives us -1, then we conclude that the policy is poverty reducing in all countries. Before going any further, however, we say a few words on the terms of trade mechanism and how it works in our model.

One of the most important mechanisms in which mitigation policies in Annex I are transmitted to non-Annex countries is through changes in the terms of trade (TOT). The TOT measures the relative difference between export and import prices. However, in a general equilibrium setting sorting out the impact of changes in export and import prices of different commodities in order to explain why a given country experiences a terms of trade gain or loss is a challenging task. A helpful approach to decomposing the terms of trade effects is provided by McDougall (1993) who decomposes the percentage change in the terms of trade for a given region into three separate effects – the world price effect, the export price effect and the import price effect:

$$tot_r = \sum_i S_i^{Xr} P_{Xir} - \sum_i S_i^{Mr} P_{Mir}$$

$$= \sum_i (S_i^{Xr} - S_i^{Mr})(P_{Wi} - P_W) \ + \sum_i S_i^{Xr} (P_{Xi} - P_{Wi}) \ - \sum_i S_i^{Mr} (P_{Mir} - P_{Wi})$$

Change in TOT = World Price Effect + Export Price Effect - Import Price Effect

The world price effect equals the sum over all traded commodities of the product of a country's net trade share (the difference between export and import shares for commodity i), ($S_i^{Xr} – S_i^{Mr}$), and the change in the price of i (e.g., rice), P_{Wi} relative to an index of average world prices for all products, P_W. The world price effect is positive in the case of a net exporter of a commodity for which Annex I reform lead to higher world prices. There is product differentiation in all commodities in this model since the Armington trade structure ensures that rice produced in one country is differentiated from rice produced in another. This gives rise to two more TOT effects, in addition to the world price effect – namely the export and import price effects. The second component in the terms of trade decomposition is the export price effect which is the sum of export share-weighted relative price changes where the relative price change is the ratio of the exporter's price for commodity *i*, P_{Xir}, relative to the worldwide average price for commodity i, P_{Wi}. The degree to which the two prices can diverge is influenced by the degree of product differentiation in the market for commodity i. The last component in the above equation is the import price effect and refers to the import share-weighted change in the country-specific import price index, P_{Mir}, relative to the average world price index, P_{Wi}.

5.1. Poverty Impacts of Fossil Fuel Tax

This section begins with the discussion of the macroeconomic impact of Annex I fossil fuel tax and then moves to show how that translates to poverty changes across developing countries. Table 3a summarizes the TOT impact of the components of the policy scenario we presented above. The first column of Table 3a presents the TOT changes following fossil fuel tax in Annex I regions. We make the following observations. First, the tax leads to increased user cost of fossil fuels, thereby reducing consumption. The world market price of fossil fuels declines in the face of declining demand in Annex I regions. As a result, countries like Mexico, Columbia, Venezuela, and Indonesia which are net exporter of these commodities now face deteriorating terms of trade. Both the world price effect and export price effect (from the TOT equation above) work in the same downward direction to worsen the TOT of these net exporters' fossil fuel commodities (see Table 3b). On the other hand, net importers now face declining world prices and pay less for their imports. For these group of countries, the world price effect and import price effect work in their favor to (declining import prices improve the terms of trade) to improve the TOT. Second, while prices of other commodities change, the overall terms of trade impact of the tax is dominated by what happens to fossil fuels (not shown here). In general, we find that the TOT deteriorates in 6 out of the 14 focus countries in our data (see Table 3a).

The above TOT changes are bound to have ramification on the domestic economy of the focus regions. Table 5a reports the relative price impact of the changes in on some key variables of interest. The average percentage change in private household earnings is reported in the first column. With the exception of Columbia, Venezuela, and Vietnam (net fossil fuel exporters, see Table 1b) all countries experience an increase in per capita earnings or real appreciation. To arrive at the real welfare impact, we need to take into account the effect of changing domestic prices. The column named "CPI" shows that the price that consumers have to pay for goods and services increase in most cases. Column 4 of the table therefore reports the real per capita welfare impact of Annex I fossil fuel tax policy. We now see that per capita real income rises in 8 out of the 14 countries in our dataset. What is important to note is the fact that with the exception of Venezuela and Vietnam, most of the gains or losses are very modest (less than half a percent).

Table 5a also reports the relative earnings impact of the tax policy. Here the changes in factor earnings are reported relative to national per capita income. Relative returns to land decline in most countries, with Colombia, Indonesia, Vietnam and Venezuela the only exceptions. The increase in returns to land for these net fossil fuel exporters has a lot to do with the expansion of the agricultural sector following the substantial decline in output of sectors like gas and oil production. With agricultural returns falling in most countries, it is not surprising to see relative returns to capital, mainly used in the non-agricultural sector increase.

The final block of columns in Table 5a report changes in the prices of food, manufactures, and services relative to the CPI for each country. With few exceptions, Bangladesh, Brazil and Thailand, the relative price of food increases across countries. The magnitude of these changes are, however, very small and are usually less than 1 percent. Fossil fuel tax in Annex I boosts exports of both agricultural and manufacturing goods as resources are released from fossil fuel intensive goods. This increases the international competition of exports. As a result, we see that our focus countries face lower prices for manufactured goods. Annex I fossil fuel tax also results in shift of relative prices of food versus manufacturing. Service prices rise in every country, with Malawi, Philippines, and Venezuela being the only exceptions.

We are now in a position to discuss the poverty impacts of the Annex I fossil fuel tax. We start the analysis first by discussing the drivers of change i.e. factor prices, subsidies/taxes, and the cost of living. Table 5b reports these results and the first point to note is that capital and labor employed in the non-agricultural sector realizes positive gains for most countries in our sample, with SC values higher than +0.74. The relative returns to factors used in agriculture experience a decline but do so in a less consistent manner across countries. The table also shows that poor households in countries like Colombia, Indonesia and Vietnam see improvement in relative returns from all sources of income. It also happens to be the case that the policy has a much bigger impact (see the AAV) on the returns to factors employed in the agricultural sector whose real return has now declined. This basically implies that the earnings driven poverty impacts from this policy is expected to be higher in the strata where income from factors employed in the agricultural sector contribute a significant share.

The relative cost of living at the poverty line (final column of Table 5b) shows a mixed picture and the cases for Colombia, Venezuela, Mexico, Indonesia, and Vietnam need further explanations. The falling world price for fossil fuels hits Venezuela hard and leads to 3 % decline in national income. This decline was enough to overcompensate he falling consumption prices of commodities and lead to a higher cost of living at the poverty line. For Colombia income falls (-1%) and this was accompanied by a small rise in consumption price for staples.

For Indonesia and Mexico, the increase in the cost of living at the poverty line is coming from rising consumption prices of agricultural commodities. The “tax” column of the table shows the impact of tax replacement. Our experiment involve no tariff changes so the observed tax changes are due solely to the tax interaction i.e. the policy scenario affects consumption, production, trade and the associated taxes. The positive sign for most countries suggests that lower fossil fuel prices diminish tax revenues and require a small increase in the form of tax replacement.

We will now aggregate the earning effects across factors and translate them into poverty changes by stratum (see Table 5c). We find that poverty falls in the earnings specialized in non-agricultural strata and self-employed labor in both urban and rural areas. The fall in poverty is consistent across our group of countries with SC values above -0.9. There is a general increase in poverty in the agricultural, transfer dependent and diversified households across our sample countries. Much of the variation in the poverty change for the agricultural stratum in our sample of counties is driven by events in Colombia, Indonesia, Vietnam and Venezuela. We are now in a position to say a few words about the national poverty impacts of the policy. To do so, we aggregate the earnings impacts across strata and add the changes in both taxes and cost of living.

Table 5d summarizes the national poverty impacts separately by earnings, taxes, and cost of living changes. The table also reports their combined effect, which is the total impact on national poverty head count. We see that the earnings impacts on poverty, while mixed, are on the balance poverty reducing. Earning changes from Annex I fossil fuel tax contributes to national poverty reduction for those countries where the non-agricultural stratum contains a relatively large share of the poor (e.g. Peru and Columbia). The earnings effect, however, contributes to increase poverty in those places where the agricultural stratum has a relatively dominant share (e.g. Mozambique and Malawi). The cost of living effect tends to raise poverty in 6 of the 14 countries in our sample. As discussed above, places like Venezuela and Vietnam experience overall GDP decline that contributes to an in increase in the relative cost of living at the poverty line. With the exception of Peru and Zambia, the earnings and spending effects are working in opposite directions and the overall impact of the policy on national poverty will therefore depend on the relative magnitude of the respective changes. There is a rise in poverty in Bangladesh and Chile and this are places where the earning effect dominates the decline in cost of living. In Bangladesh, the diversified households and the agricultural stratum constitute about 52% of the total poor in the country and, as discussed above, these two groups of households witnessed substantial decline in income following the policy implementation. A similar story holds for Chile where the diversified and agricultural strata make up about 53% of the poor. The increase in poverty for Venezuela, Mexico and Vietnam is attributed to the dominant increase in the cost of living, an issue we have discussed above. Malawi has a substantial share of the poor making a living solely out of agriculture (54%, see Table 2a) and that has contributed to the rise in national poverty. .

5.2. Poverty Impact of Non-Fossil Fuel Tax[1]

To discuss the macro impact of this policy, we will go back to Table 3a and focus on the third column. This policy leads to substantial decline in domestic output and by implication in volume of trade of agricultural commodities in Annex I countries (not shown here). These volume changes in trade encourage exports from non-Annex I regions. We make the following general observation. The world price of agricultural commodities rises while that of most of manufacturing goods decline following Annex I non-fossil fuel tax. Brazil, for example has a specialization index (see Table 1c) of 0.54 in agricultural commodities making it a net exporter while Mexico had an -0.11 index making it a net importer of these commodities. Brazil will benefit if the policy leads to increase in the price of agricultural commodities while the opposite will be true for Mexico. Table 1 provides support for this intuition and we see that strong net exporters of agricultural commodities like Brazil, Malawi, and Vietnam will see improvements in the TOT coming from both the world and export price effect. In these three countries, the world price effect dominates the overall picture. Countries like Mexico, Venezuela, and Mozambique are net importers and suffer TOT deterioration.

Table 6a shows the impacts of these TOT changes on relative price changes, where by the later are broken into earnings and spending categories. With the exception of Malawi, all the changes in the national index of primary factor prices are less than 1 percent. The same story goes to the impact on the national consumer price index (CPI column). Taking the difference between the two columns we arrive at the real per capita income, which declined in 10 out of the 14 focus countries in our sample. The relative earning impact of this policy tells the following story. Relative returns to land generally increase; with Mozambique being the only exception.

[1] This experiment also includes sequestration subsidy in Annex I regions.

The returns to capital and skilled labor decline uniformly across our focus countries. It is to be recalled that Annex I tax on non-fossil fuels encourages exports of agricultural commodities from developing countries boosting returns to factors employed in that sector. The increase in export demand for agricultural commodities leads to an increase in the relative price of food products in all countries. On the other hand, increased international competition in the manufacturing sector leads to lower demand and lower prices across the board. A similar story holds for service sector where price in our focus countries decline uniformly.

