Climate-Change Pledges, Actions and Outcomes

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Abstract

We study countries' compliance with the targets pledged in international climate-change agreements and the impact of those agreements and specific climate laws and policies on greenhouse-gas emissions and economic outcomes. To do so, we compile and codify data on international agreements and measures enacted at the national and sub-national levels. We find that compliance with targets has been mixed. Still, countries that signed the Kyoto Protocol or the Copenhagen Accord experienced significant reductions in emissions when compared to non-signatories. Having quantifiable targets led to further reductions. Effects from the Paris Agreement are not yet evident in the data. Carbon taxes and the introduction of emission-trading schemes led to material reductions in emissions. Other climate laws or policies do not appear to have had, individually, a material effect on emissions. The impact on GDP growth or inflation from most measures was largely insignificant. Overall, much more ambitious targets would be needed to offset the impact of economic and population growth on emissions and contain the expansion of the stock of gases. (JEL: Q54, O44)

Keywords: emissions, climate change, climate agreements, carbon taxes, emission-trading schemes, climate-change mitigation.

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1. Introduction

Greenhouse-gas (GHG) emissions since the Industrial Revolution have caused material changes to our environment. The cumulative flow of emissions has altered the stock of gases in the atmosphere and is thought to be the most likely cause of global warming and extreme-weather events. As such, GHG emissions are increasingly becoming one of the biggest threats to lives and livelihoods. In response to this escalating problem, three international treaties have been signed, with the overarching aim of reducing emissions: The Kyoto Protocol, the Copenhagen Accord, and the Paris Agreement. The pledges made by countries in each of the international treaties differ in the coverage, timelines and targets set by the various signatories. Moreover, in working towards their targets, countries resorted to different policies and laws over time.

This paper seeks to study the targets pledged by different countries in each of the international agreements, to quantitatively assess countries' compliance with their stated targets, and to gauge the impact on GHG emissions of each of the agreements, as well as the specific policies and laws enacted over time. The paper also explores the indirect impact on economic outputs stemming from these actions.

To do so, the paper combines and codifies historical sectoral- and country-level data on emissions and activity, along with information on individual countries' stated goals in each of the treaties, and climate-action laws and policies enacted over time. We use the data in three sets of exercises. In the first set of exercises, we compute comparable individual countries' targets pledged in each of the international agreements and compare those targets with countries' actual emission reductions over time. In the second set of exercises, we study the impact on emissions stemming from signing each of the three climate-change agreements, from stating quantifiable targets, and from implementing specific climate-related measures, including carbon taxes and emission-trading schemes. To help mitigate estimation biases arising from the potential endogeneity of the various interventions, we use propensity matching estimators in the form of inverse probability weighted (IPW) regressions. In addition, to study the dynamic effects of the various climate agreements and measures and to allow for a possible two-way feedback from emissions, we use local projection methods (Jordà 2005) augmented with IPW (Jordà and Taylor 2016 and Angrist et al. 2018).[1] Finally, in a third set of exercises we seek to gauge the indirect effects from the various interventions; specifically, we extend the IPW augmented local projection analysis to investigate the dynamic responses of GDP growth and inflation to the different agreements and specific climate-change measures.

To set the stage, the paper starts by documenting the evolution of total and per capita emissions across different countries since the 1970s, underscoring their main covariates. The trends in emissions are tightly associated with activity and population growth. In absolute levels, the top emitters since

1. The two empirical strategies, IPW regressions and IPW local projections complement each other and lead to comparable results: the first provides the ”static” or steady-state effects, while the second helps characterise the timing and trajectory of the effects.

the 1970s have been China, the United States, Russia, Japan, Germany and Canada, with Saudi Arabia, South Korea, India, and Iran joining more recently to the list. Among these top emitters, six are also in the top-ten list of oil producing nations. Other oil-producing countries also record very high per capita emissions, but they make smaller contributions to total emissions.[2]