Next, we consider the poverty impacts of the non-fossil fuel component of the policy package. Table 6b reports the impacts by earnings drivers, tax replacement, and cost of living. Non-fossil fuel policy particularly affects the agricultural sector in Annex I regions and results in output contraction and that encourages agricultural exports and output expansion from developing countries. Accordingly, we see that the relative returns to land, labor, and capital employed in agriculture all increase uniformly for all countries, save Mozambique. Relative returns of non-agricultural factors decline for all countries. The only exception is that of returns to unskilled labor which show a rather mixed outcome across countries. We should however, mention that the magnitude of the policy impact on this source of income is also the lowest among earning types. The increased demand for agricultural exports from developing countries puts pressure on domestic demand and leads to higher commodity prices and higher cost of living at the poverty line. Malawi is the only exception to this rule, where the change in income (2.8%) over compensates the rise in consumer prices leading to the reported decline in the cost of living. The change in taxes is very minimal as there were no changes in tariffs and hence no need to raise income taxes.

As before, we aggregate the earnings effects across factors and translate them into poverty changes, by stratum (see Table 6c). We now find that poverty declines in the agricultural and the diversified (both rural and urban) stratum. For some countries (e.g. Indonesia, Malawi, and Thailand) agricultural unskilled labor constitute a significant share of income for the diversified households. The decline in poverty for the above groups is consistent across countries as supported by the SC which is close to -1(recall that a -1 sign implies a uniform poverty reduction across countries). The other strata witness poverty increase, but there is less consistency with SC value which barely above 0.3.

Table 6d summarizes the national poverty impacts of fossil and non-fossil fuel policy in Annex I regions. The first column shows the poverty share-weighted sum of the percentage changes in stratum poverty headcounts due to earnings. Here, we see that the earnings impacts on poverty of non-fossil fuel policy are poverty reducing. This result is consistent across countries and the SC statistic attains its minimum value (-1). On the other hand, the cost living impacts are poverty increasing except for Malawi. The final column reports the total impact of the policy, taking into account the combined earnings and cost of living changes. Poverty falls in 10 of the 14 regions which implies that non-fossil fuel tax in Annex I regions is poverty friendly.

To recap, the foregoing discussion on the two types of policies seem to indicate an interesting result in that fossil fuel tax in Annex I helps nonagricultural households in the focus countries while and non-fossil fuel tax helps agricultural households. We tested this observation by running an independent simulation that consists only the two policies noted here. Tables 7a provides support for the idea that combining the two policies will help reduce poverty across our all types of income specializations. Table 7b generalizes the strata result to national poverty change. The overall narrative of the story remains the same as the average impact of the earning effect (-0.5) is higher than the sum of the tax and cost of living changes combined. The SC value is -0.92, indicating that poverty declines consistently across our focus countries and this poverty reduction is more consistent than either of the component policies alone.

5.3. Poverty Impact of Forest Carbon Sequestration Subsidy

We consider the macroeconomic impact of the sequestration subsidy in non-Annex I regions. As mentioned above, Annex II regions pay non-Annex regions for the sequestration activity and the level of payment is based on the amount of actual abatement achieved. The impact of this policy experiment comes from two sources; the shift in land use and the impact of the monetary transfer on macroeconomic variables of interest.

The first order impact of the sequestration subsidy is to lower the cost of land to forestry and increase the return to land owners. The changes in land rents will lead to changes in land use. Land in commercial forestry increases as expected, while land available to other agricultural activities declines. The sequestration subsidy therefore bids land away from agriculture does so in all our focus countries. This leads to decline in output of the majority of land based agricultural activities (see Figure 1). The increase in return to land will be good those households that specialized in forest based products. This benefits countries where agriculture contributes the largest share of total poor (for example, Chile) or where elasticity of the head count to changes in income is highest (for example in Philippines). For other countries, however, the decline in agricultural output will reduce non-land factor earnings (by reducing labor employment).

The second force that is at work here has a lot to do with the impact of the amount of financial flow, which has the potential to create what is called the “Dutch disease” phenomenon. For example, the sequestration subsidy transfer is about 4 % of national income in Brazil and Colombia and the same ratio is about 6 % for Malawi. Such substantial rise in revenue increases usually leads to appreciation of the real exchange rate and that draws resources (e.g., labor) away from the manufacturing sector (Pearson, 2011). Such a scenario is expected to reduce output of the manufacturing sector. However, it is very difficult to net out the impact of financial flows in our model given the way we set up the initial sequestration subsidy experiment. To see the impact of resource inflow, we run a separate experiment whereby the model was shocked by an amount that is equal to the total amount of subsidy non-Annex I region received. Table 4 reports the results of this simulation, focusing on the change in focus country TOT. With the exception of Mexico, Philippines and Thailand, all other focus countries experience TOT appreciation. If we look back at Figure 2, we note that countries that receive a higher amount of subsidy (as % of GDP) experience the highest TOT appreciation rate. That is, Malawi, Zambia, Brazil receive a subsidy that is above 4 % of GDP and there countries experience a substantial TOT appreciation. This has implication for both production and consumption decisions of households in a country. For example, Brazil, with a 6.5 % TOT appreciation, can now consume more imports, or export less and consume more domestic production. On the other hand, with a deteriorating TOT Mexico can afford fewer imports for a given amount of exports and real consumption is expected to decline. We found some support for the “Dutch disease” where in places like Brazil, Colombia and Malawi the manufacturing sector (e.g. heavy manufacturing) declined by more than seven percent(see Figure 3). Other authors have found similar “Dutch disease” effect in other types of mitigation policy scenarios. For example, Burniaux et al (2009) argued that Dutch disease reduces welfare in Eastern European countries if there were full emission trading among Annex I countries. Mattoo et al (2009) document similar effect in China and India where manufacturing sector contracts following the financial transfers from emission trading.

Table 8a briefly summarizes the above points by focusing on some key variables of interest. With the exception of Thailand and Philippines, the changes in the national index of primary factor prices are both positive and substantial in magnitude. Both Philippines and Thailand receive the least amount of sequestration subsidy (see Figure 2) and see little to no impact following the sequestration subsidy. In addition, per capita earning impact dominates the rise in the consumer price index leading to a real increase in welfare. The next block of Table 8a shows the relative earning impact of sequestration subsidy. As expected, the overall picture is dominated by the substantial rise in the returns to factors used intensively in forestry i.e. land. All other factors of production in all focus countries witness declines I n the relative to the national per capita earning.

Table 8b reports the poverty impacts of the policy on relative factor earnings. The first thing we note is that the relative returns to land increases substantially across all countries in our sample. The SC value attains its maximum value of +1.The relative return to other income sources take a big hit and decline almost uniformly across countries. These observations raise the expectation that sequestration subsidy leads to poverty decline for those households that derive substantial income from land. In our model, there are two factors that determine the mapping between earning drives and national poverty change; the earning share of land and poverty elasticity of the stratum where land is relatively important. We will briefly discuss both these factors. First, the share of income derived from land is relatively important for those households specialized in agricultural activities but land also shows up in the diversified (both rural and urban) households albeit with a much smaller share. Second, in the agricultural stratum, the role of land as a source of income differs markedly across countries with highest shares observed in Philippines (64%), Zambia (28%) and Chile(23%). For all other countries in our sample, the agriculture specialized households derive most of their income from sell of unskilled labor and the contribution of income from land is less than 8%. Third, the share of income from land in the diversified households is barely above 1%, the only exception is Philippines where both rural and urban diversified households derive about 20% of their income from land activities. Fourth, there is also significant regional variation in terms of the elasticity of poverty head count with respect to income at the agricultural stratum across countries. The last two columns of Table 8b show the tax replacement and cost of living changes. As expected, income tax declines following the provision of the subsidy and the decline is consistent across countries. The exceptions for this observation are Philippines, Thailand and Vietnam. For these countries, the amount of money received for the actual abatement was not enough to cover lost revenue due to tax interaction effects. The cost of living rises for all but Brazil, Malawi, Vietnam, and Zambia; this can be traced to the greater proportion increase in income in these countries that drives the results.

We are now in a position to aggregate the earning effects across factors and translate them to poverty changes, by stratum. Table 8c summarizes these results and provides support for the narrative outlined above. The uniform rise in land returns did not translate into a uniform poverty decline in the agricultural stratum in our sample countries. A combination of low elasticity (e.g. Colombia) and low share of income from land (e.g. Brazil) have conspired to increase poverty in the agricultural stratum for 9 out of the 14 countries in our sample. We see poverty decline in places where land is an important source of income for the agricultural stratum. Countries where this ratio is highest include Chile (23% of total income), Philippines (65%), and Zambia (28%). Rural diversified households also derive income from agricultural activities and the pattern of poverty reduction we see for the agricultural stratum is more or less repeated for the rural diversified households. The average impact of the policy on the diversified households in our sample is driven by results in Philippines and Thailand, where we found higher returns for land and agricultural labor and capital.

Table 8d summarizes the national poverty impacts of the sequestration subsidy that is provided to non-Annex I countries. The first column shows the poverty share-weighted sum of the percentage changes in stratum poverty headcounts due to earnings. The earnings impact of the policy, on average, is poverty increasing. The next column shows that the tax replacement is working to reduce poverty across countries. It should be recalled that the subsidy for sequestration abatement is helping to boost government revenue and that implies income tax reduction through tax replacement. The final column of Table 21 shows the contribution of the cost of living to poverty changes. On average, the cost living impacts of the policy is such that poverty increases in 10 out of the 14 regions in our sample.

5.4. Overall Impact of the policy package

Table 9a reports the total effect of the mitigation policy on relative factor returns, cost of living and tax changes. We make the following observations. First, we see is the impact of the policy is to boost relative returns to land and this true for all countries in our sample. Second, the relative returns to all other earning types decline and do so in a consistent manner in our sample regions with SC values above -0.8. Third, taxes decline in all countries, save Philippines and Thailand, where the subsidy provided was not high enough to balance out the tax interaction effects. Fourth, the final column of the table tells us that the policy package leads to increase in the relative cost of living at the poverty line across countries. The cost of living component of poverty change is the product of the percentage change in the real cost of living at the poverty line and the stratum-specific elasticity of poverty with respect to real income derived from the survey data. For places like Brazil, Malawi, and Zambia, the increase in the price of staples was counter balanced by the more than proportionate rise in income leading to decline the relative cost of living.

We will now aggregate the earning effects across factors and translate them into poverty changes, by stratum (see Table 9b). We now find that poverty declines in the agricultural and the diversified (both rural and urban) stratum, albeit less consistently with rather small but negative SC values. There is a general increase in poverty in the non-agricultural and the wage labor dependent households in both rural and urban areas. In fact, the magnitude of the policy impact (AAV) is higher for these later groups of households. This tells us that we will see poverty rise for countries these later groups dominate in terms poverty composition.

The national poverty changes are simply the sum of earnings impacts across strata (by using the appropriate weights) and combine this with the poverty impacts of changing taxes and consumer prices. Table 9cd depicts these results of the national poverty impacts separately for earnings and cost of living changes, in addition to their total sum (last column). Earnings changes from the policy experiment are poverty reducing in 6 out of the 14 countries in our sample with poor households in Chile witnessing the largest improvement in earnings. The cost of living impacts while mixed are generally poverty increasing. In sum, the poverty reducing earning effect dominates the cost of living change in only three countries: Chile, Philippines and Thailand where we actually see reduction in the number of poor people below the poverty line.

VI. Conclusions

Mitigating the potential impacts of climate change is one of the leading environmental policy concerns of the 21st Century. The science of climate change has made significant contribution to our understanding of the implications of warmer global climate to our survival. However, both climate change and the policy responses are fraught with uncertainties (Webster et al, 2002). As a result, the design, implementation and impact of climate change mitigation policies generate heated debate. This paper has sought to identify the impacts of climate change mitigation policy on farm households in poor countries. It has done so via innovative use of household survey data that identifies the income sources and degree of earnings specialization of households (Hertel et al, 2011).

The paper documented the poverty impacts of : (a) fossil fuel tax in Annex I; (b) non-fossil fuel tax in non-Annex I countries along with a forest carbon sequestration subsidy, (c) sequestration subsidy in non-Annex regions , and (d) the combined effect of the all the three scenarios. We found that the first two policy options, on the balance, have a favorable poverty impact on our sample of countries. For example, by helping boost agricultural export and helping farmers as a result, non-fossil fuel in Annex I countries have the largest favorable impact on reducing poverty in developing countries. We also run a separate experiment where we combined these two policies to see the joint impact on poverty. Our result indicates an SC value of -0.92 i.e. consistently poverty reducing.

However, when combined with the forest carbon sequestration subsidy in developing countries, the overall result of the policy package is such that poverty increases in all 11 of the 14 countries in our sample. Much of this poverty worsening effect of the policy is driven by the sequestration subsidy part of the package. The sequestration subsidy bids land away from agriculture in all countries and boosts returns to land, which happens to be good for those households that specialized in agriculture. This outcome benefits countries where agriculture contributes the largest share of total poor (for example, Chile) or where elasticity of the head count to changes in income is highest (for example in Philippines). For other countries, however, the sequestration subsidy has contributed to rising poverty. There are two forces at work here. The first is the one we just described i.e. sequestration subsidy increases the competition for land and the higher rents in forestry take land away from agricultural production in most of the countries in our sample. The second force at work has to do with the impact of the amount of subsidy that is coming into the country is creating what is called the "Dutch disease" phenomenon. For example, the sequestration subsidy transfer is about 4 % of national income in Brazil and Colombia and the same ratio is about 7 % for Malawi. Such substantial rise in revenue increases usually leads to appreciation of the real exchange rate and that draws resources (e.g., labor) away from the tradable manufacturing sector (Pearson, 2011). This implies decline in output of the manufacturing industry. We find such a result for Brazil, Colombia and Malawi where by the manufacturing sector (eg, heavy manufacturing) declined substantially. Other authors have found similar "Dutch disease" effect in other types of mitigation policies. For example, Burniaux et al (2009) argued that Dutch disease reduces welfare in Easter European countries if there were full emission trading among Annex I countries. Mattoo et al (2009) document similar effect in China and India where manufacturing sector contracts following the financial transfers from emission trading.

References

Antle , John and Jetse Stoorvogel (2008) "Agricultural Carbon Sequestration, Poverty and Sustainability," Environment and Development Economics 13 (2008)

Arndt, Channing, R.Benfica, F.Tarp, J. Thurlow, R. Uaiene (2008) "Biofuels, Poverty, and Growth: A Computable General Equilibrium Analysis of Mozambique", IFPRI Discussion Paper 00803, Available : http://www.ifpri.org/sites/default/files/publications/ifpridp00803.pdf

Baffes, John and Bruce Gardner (2003) "The transmission of world commodity prices to domestic markets under policy reforms in developing countries", Journal of Economic Policy Reform; Volume 6, Issues 3

Banse M., H van Meijl, A. Tabeau, and G. Woltjer (2007) "Impact of EU Biofuel Policies on World Agricultural and Food Markets." Paper presented at the Tenth Annual Conference on Global Economic Analysis, Purdue University, West Lafayette, IN. 7-9 June, 2007.

Birur, Dileep, T.Hertel, and W. Tyner (2008) "Impact of Biofuel Production on World Agricultural Markets: A Computable General Equilibrium Analysis", GTAP Working Paper No.53

Burniaux, J., J. Chateau, R.Dellink, R.Duvall, and S.Jamet (2009) " The Economics of Climate Change Mitigation: How to build the Necessary Global Action in a Cost-Effective Manner, OECD Working Paper 701

Chen, Shaohua and M. Ravallion (2003) "Household welfare impacts of China's accession to the World Trade Organization," Policy Research Working Paper Series 3040, The World Bank. http://www.iisd.org/pdf/2007/trade_climate_linkages.pdf

Chen, Shaohua and Ravallion, Martin(2001) "How Did the World's Poorest Fare in the 1990s?"Review of Income and Wealth, International Association for Research in Income and Wealth, vol. 47(3), pages 283-300.

Cororaton,Caesar., G.Timilsina, and S.Mevel (2010) "Climate Change in World Agriculture: Mitigation, Adaptation, Trade and Food Security", Contributed Paper at the IATRC Public Trade Policy Research and Analysis Symposium

Cranfield, John., P. Preckel, J. Eales, T.Hertel,(2003) "Estimating Consumer Demands across the Development Spectrum: Maximum Likelihood Estimates of an Implicit Direct Additivity Model," Journal of Development Economics, (68): 289-307.

De Janvry, Alain and E.Sadoulet(2008) "Methodological Note: Estimating the Effects of the Food Price Surge on the Welfare of the Poor", Available at : http://are.berkeley.edu/~sadoulet/papers/FoodPriceMethodologyDec08.pdf

Ferreira Filho, J. B. S., and M. Horridge. 2005. "The Doha Round, Poverty, and Regional Inequality in Brazil." In Poverty and the WTO: Impacts of the Doha Development Agenda, T. Hertel and L. A.Winters,(eds).. Basingstoke, U.K.: Palgrave Macmillan;Washington, DC:World Bank

Gong, Y., G. Bull, and K. Baylis(2010) "Participation in the World's First Clean Development Mechanism Forest Project: The Role of Property Rights, Social Capital, and Contractual Rules", Ecological Economics, 69:1292-1302

Golub, Alla. B.Henderson, T.Hertel,S.Rose,M.Avetisyan,B.Sohngen (2010) "Effects of GHG Mitigation Policies on Livestock Sectors", GTAP Working Paper No.62

Golub, Alla., Thomas Hertel, Huey-Lin Lee, Steven Rose, Brent Sohngen (2009) “ The opportunity cost of land use and the global potential for greenhouse gas mitigation in agriculture and forestry,” Resource and Energy Economics 31 pp 299-319

Grainger, Corbett and Charles Kolstad (2009) “Who Pays a Price on Carbon? ”, NBER Working Paper No W15239.

Hamilton, K., Cameron, G.,(1994) “Simulating the distributional effects of a Canadian carbon tax,” Canadian Public Policy 20, 385–399.

Hertel, Thomas, M.Verma,M. Ivanic, A.Rios (2011) “GTAP-POV: A Framework for Assessing the National Poverty Impacts of Global Economic and Environmental Policies”, GTAP Technical Paper No.31

Hertel, Thomas and Stephanie Rosch (2010) “ Climate Change, Agriculture and Poverty”, World Bank Policy Research Working Paper No. 5468

Hertel, Thomas, R. Keeney, M. Ivanic and L.A. Winters (Apr 2007). “Distributional Impacts of WTO Reforms in Rich and Poor Countries,” Economic Policy, 50(1):1-49.

Hertel, Thomas W. and L. Alan Winters (2006). “Poverty and the WTO: Impacts of the Doha Development Agenda”. World Bank and Palgrave.

Hertel, Thomas W., Maros Ivanic, Paul Preckel and John A.L. Cranfield. and L. (2004). “The Earnings Effects of Multilateral Trade Liberalization: Implications for Poverty in Developing Countries.” The World Bank Economic Review, 18 (2), 205-236.

Intergovernmental Panel on Climate Change (2007) “The Physical Science Basis: Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change”, Geneva, Switzerland: IPCC.

Intergovernmental Panel on Climate Change(2001), Climate Change 2001: Litigation. University Press, Cambridge

Ivanic, Maros, and Will Martin (2008) “Implications of Higher Global Food Prices for Poverty in Low- Income Countries,” World Bank Policy Research Working Papers No. 4594, Washington, DC.

Jorgenson, Dale. R. Goettle, M. Ho, D. Slesnick,P. Wilcoxen(2010) “ The Distributional Impact of Climate Policy”, The B.E. Journal of Economic Analysis and Policy, Vol.10 Issue 2.

Kerkhof,A.C.,Moll,H.C.,Drissen,E.,Wilting,H.C. (2008) “Taxation of multiple greenhouse gases and the effects on income distribution :a case study of the Netherlands,” Ecological Economics67(2),318–326.

Matto, A., A. Subramanian, D. Van der Mensbrugghe, and J.He (2009) “Can Global De-Carbonization Inhibit Developing Country Industrialization?”, World Bank Policy Working Paper 5121.

McDougall, R. and Golub, A. (2007) “GTAP-E Release 6: A Revised Energy- Environmental Version of the GTAP Model,” GTAP Research Memorandum No. 15.

McDougall, Robert A.(1993) “Two Small Extensions to SALTER,” SALTER Working Paper No.12, Industry Commission, Canberra, Australia

McDonald, S., S. Robinson and K. Thierfelder (2006) “Impact of Switching Production to Bioenergy Crops: The Switchgrass Example,” Energy Economics, 28: 243-265.

Nicita, Alessandro (2006) “Multilateral Trade Liberalization and Mexican Households: The Effect of the Doha Development Agenda”, In Poverty and the WTO: Impacts of the Doha Development Agenda, T.Hertel and A.Winters (eds.) Basingstoke, U.K.: Palgrave Macmillan; Washington, DC: World Bank

OECD (1995) “Climate Change, Economic Instruments and Income Distribution,” Organization for Economic Cooperation and Development, Paris.

Pearson, Charles (2011) “ Economics and the Challenge of Global Warming”, Cambridge : Cambridge University Press

Peskett, Leo, Rachel Slater, Chris Stevens and Annie Dufey (2007) “ Biofuels, Agriculture and Poverty Reduction”, DFID. Available at: http://www.odi.org.uk/resources/download/78.pdf

Pagiola, S., A. Arcenas, and G. Platais. 2005. Can payments for environmental services help reduce poverty? An exploration of the issues and the evidence to date from Latin America. World Development 33, no. 2: 237–253.

Rimmer, M.T., and A.A. Powell (1996) “An Implicitly Additive Demand System,” Applied Economics 28:1613-1622.