We find that compliance with emission-reduction targets has been mixed, with several countries undershooting their targets.[3] Nevertheless, signing the Kyoto Protocol or the Copenhagen Accord have led to significant reductions in emissions, when compared to the (control) group of countries that did not sign the agreements. In contrast, signing the Paris Agreement does not appear to have led (yet) to any significant reduction in emissions.[4] Moreover, having quantifiable targets helped further in reducing emissions. Of all climate-related measures enacted, two stand out as having a material impact in emission reductions: carbon taxes and the introduction of emission-trading schemes (ETS). A few other specific climate-related laws or policies, as well as the total number of climate-related laws enacted, appear to have statistically significant

2. The emissions measure we used (and on which the agreements are based) corresponds to territorial emissions, that is, those produced within a country's geographical borders, as opposed to consumption emissions embodied in the goods and services consumed by the residents of the country. Hence the relevance of oil production as determinant.

3. Relatively few countries overshot their targets, and those who overshot tended to have less ambitious targets to start with.

4. As we discuss later, it might still be too early to see the effects from the Paris Agreement, given that our sample finishes in 2018.

but quantitatively small effects on emissions. The estimated effects on GDP growth and inflation from these measures are largely insignificant.

Overall, it is clear that much more ambitious targets and stricter compliance would be needed to offset the large impact of economic and population growth on the flow of emissions and contain a further expansion in the stock of greenhouse gases.

The findings that signing an agreement and having quantifiable targets matter have an interesting parallel in the micro-evidence presented by Ramadorai and Zeni (2020); using data from a sample of North American public firms, the authors find that firms that consistently report plans for future emission reduction and abatement exhibit more consistent reductions in emissions than firms that do not. (They also provide evidence that the announcement of the Paris Agreement had a significant impact on carbon abatement activities among these firms; in contrast, we do not see an effect from the Paris agreement in the aggregate data.)

The importance of carbon taxes in reducing emissions over time and across countries is consistent with recent work by Metcalf (2019); using data on Canadian provinces over the 1990-2016 time period, he finds evidence of a significant negative impact of the British Columbia carbon tax on emissions.[5] Our findings on carbon taxes support the conclusions from Hassler, Krusell and

5. See Metcalf (2019) for a survey of the literature on emission reduction impacts of carbon taxes.

Nycander (2016) emphasising the quantitative importance of carbon taxes for reducing emissions; using a quantitative model, the authors argue that while the optimal carbon tax is relatively modest, carbon taxes are more effective than alternative policies such as quantity-based systems or subsidies to green technology.[6]

The finding of negligible effects of carbon taxes on GDP growth is consistent with the results documented by Metcalf and Stock (2020), who estimate a zero to modest positive impact on GDP growth rates, focusing on a sample of European countries; importantly, they find no robust evidence of a negative effect of the tax on either employment or GDP growth. The significant effect of carbon taxes on emissions in our paper is also in line with their study. Our results on the impact of carbon taxes and emission-trading schemes are also consistent with evidence by Kanzig (2021), who uses high-frequency data on changes in carbon futures prices in the European carbon market to estimate the effects of carbon pricing shocks on emissions and economic activity. The author finds that while carbon pricing is successful at reducing emissions, it has less persistent effects on real GDP.

6. Hassler, Krusell, Olovsson and Reiter (2020) take the argument further using a quantitative integrated assessment model to show that carbon taxes that are based on overly-pessimistic views on the climate challenge (that is, higher carbon taxes) are less costly to welfare than taxes based on overly-optimistic views on climate change.

The paper is organised as follows. The next Section describes the data used in the various exercises and discusses the trends in emissions over the 1970-2018 period. Section 3 provides a characterization of the three international climate-change agreements, computes country-specific targets pledged in each of the agreements and contrasts the targeted emissions pledged with actual emissions. It also provides a description of specific climate-change related laws and policies adopted by different countries. Section 4 studies the impact of climate-related pledges, laws and policies on emissions as well as their effect on other economic variables. Section 5 offers concluding remarks.