Rose, S. and H-L. Lee, (2009) “Non-CO2 Greenhouse Gas Emissions Data for Climate Change Economic Analysis” in T.W. Hertel, S. Rose, R. Tol (eds.), Economic Analysis of Land Use in Global Climate Change Policy, Routledge Publishing, pp343

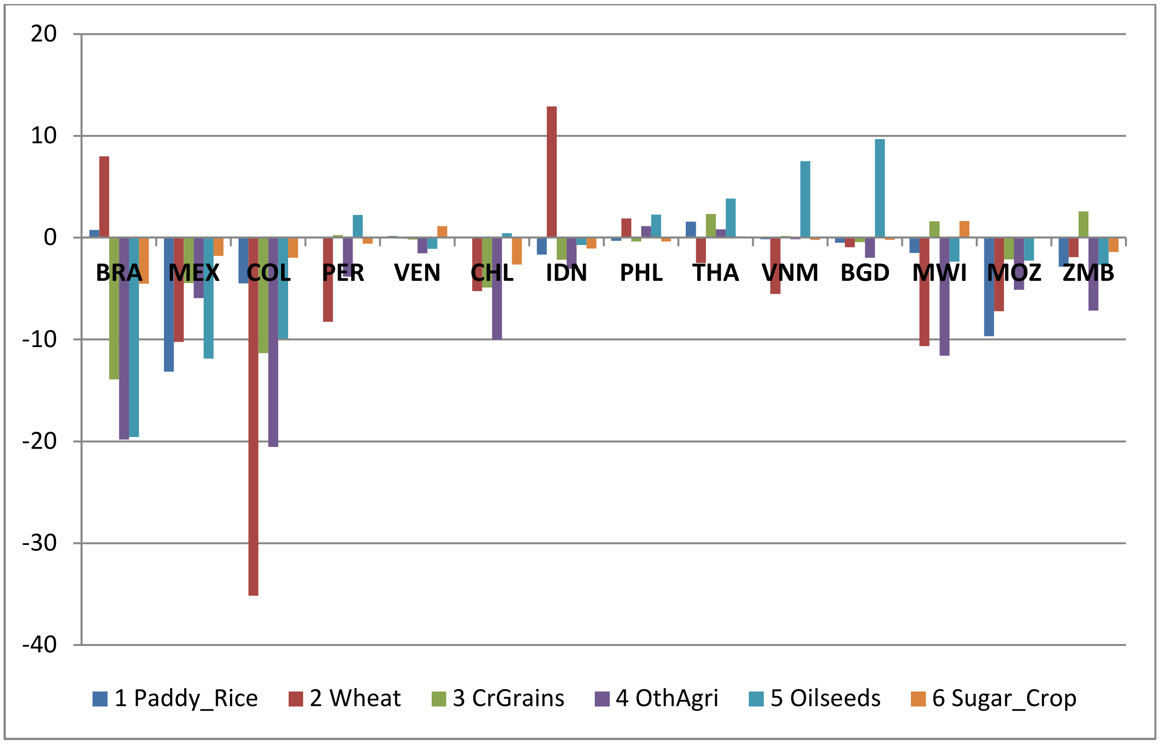
Sohngen, B. and R. Mendelsohn (2007) “An optimal control model of forest carbon sequestration.” American Journal of Agricultural Economics 85 (2), 448–457, 2007

Swinnen, Jo (2010) “Food Prices and Poverty: How the Food Crisis Changed Policy Perspectives,” in Food Prices and Rural Poverty, M. Aksoy and B. Hoekman (eds), The World Bank.

Symons, E.J., J. Proops, P. Gay(1991) “Carbon taxes, consumer demand and carbon dioxide emission: A simulation analysis for the UK,” Department of Economics and Management Science, Working Paper No. 91–25, University of Keele.

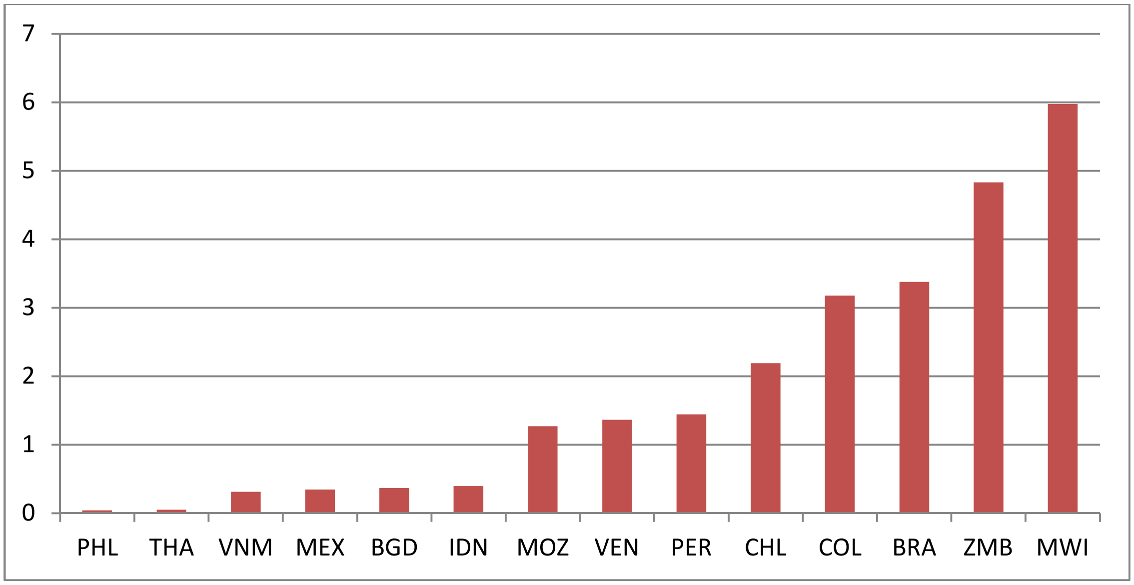
Annex

Figure 1: Impact of forest carbon sequestration subsidy on cropping sectors



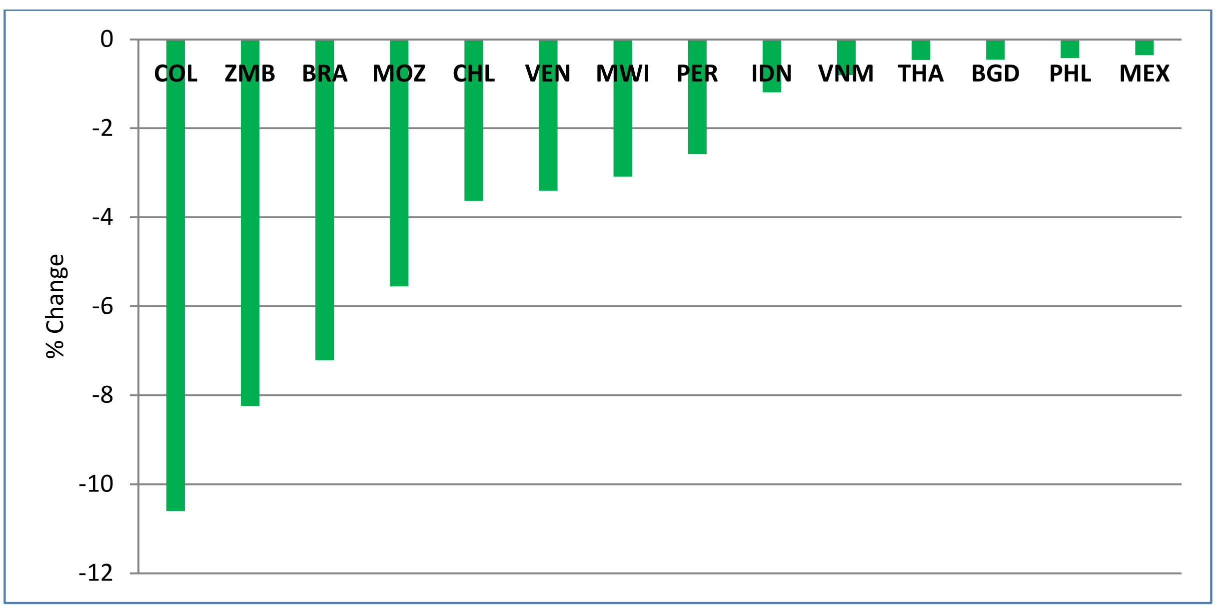
Source: Authors' simulations

Figure 2: Sequestration Subsidy, % of GDP



Source: Authors' simulations

Figure 3: Change (%) in output of Heavy Manufacturing sector



Source: Authors' simulations

Table 1a: Trends in Trade Specialization Indices

	Grains_Crops			Livestock			Food Processing		
Countries	75-84	85-94	95-2002	75-84	85-94	95-2002	75-84	85-94	95-2002
Brazil	0.50	0.49	0.34	0.46	0.52	0.74	0.86	0.72	0.55
Mexico	0.14	0.08	-0.04	-0.11	-0.3	-0.45	0.21	-0.02	0.11
Colombia	0.81	0.77	0.51	0.02	-0.47	-0.25	-0.01	0.28	0.12
Peru	-0.05	-0.04	-0.09	-0.33	-0.41	0.33	0.35	0.38	0.33
Venezuela	-0.79	-0.64	-0.6	-0.98	-0.49	-0.48	-0.88	-0.51	-0.39
Chile	-0.02	0.67	0.62	0.29	0.32	-0.16	0.17	0.67	0.65
Indonesia	0.34	0.36	0.10	0.59	0.38	0.1	0.29	0.53	0.51
Philippines	0.39	0.15	-0.18	-0.4	-0.28	-0.81	0.64	0.35	-0.02
Thailand	0.8	0.67	0.63	0.46	0.45	0.47	0.75	0.6	0.54
Vietnam	n.a.	0.89	0.81	0.6	0.87	0.17	n.a.	0.6	0.17
Bangladesh	-0.41	-0.51	-0.70	-0.33	-0.17	-0.86	-0.51	-0.21	-0.18
Malawi	0.95	0.85	0.88	-0.59	-0.29	-0.82	0.53	0.32	0.1
Mozambique	0.53	-0.44	0.04	0.06	-0.83	-0.89	0.41	0.09	0.19
Zambia	-0.22	0.38	0.28	-0.16	-0.23	-0.13	-0.39	-0.73	0.01

Source: Authors' calculations based on GTAP 6 database.

Table 1b: Trends in Trade Specialization Indices

	Fossil Fuel			Textile and Apparel			Other Manufacturing		
Countries	75-84	85-94	95-2002	75-84	85-94	95-2002	75-84	85-94	95-2002
Brazil	-0.97	-1.00	-0.86	0.52	0.58	-0.11	-0.07	0.25	-0.08
Mexico	0.84	0.95	0.95	0.01	0.03	0.22	-0.37	-0.11	0.04
Colombia	-0.75	0.88	0.99	-0.01	0.16	0.17	-0.66	-0.55	-0.42
Peru	0.38	-0.51	-0.43	0.14	0.48	0.42	-0.1	-0.03	-0.14
Venezuela	0.99	0.99	0.99	-0.99	-0.76	-0.77	-0.23	-0.07	-0.03
Chile	-0.92	-0.99	-0.98	-0.96	-0.74	-0.71	0.12	0.04	0.01
Indonesia	0.90	0.84	0.73	-0.42	0.58	0.64	-0.33	-0.24	0.1
Philippines	-1.00	-0.95	-0.99	0.19	0.35	0.35	-0.31	-0.19	-0.04
Thailand	-1.00	-0.83	-0.85	0.49	0.64	0.62	-0.54	-0.33	-0.01
Vietnam	0.66	0.95	0.99	-0.82	-0.13	0.14	-0.85	-0.71	-0.41
Bangladesh	-1.00	-1.00	-1.00	0.45	0.43	0.46	-0.91	-0.82	-0.67
Malawi	-0.75	-0.70	0.25	-0.89	-0.4	0.13	-0.98	-0.97	-0.94
Mozambique	0.19	0.72	-0.14	-0.92	-0.86	-0.59	-0.55	-0.47	-0.63
Zambia	-0.76	-0.02	-0.87	-0.97	-0.72	0.05	0.31	0.34	0.07

Source: Authors' calculations based on GTAP 6 database.

Table 1c. Trade Specialization Indices :(X-M)/(X+M) for Year 2001

Countries	Grains - Crops	Meat-Livestk	Fossil Fuels	Proc Food	Tex Appl	Light Manu	Heavy Manu
Brazil	0.54	0.90	0.03	0.66	-0.01	0.27	-0.29
Mexico	-0.11	-0.53	0.87	0.03	0.23	0.09	0.03
Colombia	0.41	-0.1	0.96	0.1	0.24	-0.24	-0.29
Peru	-0.1	0.51	0.23	0.44	0.42	-0.47	-0.05
Venezuela	-0.76	-0.4	0.97	-0.54	-0.85	-0.78	0.02
Chile	0.68	-0.02	0.15	0.7	-0.74	-0.04	-0.02
Indonesia	0.03	0.32	0.67	0.49	0.63	0.46	0.07
Philippines	-0.22	-0.81	-0.83	-0.15	0.33	-0.11	0.00
Thailand	0.59	0.53	-0.87	0.49	0.58	0.19	0.06
Vietnam	0.7	0.33	0.97	0.15	0.22	0.23	-0.61
Bangladesh	-0.79	-0.77	-0.93	-0.39	0.51	-0.48	-0.76
Malawi	0.86	-1.00	0.33	0.11	0.05	-0.84	-0.95
Mozambique	-0.02	-1.00	-0.01	-0.08	-0.85	-0.92	-0.09
Zambia	0.3	0.60	-0.45	-0.17	0.07	-0.62	0.18

Source: Authors' calculations based on GTAP 6 database. Year=2001

Table 1d: Share of focus country exports to Annex I ,2001

	Grains_crops	MeatLivst	FossilFuel	ProcFood	TexAppl	LightManu	HeavyManu
Brazil	0.68	0.57	0.52	0.63	0.42	0.65	0.56
Mexico	0.96	0.97	0.88	0.85	0.95	0.97	0.92
Colombia	0.95	0.35	0.9	0.43	0.49	0.28	0.38
Peru	0.92	0.68	0.46	0.44	0.72	0.58	0.73
Venezuela	0.6	0.78	0.75	0.51	0.1	0.51	0.57
Chile	0.7	0.55	0.58	0.68	0.16	0.52	0.57
Indonesia	0.62	0.31	0.61	0.52	0.65	0.63	0.5
Philippines	0.59	0.75	0.84	0.72	0.92	0.81	0.59
Thailand	0.37	0.79	0.45	0.73	0.69	0.74	0.51
Vietnam	0.49	0.39	0.49	0.81	0.83	0.89	0.49
Bangladesh	0.19	1	0	0.93	0.96	0.67	0.67
Malawi	0.73	0	0	0.57	0.38	0.5	0
Mozambique	0.56	0	0.53	0.82	0.33	0.43	0.96
Zambia	0.68	0	0	0.14	0.57	0.65	0.63

Source: Author' calculations from GTAP database 6. Exports to Annex I as share of each focus country's total export of the commodity group

Table 1e: Share of focus country Imports from Annex I ,2001

	Grains_crops	MeatLivst	FossilFuel	ProcFood	TexAppl	LightManu	HeavyManu
Brazil	0.07	0.47	0.14	0.51	0.29	0.74	0.7
Mexico	0.9	0.96	0.74	0.87	0.82	0.89	0.86
Colombia	0.68	0.55	0.41	0.27	0.36	0.65	0.65
Peru	0.41	0.5	0.03	0.3	0.22	0.48	0.54
Venezuela	0.66	0.36	0.22	0.46	0.22	0.56	0.66
Chile	0.19	0.08	0.03	0.33	0.19	0.62	0.59
Indonesia	0.6	0.76	0.03	0.55	0.2	0.56	0.47
Philippines	0.64	0.55	0.08	0.57	0.22	0.6	0.64
Thailand	0.56	0.63	0.04	0.53	0.3	0.68	0.55
Vietnam	0.43	0.08	0.17	0.36	0.24	0.23	0.36
Bangladesh	0.46	0.24	0.02	0.18	0.05	0.38	0.35
Malawi	0	0	0	0	0	0.32	0.23
Mozambique	0.15	0	0	0.11	0.08	0.32	0.21
Zambia	0.02	0	0	0.01	0.17	0.18	0.19

Source: Authors' calculations from GTAP database 6. Imports from to Annex I as share of each focus country's total imports of the commodity group

Table 2a: Stratum contribution to the $1/day poverty population

Country	Agric	Non-Agric	Urban Labor	Rural Labor	Transfer	Urban Diverse	Rural Diverse
Bangladesh	0.15	0.13	0.04	0.22	0.03	0.07	0.37
Brazil	0.14	0.09	0.24	0.15	0.32	0.04	0.03
Chile	0.26	0.01	0.09	0.09	0.28	0.15	0.12
Colombia	0.28	0.43	0.03	0.04	0.12	0.05	0.04
Indonesia	0.42	0.12	0.02	0.07	0.04	0.06	0.28
Malawi	0.54	0.11	0.00	0.03	0.07	0.01	0.25
Mexico	0.05	0.06	0.05	0.12	0.28	0.14	0.29
Mozambique	0.41	0.13	0.01	0.05	0.14	0.06	0.19
Peru	0.06	0.35	0.01	0.02	0.22	0.11	0.23
Philippines	0.11	0.06	0.03	0.05	0.03	0.23	0.49
Thailand	0.06	0.02	0.00	0.06	0.11	0.07	0.68
Venezuela	0.08	0.24	0.17	0.10	0.28	0.08	0.05
Vietnam	0.04	0.11	0.00	0.00	0.05	0.10	0.70
Zambia	0.34	0.23	0.10	0.07	0.07	0.09	0.11

Source: Hertel et al (2004). Note the numbers are shares of the poor population that are deemed to have specialized in particular stratum of earnings. See Hertel et al (2011) for details.

Table 2b: Elasticity of poverty headcount by stratum ($1/day) wrt total income

Country	Agric	Non-Agric	Urban Labor	Rural Labor	Transfer	Urban Diverse	Rural Diverse	Total
Bangladesh	1.64	2.02	1.58	0.63	0.56	1.74	1.09	1.24
Brazil	0.75	1.28	1.94	2.19	0.34	3.63	2.69	1.34
Chile	1.90	2.24	2.06	1.55	2.45	2.29	2.60	2.18
Colombia	0.79	0.6	1.73	1.72	0.93	1.14	1.00	0.82
Indonesia	2.35	2.14	2.38	2.89	1.17	2.58	2.87	2.47
Malawi	0.49	0.30	2.26	1.97	0.43	1.04	0.76	0.58
Mexico	1.73	1.90	3.33	2.08	2.28	1.63	1.80	2.02
Mozambique	0.28	0.94	0.97	0.76	0.48	1.58	0.99	0.65
Peru	1.50	1.32	2.37	1.73	0.44	1.09	1.05	1.07
Philippines	2.25	1.96	2.98	2.44	1.69	2.42	1.98	2.15
Thailand	2.30	2.42	2.98	2.45	2.78	2.42	2.59	2.58
Venezuela	0.69	1.16	2.57	2.17	0.01	1.72	1.53	1.20
Vietnam	0.48	1.12	2.81	8.98	0.84	0.86	1.01	0.98
Zambia	0.00	0.64	2.28	0.91	0.45	1.29	0.37	0.61

Source: Hertel et al (2004). The "Total" column is the poverty share weighted elasticity.

Table 3a: Terms of Trade Results

	Annex I		Non-Annex I	
Countries	Fossil Fuel Policy	Non-Fossil Fuel Policy	Sequestration Subsidy	Total
Bangladesh	0.55	-0.12	0.49	0.92
Brazil	0.69	0.67	5.65	7.01
Chile	0.51	0.13	0.62	1.26
Colombia	-3.23	0.01	4.36	1.14
Indonesia	-0.4	-0.22	0.38	-0.25
Malawi	-0.1	2.01	6.21	8.12
Mexico	-0.5	-0.21	0.64	-0.07
Mozambique	0.34	-0.23	-0.41	-0.3
Peru	0.6	-0.08	0.92	1.44
Philippines	0.51	-0.07	0.07	0.51
Thailand	0.48	0.1	0.36	0.93
Venezuela	-5.8	-0.35	0.62	-5.52
Vietnam	-1.2	0.35	1.24	0.39
Zambia	0.71	-0.15	0.25	0.82

Source: Authors' simulations

Table 3b: TOT Decomposition, Annex I Fossil Fuel Policy

	World Price Effect	Export Price Effect	Import Price Effect
Bangladesh	0.17	0.32	0.05
Brazil	0.2	0.42	0.06
Chile	0.66	0	-0.13
Colombia	-2.11	-1.14	0.13
Indonesia	-0.39	-0.1	0.07
Malawi	-0.18	-0.08	0.21
Mexico	-0.46	-0.09	0.05
Mozambique	1.33	-1.22	0.23
Peru	0.37	0.19	0.04
Philippines	0.38	0.13	0
Thailand	0.5	0.01	-0.02
Venezuela	-4.41	-1.49	0.09
Vietnam	-0.81	-0.37	-0.01
Zambia	0.88	-0.38	0.22

Source: Authors' simulations. Results do not necessarily add up to those reported in Table1. This simulation was run separately to generate these results.

Table 3c: TOT Decomposition, Annex I Non-Fossil Fuel Policy

	World Price Effect	Export Price Effect	Import Price Effect
Bangladesh	-0.17	0.07	-0.03
Brazil	0.58	0.12	0.02
Chile	0.13	0.09	-0.01
Colombia	0.12	0.18	-0.11
Indonesia	-0.14	-0.01	-0.04
Malawi	1.83	0.08	0.09
Mexico	-0.1	-0.04	-0.04
Mozambique	-0.26	0.08	0.01
Peru	-0.04	0.09	-0.03
Philippines	-0.04	-0.01	-0.02
Thailand	0.13	-0.02	-0.01
Venezuela	-0.24	-0.02	-0.1
Vietnam	0.31	0.03	0
Zambia	-0.09	-0.03	-0.01

Source: Authors' simulations. Results do not necessarily add up to those reported in Table1. This simulation was run separately to generate these results.