2. Data

Our study compiles and codifies data from a number of different sources. This Section describes the data sources for each of the variables used in the analysis and outlines the trends in emissions across regions and countries from 1970 to 2018.

2.1. Emissions

We use historical emission data from two sources. The first is the Climate Analysis Indicators Tool (CAIT) Climate Data Explorer compiled by the World Resources Institute (2017). We use this series in Section 3 to construct the targets pledged by each country in each of the international agreements.

The original dataset records historical GHG emissions (which include carbon-dioxide, methane, nitrous oxide and fluoridated gases) for 196 countries, by sector, for eleven sectors (including energy, transportation, agriculture, industrial processes, land use changes, waste, etc.) from 1850 to 2014. As we explain in more detail in Section 3, we combine this data with the pledges made by countries in each of the international agreements. Given that emission-reduction pledges are often sector-specific (that is, they state a targeted reduction in emissions for a specific sector), we use the data from this source to compute the implied reduction in emissions in millions of metric tons of carbon dioxide equivalent (MTCO2 eq) from the starting year of each pledge. This allowed us to have aggregate comparable targeted emission reductions across time and countries. Since the stated targets also differ across countries in terms of benchmark years (vis-a-vis which emission reductions are pledged), we make the targets comparable by computing the pledged reductions in terms of the emission levels in the starting year of each pledge. Because this dataset ends in 2014, we used the sectoral emissions in 2014 as the benchmark year for the Paris Pledge.

The second source of data on emissions, which we use both to assess compliance against the targets and in our regression analysis, come from the Emission Database for Global Atmospheric Research (EDGAR) compiled by

Crippa et al. (2019). This database contains records of fossil CO2 emissions from 212 countries over the 1970 through 2018 period.[7]

While EDGAR reports data on both GHG emissions and Fossil C02 emissions, our regressions focus on the latter, as the series of GHG emissions ends in 2015, whereas Fossil C02 runs until 2018. We show in the next Section that both series are highly correlated since Fossil C02 emissions are the main component of GHG emissions. As explained in detail in Crippa et al. (2019), the series are computed using energy-balance statistics from the International Energy Agency (IEA), which are based on country-specific sectoral activity and technology-mix data, combined with information on fuel consumption. For more information, we refer interested readers to Crippa et al. (2019).

2.2. Climate-change agreements

Information on climate-change agreements and climate-change pledges are obtained from the official documentation of the United Nations Framework Convention on Climate Change (UNFCCC 2008, 2010 and 2011), as well as processed information on the Copenhagen Accord and Paris Agreement from the CAIT Climate Data Explorer database (World Resources Institute 2015 and 2016). In order to quantify the emission-reduction pledges in a way

7. While this dataset also reports GHG emissions by sector, the level of disaggregation is lower than in the CAIT database, with five sectors as opposed to eleven, which makes it somewhat less accurate for the computation of targeted emission reductions; hence our choice to use the CAIT sectoral data to compute targets.

that they are comparable across countries, we augment this information using estimated emissions under business-as-usual (BAU) scenarios from the World Resources Institute's CAIT 2.0 (2015) and Fenhann's Pledge Pipeline (2019). We complement this with information from the World Resources Institute (2018) and Climate Analytics and New Climate Institute (2020). This is necessary to compute targets for countries whose pledges are expressed in terms of BAU scenarios.

Given that the target for European Union (EU) countries is reported collectively for the union in these agreements, in order to calculate country-specific targets for EU countries, we use information from European Commission (2020) and European Union (2020) regulations that specify the distribution of emission-reduction targets for each country within the EU.

2.3. Climate-related laws and policies

Data on climate-related laws and policies were taken from the Grantham Research Institute's Climate Change Laws of the World Database (2020). This database includes information on climate-related laws and policies that are currently in implementation for 198 countries. The data include the starting date and keywords for each law or policy. This database is supplemented with information on carbon price initiatives (carbon taxes and ETS) obtained from the World Bank's Carbon Pricing Dashboard (2020a). This dataset lists carbon taxes and ETS, together with their start date, jurisdiction and coverage.