Table 4: TOT Decomposition, Non-Annex I Sequestration Subsidy

	World Price Effect	Export Price Effect	Import Price Effect
Bangladesh	-0.15	1.08	-0.47
Brazil	0.78	6.23	-1.44
Chile	0.66	1.98	-2.02
Colombia	0.66	4.54	-0.87
Indonesia	0.17	0.08	0.11
Malawi	4.28	4.1	-2.25
Mexico	-0.07	0.32	0.39
Mozambique	0.23	1.19	-1.85
Peru	0.36	2.24	-1.68
Philippines	-0.02	-0.09	0.18
Thailand	0.3	-0.01	0.05
Venezuela	0.41	1.06	-0.87
Vietnam	0.99	0.21	0.03
Zambia	0.17	2.73	-2.67

Source: Authors' simulations. Results do not necessarily add up to those reported in Table1. This simulation was run separately to generate the reported results.

Table 5a: Impacts of Fossil Fuel Tax in Annex I on key variables in developing countries

				Relative Earnings				Relative Spending		
Countries	Per capita Earnings	CPI	Real	Land	Capital	Unskilled Labor	Skilled Labor	Food	Manuf	Svces
Bangladesh	1.74	1.53	0.21	-0.49	0.32	-0.22	-0.16	-0.09	-0.07	0.11
Brazil	2.02	1.72	0.30	-3.97	0.39	-0.04	0	-0.02	-0.71	0.2
Chile	1.66	1.33	0.33	-1.91	0.24	-0.01	0.01	0.09	-0.21	0.17
Colombia	-0.33	0.16	-0.49	1.62	0.55	0.62	0.34	0.28	-1.87	0.00
Indonesia	0.62	0.79	-0.17	0.88	0.61	0.44	0.27	0.27	-0.98	0.13
Malawi	0.93	0.97	-0.04	-0.87	0.3	0.02	-0.04	0.03	-0.42	-0.03
Mexico	0.89	1.02	-0.13	-0.01	0.26	0.28	0.14	0.06	-0.49	0.02
Mozambique	1.32	1.08	0.24	-1.07	0.19	-0.03	-0.08	0.11	0.02	0.18
Peru	1.70	1.33	0.37	-1.15	0.39	0.01	0.08	0.18	-0.27	0.23
Philippines	1.95	1.46	0.49	-0.95	0.41	0.04	0.06	0.08	-0.79	-0.03
Thailand	1.73	1.25	0.48	-1.22	0.41	0.00	0.00	-0.19	-0.49	0.12
Venezuela	-2.62	-1.53	-1.09	0.09	0.82	0.96	0.54	0.2	-1.33	-0.18
Vietnam	-0.43	0.34	-0.77	1.73	0.21	0.45	0.33	0.43	-0.34	0.06
Zambia	1.79	1.34	0.45	-1.03	0.23	-0.07	0.07	0.04	-0.47	0.16

Notes: All prices are relative to the numeraire, which is the average return to primary factors worldwide. Earning impacts are reported relative to national per capita earnings. Spending impacts are reported relative to the CPI.

Table 5b. Impact of Annex I fossil fuel tax on factor earnings, taxes and cost of living (%)

Countries	Land	Ag Unskilled Labor	Ag Skilled Labor	Non-Ag Unskilled Labor	Non-Ag Skilled Labor	Wage Labor Unskilled	Wage Labor Skilled	Ag-Capital	Non-AgCapital	Transfer	Tax	CoL
Bangladesh	-0.5	-0.7	-0.6	-0.2	-0.2	-0.2	-0.2	-0.4	0.4	0	0.0	-0.2
Brazil	-4.0	-1.8	-1.8	0.0	0.0	0.0	0.0	-1.6	0.5	0	0.0	-0.4
Chile	-1.9	-1.1	-1.1	0.2	0.0	0.0	0.0	-1.0	0.3	0	0.1	-0.3
Colombia	1.6	1.2	1.1	0.6	0.3	0.6	0.3	1.1	0.5	0	0.0	0.6
Indonesia	0.9	0.3	0.2	0.5	0.3	0.4	0.3	0.4	0.6	0	-0.1	0.2
Malawi	-0.9	-0.2	-0.2	0.1	0.0	0.0	0.0	0.0	0.4	0	0.0	0
Mexico	0.0	-0.1	-0.2	0.3	0.1	0.3	0.1	-0.2	0.3	0	0.0	0.2
Mozambique	-1.1	-0.4	-0.4	0.1	-0.1	0.0	-0.1	-0.3	0.2	0	0.1	-0.2
Peru	-1.2	-0.6	-0.6	0.2	0.1	0.0	0.1	-0.5	0.4	0	0.1	-0.2
Philippines	-1.0	-0.1	-0.1	0.2	0.1	0.0	0.1	0.1	0.4	0	0.2	-0.4
Thailand	-1.2	-0.7	-0.7	0.1	0.0	0.0	0.0	-0.5	0.4	0	0.2	-0.4
Venezuela	0.1	0.3	0.1	1.0	0.5	1.0	0.5	0.3	0.8	0	0.0	1.3
Vietnam	1.7	0.6	0.6	0.4	0.3	0.4	0.3	0.5	0.2	0	-0.2	0.9
Zambia	-1.0	-0.7	-0.6	0.2	0.1	-0.1	0.1	-0.5	0.3	0	0.2	-0.4
Average	-0.6	-0.3	-0.3	0.3	0.1	0.2	0.1	-0.2	0.4	0	0.0	0.1
AAV	1.2	0.6	0.6	0.3	0.2	0.2	0.2	0.5	0.4	0	0.1	0.4
SC	-0.5	-0.5	-0.5	0.9	0.7	0.8	0.7	-0.3	1	0	0.5	0.1

Source: Authors' simulations. AAV is the average absolute value of the data in the column. SC is sign consistency and is calculated as the ratio of the Average to the AAV of the column.

Table 5c. Annex I fossil fuel tax: Earnings-driven change (%) in the poverty headcount ($1/day) across strata

Countries	Agriculture	Non-Agriculture	Urban Labor	Rural Labor	Transfer	Urban Diverse	Rural Diverse
Bangladesh	0.20	0.00	0.00	0.00	0.00	0.00	0.10
Brazil	0.20	0.00	0.00	0.00	0.00	0.00	0.00
Chile	0.40	0.00	0.00	0.00	0.00	0.10	0.10
Colombia	-0.30	-0.10	0.00	0.00	0.00	0.00	0.00
Indonesia	-0.40	-0.10	0.00	-0.10	0.00	-0.10	-0.40
Malawi	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mexico	0.00	0.00	0.00	-0.10	0.00	0.00	-0.10
Mozambique	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Peru	0.10	-0.10	0.00	0.00	0.00	0.00	0.00
Philippines	0.10	0.00	0.00	0.00	0.00	0.10	0.10
Thailand	0.10	0.00	0.00	0.00	0.00	0.00	0.30
Venezuela	0.00	-0.30	-0.40	-0.20	0.00	-0.10	-0.10
Vietnam	0.00	0.00	0.00	0.00	0.00	0.00	-0.20
Zambia	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Average	0.00	-0.10	0.00	0.00	0.00	0.00	0.00
AAV	0.10	0.10	0.00	0.00	0.00	0.00	0.10
SC	0.20	-0.90	-1.00	-0.90	0.60	0.10	0.00

Source: Authors' simulations

Table 5d. Annex I fossil fuel tax: Decomposed change (%) in the poverty headcount ($1/day)

Countries	Earnings	Taxes	Cost of Living	Total
Bangladesh	0.36	0.04	-0.27	0.04
Brazil	0.25	0.05	-0.47	-0.27
Chile	0.65	0.10	-0.54	0.01
Colombia	-0.59	0.01	0.53	-0.07
Indonesia	-0.92	-0.16	0.49	-0.27
Malawi	0.03	-0.02	0.03	0.07
Mexico	-0.25	-0.01	0.30	0.06
Mozambique	0.05	0.04	-0.16	-0.14
Peru	-0.01	0.14	-0.22	-0.37
Philippines	0.33	0.42	-0.76	-0.85
Thailand	0.49	0.32	-1.04	-0.87
Venezuela	-1.08	-0.04	1.60	0.56
Vietnam	-0.26	-0.17	0.85	0.76
Zambia	-0.04	0.09	-0.24	-0.37
Average	-0.07	0.06	0.01	-0.12
AAV	0.38	0.12	0.53	0.34
SC	-0.19	0.50	0.01	-0.36

Source: Authors' simulations

Table 6a: Impacts of non-fossil fuel tax in Annex I on key variables in developing countries

	Per capita Earnings	CPI	Real	Relative Earnings: Land	Relative Earnings: Capital	Relative Earnings: Unskilled Labor	Relative Earnings: Skilled Labor	Relative Spending: Food	Relative Spending: Manuf	Relative Spending: Svces
Bangladesh	0.03	0.12	-0.09	1.36	-0.09	-0.13	-0.17	0.32	-0.09	-0.19
Brazil	0.65	0.52	0.13	6.7	0.06	-0.17	-0.13	0.54	-0.24	-0.03
Chile	0.17	0.2	-0.03	5.06	-0.25	0.02	-0.19	0.6	-0.42	-0.21
Colombia	0.27	0.37	-0.1	5.8	-0.2	-0.14	-0.22	0.99	-0.47	-0.28
Indonesia	0.01	0.22	-0.21	2.09	-0.25	0.06	-0.24	0.68	-0.54	-0.38
Malawi	2.53	1.76	0.77	2.45	-0.7	-0.15	-0.73	0.4	-0.99	0.08
Mexico	0.01	0.11	-0.1	9.98	-0.19	0.07	-0.15	1.25	-0.3	-0.3
Mozambique	-0.25	-0.17	-0.08	-4.21	0.15	0.28	0.05	0.33	-0.77	0.08
Peru	0.2	0.28	-0.08	5.4	-0.21	0.06	-0.16	0.6	-0.29	-0.24
Philippines	0.29	0.41	-0.12	2.34	-0.25	0.08	-0.15	0.47	-0.62	-0.46
Thailand	0.05	0.05	0.00	4.7	-0.35	-0.11	-0.29	0.94	-0.19	-0.22
Venezuela	-0.27	-0.2	-0.07	1.73	-0.04	-0.01	-0.06	0.27	-0.04	-0.08
Vietnam	0.49	0.3	0.19	3.45	-0.25	-0.12	-0.28	0.71	-0.45	-0.25
Zambia	-0.16	-0.08	-0.08	-0.05	-0.09	0.23	-0.06	0.17	-0.16	-0.07

Notes: All prices are relative to the numeraire, which is the average return to primary factors worldwide. Earning impacts are reported relative to national per capita earnings. Spending impacts are reported relative to the CPI.

Table 6b. Impact of Annex I non-fossil fuel Tax on factor earnings, taxes and cost of living

Countries	Land	Ag Unskilled Labor	Ag Skilled Labor	Non-Ag Unskilled Labor	Non-Ag Skilled Labor	Wage Labor Unskilled	Wage Labor Skilled	Ag Capital	Non-Ag Capital	Transfer	Tax	CoL
Bangladesh	1.4	0.8	0.8	-0.3	-0.2	-0.1	-0.2	0.8	-0.2	0	0.0	0.1
Brazil	6.7	4.2	4.3	-0.3	-0.1	-0.2	-0.1	4.4	-0.2	0	0.0	0.0
Chile	5.1	5.9	5.8	-0.9	-0.2	0.0	-0.2	5.8	-0.5	0	0.0	0.3
Colombia	5.8	4.1	4.1	-0.7	-0.2	-0.1	-0.2	4.1	-0.5	0	0.0	0.6
Indonesia	2.1	1.5	1.2	-0.3	-0.2	0.1	-0.2	1.4	-0.3	0	0.0	0.5
Malawi	2.4	2.5	2.2	-1.7	-0.8	-0.1	-0.7	2.2	-1.3	0	0.0	-1.1
Mexico	10.0	8.3	8.2	-0.8	-0.2	0.1	-0.2	8.2	-0.4	0	0.0	0.7
Mozambique	-4.2	2.3	2.2	-0.6	0.0	0.3	0.1	2.3	-0.1	0	0.0	0.0
Peru	5.4	3.6	3.5	-0.9	-0.2	0.1	-0.2	3.5	-0.4	0	0.0	0.4
Philippines	2.3	1.2	1.1	-0.7	-0.2	0.1	-0.2	1	-0.3	0	0.1	0.4
Thailand	4.7	3	2.9	-0.8	-0.3	-0.1	-0.3	2.9	-0.4	0	0.0	0.4
Venezuela	1.7	1.4	1.3	-0.2	-0.1	0.0	-0.1	1.6	-0.1	0	0.0	0.2
Vietnam	3.5	2.2	2.1	-0.5	-0.3	-0.1	-0.3	2.1	-0.3	0	0.1	0.1
Zambia	-0.0	2.4	2.3	-0.6	-0.1	0.2	-0.1	2.3	-0.3	0	0.0	0.1
Average	3.3	3.1	3.0	-0.7	-0.2	0.0	-0.2	3.0	-0.4	0	0.0	0.2
AAV	3.9	3.1	3.0	0.7	0.2	0.1	0.2	3.0	0.4	0	0.0	0.3
SC	0.8	1.0	1.0	-1.0	-1.0	0.0	-1.0	1.0	-1.0	0	0.5	0.6

Source: Authors' simulations

Table 6c. Annex I Non-fossil fuel tax: Earnings-driven change (%) in the poverty headcount ($1/day) across strata

Countries	Agriculture	Non-Agriculture	Urban Labor	Rural Labor	Transfer	Urban Diverse	Rural Diverse
Bangladesh	-0.20	0.10	0.00	0.00	0.00	0.00	0.00
Brazil	-0.50	0.00	0.10	0.10	0.00	-0.10	-0.10
Chile	-2.10	0.00	0.00	0.00	0.00	-0.60	-0.50
Colombia	-1.10	0.20	0.00	0.00	0.00	0.00	0.00
Indonesia	-1.40	0.10	0.00	0.00	0.00	-0.10	-0.40
Malawi	-0.70	0.00	0.00	0.00	0.00	0.00	-0.20
Mexico	-0.80	0.10	0.00	0.00	0.00	-0.20	-0.70
Mozambique	-0.30	0.00	0.00	0.00	0.00	-0.10	-0.20
Peru	-0.30	0.30	0.00	0.00	0.00	-0.10	-0.10
Philippines	-0.40	0.10	0.00	0.00	0.00	-0.30	-0.50
Thailand	-0.40	0.00	0.00	0.00	0.00	-0.10	-1.40
Venezuela	-0.10	0.10	0.00	0.00	0.00	0.00	0.00
Vietnam	0.00	0.10	0.00	0.00	0.00	-0.10	0.00
Zambia	0.00	0.10	0.00	0.00	0.00	0.00	0.00
Average	-0.60	0.10	0.00	0.00	0.00	-0.10	-0.30
AAV	0.60	0.10	0.00	0.00	0.00	0.10	0.30
SC	-1.00	1.00	0.30	0.20	-0.90	-1.00	-1.00

Source: Authors' simulations

Table 6d. Annex I Non-fossil fuel tax: Decomposed change (%) in the poverty headcount ($1/day)

Countries	Earnings	Taxes	Cost of Living	Total
Bangladesh	-0.13	-0.02	0.14	0.03
Brazil	-0.53	0.02	0.02	-0.53
Chile	-3.08	-0.03	0.61	-2.44
Colombia	-1.02	-0.01	0.47	-0.53
Indonesia	-1.86	-0.05	1.21	-0.60
Malawi	-0.79	0.01	-0.55	-1.34
Mexico	-1.60	0.05	1.45	-0.21
Mozambique	-0.50	0.02	0.01	-0.51
Peru	-0.23	0.01	0.40	0.17
Philippines	-1.16	0.11	0.82	-0.45
Thailand	-1.93	0.00	1.14	-0.79
Venezuela	-0.03	0.00	0.19	0.16
Vietnam	-0.06	0.04	0.09	-0.02
Zambia	0.02	0.00	0.06	0.07
Average	-0.92	0.01	0.43	-0.50
AAV	0.92	0.03	0.51	0.56
SC	-1.00	0.42	0.85	-0.89

Source: Authors' simulations

Table 7a. Combining Fossil and Non-Fossil Fuel Tax: Earnings-driven change (%) in the poverty headcount ($1/day) across strata

Countries	Agriculture	Non-Agriculture	Urban Labor	Rural Labor	Transfer	Urban Diverse	Rural Diverse
Bangladesh	0.04	0.07	0.02	0.03	0.00	0.02	0.08
Brazil	-0.13	0.02	0.06	0.04	0.00	-0.02	-0.01
Chile	-1.02	0.01	0.01	0.01	0.00	-0.23	-0.17
Colombia	-0.71	-0.04	-0.03	-0.04	0.00	-0.05	-0.04
Indonesia	-0.87	-0.07	-0.01	-0.07	0.00	-0.10	-0.51
Malawi	-0.25	0.02	0.00	0.01	0.00	0.00	-0.07
Mexico	-0.37	0.02	-0.04	-0.07	0.00	-0.16	-0.41
Mozambique	-0.09	0.03	0.00	0.00	0.00	-0.03	-0.06
Peru	-0.12	0.10	0.00	0.00	0.00	-0.03	-0.07
Philippines	-0.11	0.01	0.00	0.00	0.00	-0.08	-0.15
Thailand	-0.12	0.01	0.00	0.01	0.00	-0.04	-0.41
Venezuela	-0.06	-0.27	-0.42	-0.22	0.00	-0.09	-0.06
Vietnam	-0.03	-0.01	0.00	0.00	0.00	-0.08	-0.16
Zambia	0.00	0.03	0.01	0.00	0.00	0.00	0.00
Average	-0.27	-0.01	-0.03	-0.02	0.00	-0.06	-0.14
AAV	0.28	0.05	0.04	0.04	0.00	0.07	0.16
SC	-0.98	-0.10	-0.68	-0.59	-0.77	-0.95	-0.92

Source: Authors’ simulations

Table 7b. Combining Fossil and Non-Fossil Fuel Tax, Decomposed change(%) in the poverty headcount ($1/day)

Countries	Earnings	Taxes	Cost of Living	Total
Bangladesh	0.27	0.02	-0.15	0.27
Brazil	-0.04	0.06	-0.39	-0.04
Chile	-1.38	0.09	-0.21	-1.38
Colombia	-0.91	0.01	0.80	-0.91
Indonesia	-1.63	-0.24	1.15	-1.63
Malawi	-0.30	-0.01	-0.26	-0.30
Mexico	-1.03	0.00	1.17	-1.03
Mozambique	-0.14	0.01	-0.08	-0.14
Peru	-0.11	0.15	0.00	-0.11
Philippines	-0.34	0.44	-0.24	-0.34
Thailand	-0.55	0.32	-0.52	-0.55
Venezuela	-1.11	-0.04	1.72	-1.11
Vietnam	-0.28	-0.17	0.94	-0.28
Zambia	0.04	0.06	-0.21	0.04
AVG	-0.54	0.05	0.27	-0.54
AAVG	0.58	0.12	0.56	0.58
SC	-0.92	0.44	0.47	-0.92

Source: Authors' simulations

Table 8a: Impacts of non-Annex sequestration subsidy on key variables

	Per capita Earnings	CPI	Real	Relative Earnings				Relative Spending		
				Land	Capital	Unskilled Labor	Skilled Labor	Food	Manuf	Svces
Bangladesh	3.04	1.13	1.91	35.24	-0.19	-1.15	-0.94	3.57	-3.02	-1.39
Brazil	11.6	5.76	5.84	705.37	-5.2	-4.84	-3.4	8.99	-1.09	-1.48
Chile	9.57	2.74	6.83	315.62	-3.91	-4.17	-2.73	5.42	-2.38	-2.29
Colombia	11.71	5.85	5.86	236.88	-4.77	-5.12	-2.89	9.97	-5.01	-2.17
Indonesia	2.8	1.47	1.33	27.08	-0.23	-0.36	-0.35	2.49	-3.23	-1.38
Malawi	17.19	7.51	9.68	195.56	-8.58	-7.42	-6.85	2.59	-1	-2.4
Mexico	1.78	-0.02	1.8	94.56	-0.39	-0.5	-0.25	2.93	-1.63	-0.43
Mozambique	10.81	3.93	6.88	226.22	-3.21	-3.12	-2.52	5.32	-5.74	-3.59
Peru	6.01	2.63	3.38	173.3	-3.04	-2.63	-1.79	4.51	-1.85	-1.69
Philippines	0.22	0.17	0.05	7.72	-0.53	-0.07	-0.32	1.04	-1.01	-0.97
Thailand	-0.06	-0.31	0.25	15.86	-0.71	-0.33	-0.61	2.71	-0.54	-0.61
Venezuela	4.74	2.92	1.82	161.65	-2.48	-2.38	-1.75	4.27	-1.64	-1.28
Vietnam	2.65	0.85	1.8	17.52	-0.3	-0.31	-0.51	2.21	-2.62	-0.68
Zambia	18.26	6.87	11.39	344.54	-8.43	-6.13	-5.92	2.72	-3.51	-5.64

Notes: All prices are relative to the numeraire, which is the average return to primary factors worldwide. Earning impacts are reported relative to national per capita earnings. Spending impacts are reported relative to the CPI.