2.4. Other variables

We obtain background data on real Gross Domestic Product (GDP), expressed in constant 2010 US$, GDP growth rates, total and urban population, inflation rates, and oil rents as a percentage of GDP from the World Bank's World Development Indicators database (2020b).

2.5. Trends in emissions

To set the stage for our analysis, we start by describing the underlying trends in emissions over the period we analyse. Both total GHG emissions and fossil CO2 emissions have more than doubled over the 1970-2015(18) period.[8,9] Countries' per capita emissions show a different trend, with visible declines over the 1980s and 1990s followed by a rapid increase from 2000 onward (see Figure 1). Since the time series on GHG emissions ends in 2015, for the remainder of the analysis, we use the series on fossil CO2 emissions, which goes on to 2018. Historically, both series show a very high correlation, not least because fossil CO2 is the main component of GHG emissions.

The total volume of emissions by region, plotted in Figure 2, indicates that the rise in total emissions over the past two decades has been driven by higher

8. Fossil CO2 emissions include sources from fossil fuel use (combustion, flaring), industrial processes (cement, steel, chemicals and urea) and product use. GHG emissions comprise fossil CO2, CH4, N2O and F-gases.

9. The latest year for which data on GHG emissions are available is 2015 and the latest year for fossil CO2 emissions is 2018.

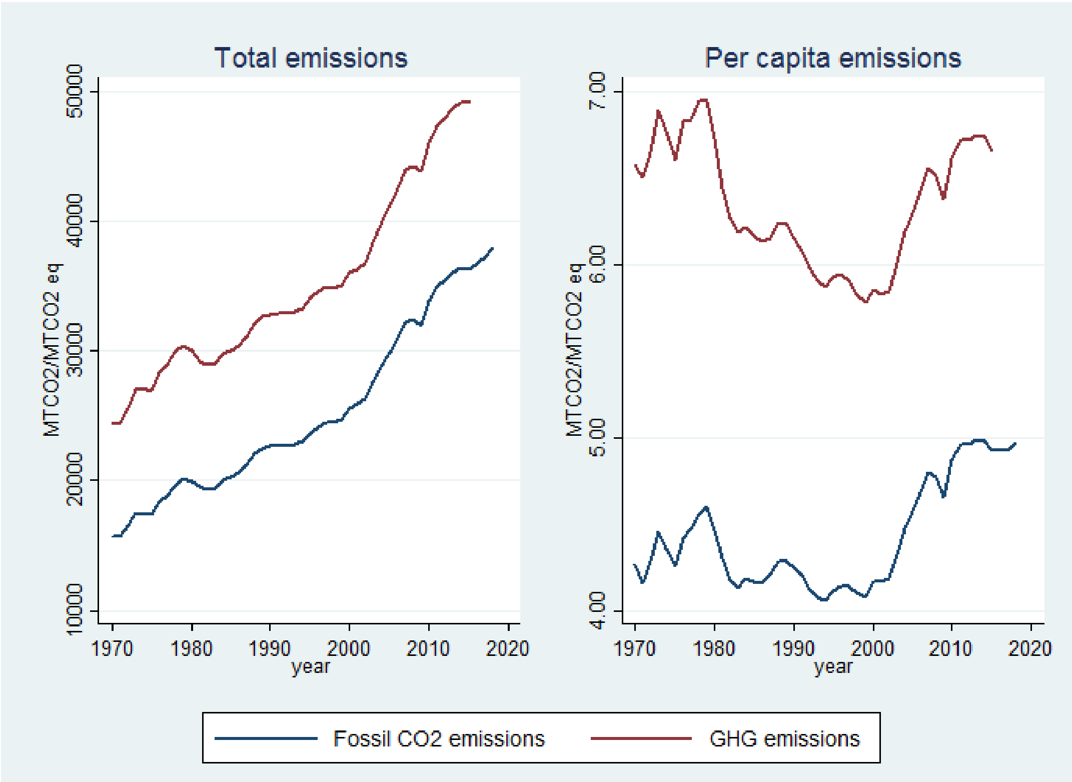


Figure 1. Trends in total and per capita emissions

Note: The figures plot the trends in global fossil CO2 emission and greenhouse gas emissions in total and per capita terms. Data on emissions are from EDGAR.

emissions from the Asia-Pacific region, primarily China. Emissions from North America and Europe, which were the largest emitting regions until the 1990s, appear to have stabilized in the following decade and a half, and are gradually declining, albeit from high levels. Emissions from the remaining regions have been increasing, particularly in the South Asian region, led most notably by India. Sub-Saharan Africa remains the region with the lowest total emissions. Interestingly, emissions from the Middle East (the largest oil-producing region in the world) remain at a lower level than in the West or East Asia.

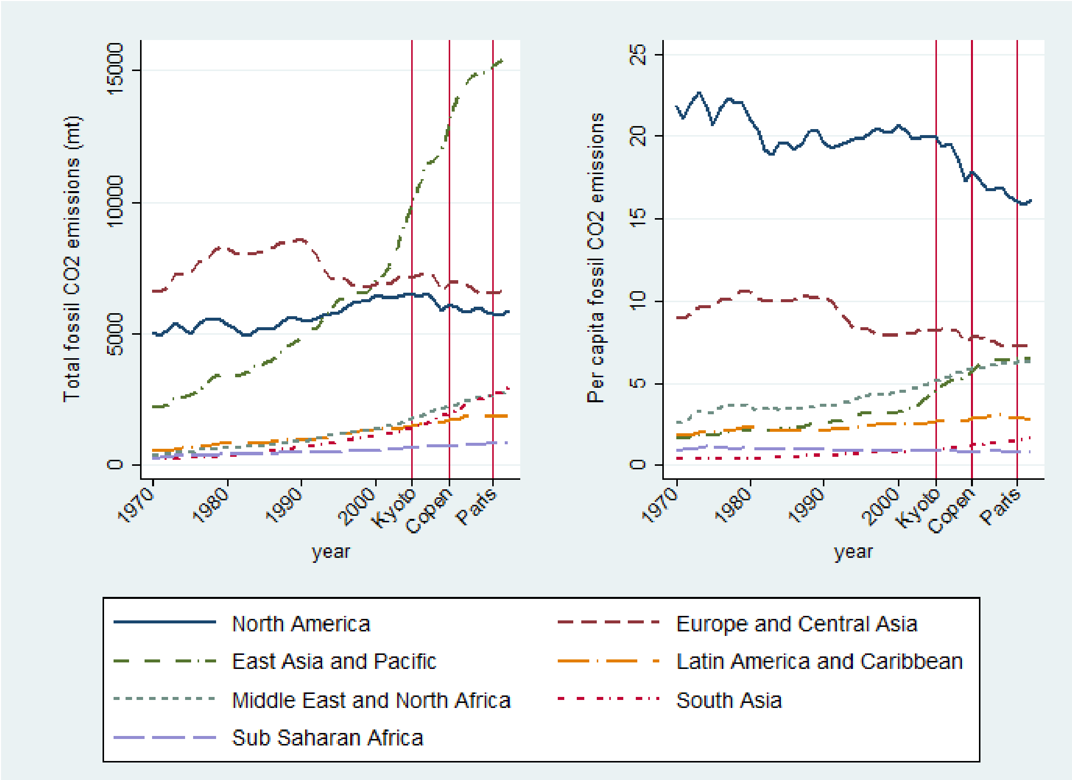


FIGURE 2. Trends in total and per capita emissions by region

Note: The figures plot the trends in fossil CO2 emissions in total and per capita terms by region, as defined by the World Bank. The vertical lines indicate the year of signing of the Kyoto, Copenhagen and Paris Agreements. Data on emissions are from EDGAR.

Per capita emissions, however, remain highest by far in North America, followed by Europe and Central Asia. These regions show a gradual decline since the 2000s. In contrast, East Asia and the Middle East seem to be converging upwards to the European level.