Table 8b. Impact of non-Annex I forest carbon sequestration subsidy on factor earnings, taxes and cost of living (%)

Countries	Land	Ag Unskilled Labor	Ag Skilled Labor	Non-Ag Unskilled Labor	Non-Ag Skilled Labor	Wage Labor Unskilled	Wage Labor Skilled	Ag Capital	Non-Ag Capital	Transfer	Tax	CoL
Bangladesh	35.2	-1.7	-1.6	-1.1	-0.9	-1.1	-0.9	-1.2	-0.1	0	-0.7	0.3
Brazil	705.4	-27.2	-26.6	-4.2	-3.4	-4.8	-3.4	-27.4	-3.6	0	-0.2	-0.9
Chile	315.6	-17.1	-16.6	-2	-2.7	-4.2	-2.7	-17	-3.4	0	-0.9	1.1
Colombia	236.9	-27.8	-27	-2.2	-2.8	-5.1	-2.9	-27.7	-2.9	0	-0.8	0.4
Indonesia	27.1	-1.1	-1.1	-0.2	-0.4	-0.4	-0.4	-0.9	-0.2	0	-0.3	1.4
Malawi	195.6	-20.2	-19.9	0	-6.7	-7.4	-6.9	-20.7	-6	0	0	-6.5
Mexico	94.6	-8	-7.9	0.3	-0.2	-0.5	-0.2	-7.9	-0.2	0	-0.3	1.2
Mozambique	226.2	-6.7	-6.4	-1.6	-2.5	-3.1	-2.5	-6.8	-2.8	0	-4.4	1.1
Peru	173.3	-4.9	-4.6	-2	-1.8	-2.6	-1.8	-5.1	-3	0	-0.2	1.1
Philippines	7.7	1.3	1.2	-1.1	-0.4	-0.1	-0.3	1.1	-0.6	0	0.2	0.8
Thailand	15.9	3.7	3.5	-1.2	-0.6	-0.3	-0.6	3.5	-0.8	0	0.1	1.2
Venezuela	161.7	-0.8	-0.6	-2.6	-1.8	-2.4	-1.7	-0.9	-2.5	0	-0.1	0.4
Vietnam	17.5	-0.2	-0.3	-0.3	-0.5	-0.3	-0.5	-0.2	-0.3	0	0.1	-0.2
Zambia	344.5	-10.5	-10.3	-4.4	-5.9	-6.1	-5.9	-11.6	-8.1	0	-6.6	-1.4
Average	182.7	-8.7	-8.4	-1.6	-2.2	-2.8	-2.2	-8.8	-2.5	0	-1	0
AAV	182.7	9.4	9.1	1.7	2.2	2.8	2.2	9.4	2.5	0	1.1	1.3
SC	1.0	-0.9	-0.9	-1.0	-1	-1	-1	-0.9	-1	0	-0.9	0

Source: Authors' simulations

Table 8c. Non-Annex I forest carbon sequestration subsidy: Earnings-driven change(%) in the poverty headcount ($1/day) across strata

Countries	Agriculture	Non-Agriculture	Urban Labor	Rural Labor	Transfer	Urban Diverse	Rural Diverse
Bangladesh	0.20	0.20	0.10	0.10	0.00	0.10	0.30
Brazil	2.70	0.40	2.10	1.50	0.00	0.90	0.50
Chile	-7.30	0.10	0.80	0.60	0.00	-1.10	-0.30
Colombia	7.20	0.50	0.30	0.30	0.00	0.40	0.40
Indonesia	0.50	0.00	0.00	0.10	0.00	-0.10	-0.60
Malawi	3.40	0.00	0.00	0.40	0.00	0.00	1.20
Mexico	0.70	0.00	0.10	0.10	0.00	0.20	0.50
Mozambique	0.50	0.20	0.00	0.10	0.00	0.30	0.60
Peru	0.20	0.90	0.00	0.10	0.00	0.20	0.00
Philippines	-1.20	0.10	0.00	0.00	0.00	-0.80	-1.50
Thailand	-0.60	0.10	0.00	0.00	0.00	-0.20	-2.30
Venezuela	0.00	0.70	1.10	0.50	0.00	0.20	0.10
Vietnam	0.00	0.00	0.00	0.00	0.00	0.00	0.10
Zambia	0.00	0.80	1.20	0.40	0.00	0.40	0.10
Average	0.50	0.30	0.40	0.30	0.00	0.00	-0.10
AAV	1.80	0.30	0.40	0.30	0.00	0.30	0.60
SC	0.30	1.00	1.00	1.00	-0.30	0.10	-0.10

Source: Authors' simulations

Table 8d. Non-Annex I forest carbon sequestration subsidy: Decomposed change(%) in the poverty headcount ($1/day)

Countries	Earnings	Taxes	Cost of Living	Total
Bangladesh	1.07	-0.82	0.32	2.2
Brazil	8.08	-0.2	-1.17	7.11
Chile	-7.29	-1.09	2.28	-3.92
Colombia	9.17	-0.56	0.24	9.96
Indonesia	-0.07	-0.78	3.42	4.13
Malawi	5.05	0.02	-3.31	1.72
Mexico	1.59	-0.34	2.51	4.43
Mozambique	1.68	-2.2	0.69	4.57
Peru	1.49	-0.17	1.15	2.81
Philippines	-3.43	0.35	1.6	-2.19
Thailand	-2.96	0.14	3.08	-0.01
Venezuela	2.67	-0.09	0.43	3.19
Vietnam	0.05	0.09	-0.21	-0.25
Zambia	2.83	-3.53	-0.78	5.59
Average	1.42	-0.65	0.73	2.81
AAV	3.39	0.74	1.51	3.72
SC	0.42	-0.88	0.48	0.76

Source: Authors' simulations

Table 9a. Impact of the complete policy package on factor earnings, taxes and cost of living (%)

Countries	Land	Ag Unskilled Labor	Ag Skilled Labor	Non-Ag Unskilled Labor	Non-Ag Skilled Labor	Wage Labor Unskilled	Wage Labor Skilled	Ag Capital	Non-Ag Capital	Transfer	Tax	CoL
Bangladesh	36.1	-1.6	-1.4	-1.5	-1.3	-1.5	-1.3	-0.8	0.1	0	-0.7	0.2
Brazil	708.1	-24.8	-24.1	-4.5	-3.5	-5.1	-3.5	-24.7	-3.3	0	-0.1	-1.2
Chile	318.8	-12.3	-11.8	-2.8	-2.9	-4.2	-2.9	-12.2	-3.6	0	-0.8	1.2
Colombia	244.3	-22.5	-21.9	-2.3	-2.7	-4.6	-2.8	-22.4	-2.9	0	-0.8	1.6
Indonesia	30	0.6	0.3	0	-0.3	0.1	-0.3	0.9	0.1	0	-0.4	2.1
Malawi	197.1	-17.8	-17.9	-1.6	-7.5	-7.6	-7.6	-18.5	-7	0	0	-7.5
Mexico	104.5	0.1	0	-0.2	-0.3	-0.1	-0.3	0.1	-0.3	0	-0.3	2.1
Mozambique	220.9	-4.8	-4.6	-2.1	-2.5	-2.9	-2.5	-4.8	-2.7	0	-4.3	0.9
Peru	177.5	-1.9	-1.7	-2.7	-1.9	-2.6	-1.9	-2.1	-2.9	0	0	1.3
Philippines	9.1	2.4	2.2	-1.6	-0.5	0	-0.4	2.2	-0.4	0	0.5	0.8
Thailand	19.3	6	5.7	-1.8	-0.9	-0.4	-0.9	5.9	-0.7	0	0.3	1.3
Venezuela	163.5	0.8	0.8	-1.7	-1.3	-1.4	-1.3	1.1	-1.8	0	-0.1	1.8
Vietnam	22.7	2.6	2.3	-0.4	-0.5	0	-0.5	2.4	-0.4	0	0	0.8
Zambia	343.5	-8.7	-8.7	-4.9	-5.9	-6	-5.9	-9.9	-8.1	0	-6.5	-1.8
Average	185.4	-5.8	-5.8	-2	-2.3	-2.6	-2.3	-5.9	-2.4	0	-0.9	0.3
AAV	185.4	7.6	7.4	2	2.3	2.6	2.3	7.7	2.5	0	1.1	1.8
SC	1	-0.8	-0.8	-1	-1	-1	-1	-0.8	-1	0	-0.9	0.1

Source: Authors' simulations

Table 9b. Complete policy package: Earnings-driven change (%) in the poverty headcount ($1/day) across strata

Countries	Agriculture	Non-Agriculture	Urban Labor	Rural Labor	Transfer	Urban Diverse	Rural Diverse
Bangladesh	0.20	0.30	0.10	0.20	0.00	0.10	0.40
Brazil	2.30	0.50	2.20	1.50	0.00	0.90	0.50
Chile	-8.90	0.10	0.80	0.60	0.00	-1.60	-0.70
Colombia	5.70	0.60	0.30	0.30	0.00	0.40	0.30
Indonesia	-1.20	0.00	0.00	0.00	0.00	-0.20	-1.40
Malawi	2.80	0.10	0.00	0.40	0.00	0.00	1.00
Mexico	0.00	0.00	0.00	0.00	0.00	-0.10	-0.20
Mozambique	0.20	0.30	0.00	0.10	0.00	0.20	0.40
Peru	-0.10	1.20	0.00	0.10	0.00	0.10	-0.10
Philippines	-1.50	0.10	0.00	0.00	0.00	-1.00	-1.90
Thailand	-0.90	0.10	0.00	0.10	0.00	-0.30	-3.40
Venezuela	0.00	0.50	0.60	0.30	0.00	0.10	0.10
Vietnam	-0.10	0.00	0.00	0.00	0.00	-0.10	-0.10
Zambia	0.00	0.80	1.10	0.40	0.00	0.40	0.10
Average	-0.10	0.30	0.40	0.30	0.00	-0.10	-0.40
AAV	1.70	0.30	0.40	0.30	0.00	0.40	0.70
SC	-0.10	1.00	1.00	1.00	-0.50	-0.20	-0.50

Source: Authors' simulations

Table 9c. Complete policy package: Decomposed change(%) in the poverty headcount ($1/day)

Countries	Earnings	Taxes	Cost of Living	Total
Bangladesh	1.29	-0.79	0.19	2.28
Brazil	7.8	-0.13	-1.61	6.31
Chile	-9.72	-1.02	2.35	-6.35
Colombia	7.56	-0.56	1.24	9.36
Indonesia	-2.85	-0.99	5.12	3.26
Malawi	4.29	0.01	-3.83	0.45
Mexico	-0.26	-0.3	4.25	4.29
Mozambique	1.23	-2.15	0.54	3.92
Peru	1.26	-0.02	1.34	2.61
Philippines	-4.27	0.88	1.66	-3.49
Thailand	-4.4	0.46	3.18	-1.67
Venezuela	1.56	-0.13	2.22	3.91
Vietnam	-0.27	-0.04	0.73	0.49
Zambia	2.81	-3.44	-0.96	5.29
Average	0.43	-0.59	1.17	2.19
AAV	3.54	0.78	2.09	3.83
SC	0.12	-0.75	0.56	0.57

Source: Authors' simulations