In order to identify the main contributors to fossil CO2 emissions, we examine total and per capita emissions by country. Figure 3 plots per capita emissions against total emissions. The plot identifies a few countries that record high emissions on both total and per capita dimensions. Country codes are

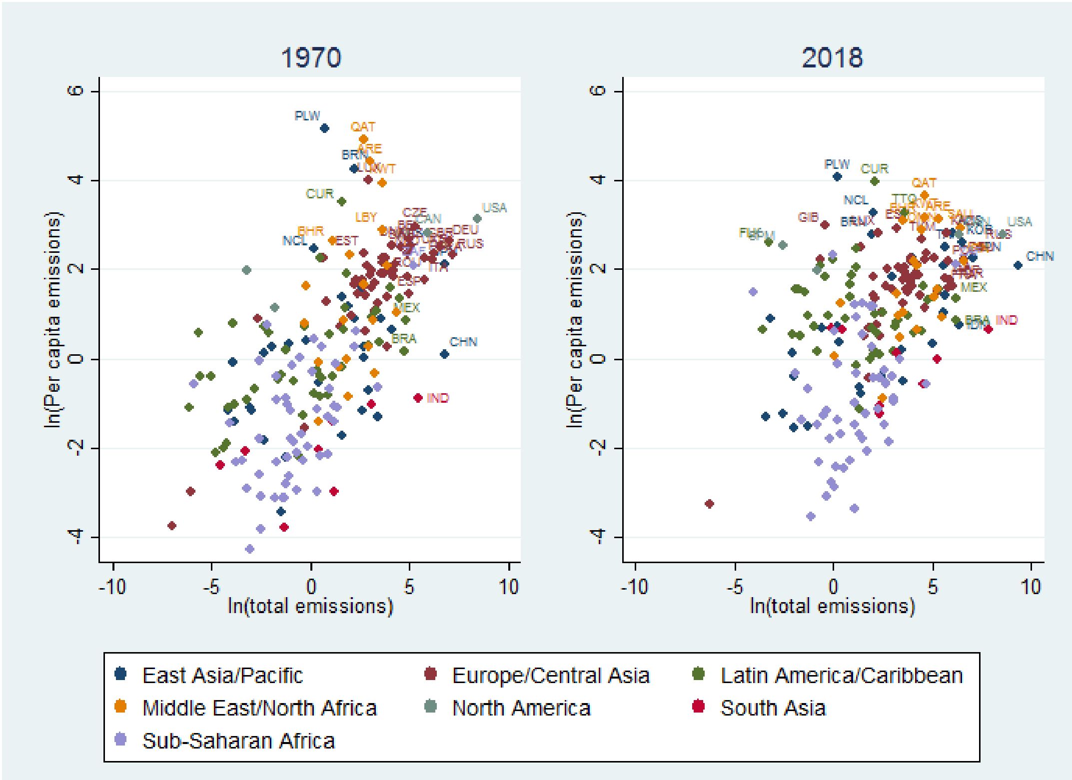


FIGURE 3. Total and per-capita emissions by country, 1970 and 2018

Note: The figures plot total emissions against per capita emissions (in logs) for 1970 and 2018. Data on emissions are from EDGAR.

displayed for the countries in the top 10% of per capita emissions or total emissions in the respective year.

By and large, it is the same set of countries that appear in both 1970 and 2018. India and China are outliers in that they show relatively low per capita emissions but high total emissions. The United States records higher per capita emissions than either of these countries, being the largest emitter of fossil CO2 in 1970 and the second highest in 2018. As Figure 4 shows, most high-income countries record higher emissions, though the relationship with income is more strongly positive for per capita emissions. The clustering of points indicates

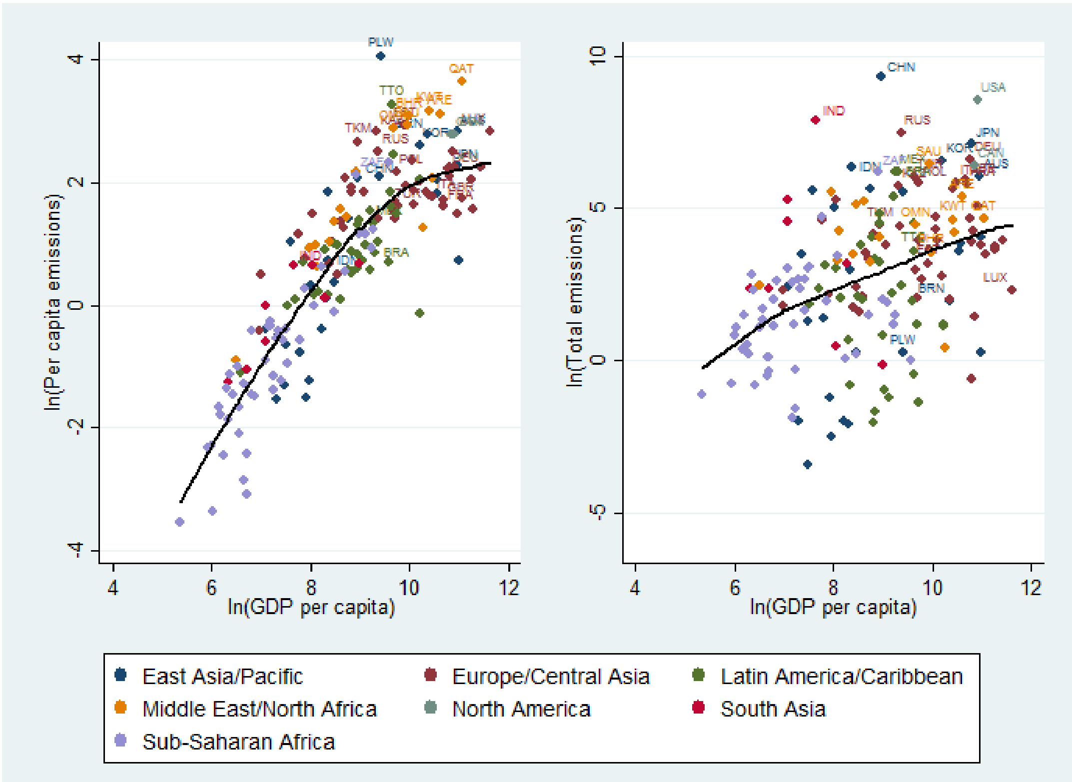


FIGURE 4. Emissions and GDP per capita relationship, 2018

Note: The figures show the scatterplots and fitted line (that is, the lowess smoothed relationship) between total and per capita emissions and per capita GDP for 2018. All variables are converted to logs. Data on emissions are from EDGAR and data on per capita GDP is from the World Development Indicators database.

that countries within Europe, North America, and Latin America are more homogeneous in terms of per capita income and emissions than countries in East and South Asia, Sub-Saharan Africa or the Middle East and North Africa.

Based on the countries identified as having the highest total emissions in 2018, we now examine the trends in the top-ten countries in terms of total emissions. These ten countries account for more than two-thirds (67.3%) of total emissions in 2018. Among them, the United States, Canada, Russia and China were also among the top-ten oil-producing countries in 2018; they were already among the top-ten emitters in 1970, which compounds their contribution to cumulative GHG emissions. Iran and Saudi Arabia, in turn, rank among the top-ten emitting countries in 2018 as well as among the top-ten oil-producing nations.

Figure 5 shows that total emissions have grown very rapidly in most of these countries over the past five decades (note that the graph shows trends in the log of emissions), with particularly rapid growth in China, India, Iran, South Korea and Saudi Arabia. Total emissions in the remaining countries, notably the United States, Russia, Japan, and Canada have remained stable at very high levels. The only country in which total emissions have declined, albeit from a high starting position, is Germany. In terms of per capita emissions, the biggest emitters are Saudi Arabia, the United States and Canada, though per capita emissions have decreased slightly in Canada and the United States over the past decade. Steep increases in per capita emissions are observed in India, China, Iran and South Korea.

Table 1 provides a numerical summary of the results illustrated in the previous graphs.

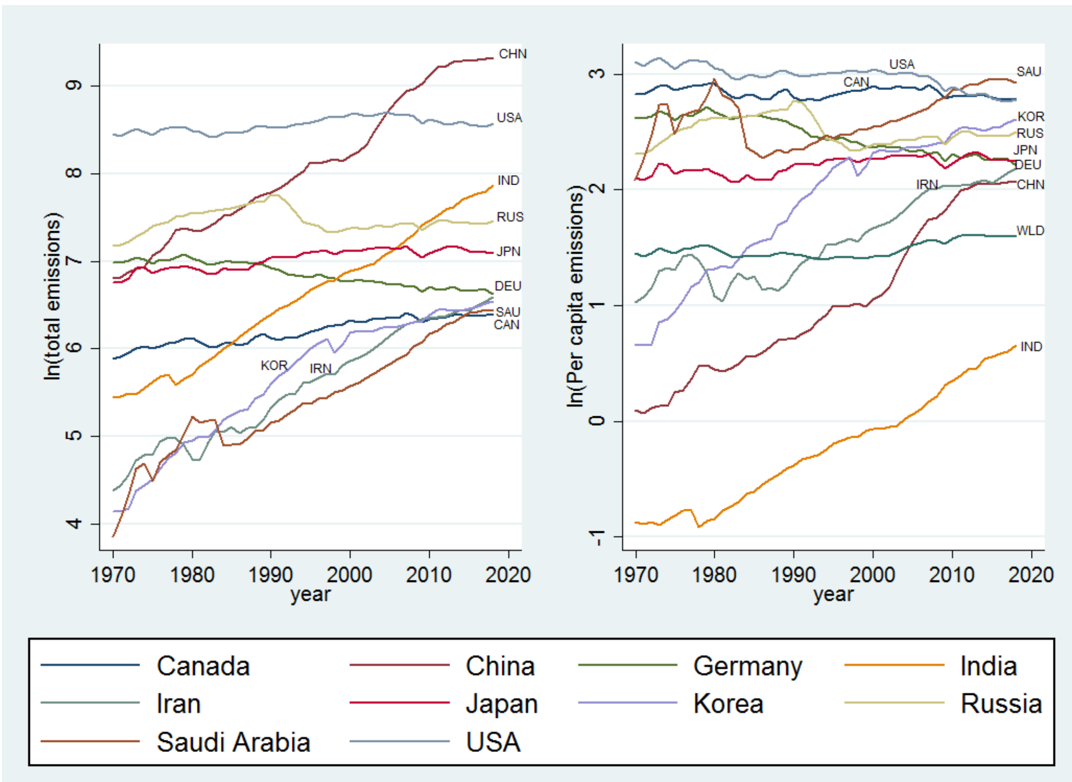


FIGURE 5. Trends in emissions among top 10 emitters

Note: The figures plot the trends in total and per capita emissions (in logs) for the ten countries with the highest levels of total emissions in 2018. Data on emissions are from EDGAR.

TABLE 1. Fossil CO2 emissions by region and top emitting countries

Country/Region	Per capita emissions 1970	Per capita emissions 2018		Total emissions 1970	Total emissions 2018		Share of world's emissions 1970 (%)	Share of world's emissions 2018 (%)	
World	4.27	4.97	⇑	15775.86	37887.22	⇑			
East Asia and Pacific	1.47	6.58	⇑	2160.05	15340.13	⇑	13.69	40.49	⇑
EU27+UK	9.51	6.78	⇓	4198.20	3457.29	⇓	26.61	9.13	⇓
Europe and Central Asia	8.39	7.28	⇓	6585.20	6649.63	⇑	41.74	17.55	⇓
Latin America and Caribbean	1.78	2.80	⇑	526.30	1830.03	⇑	3.34	4.83	⇑
Middle East and North Africa	5.43	6.34	⇑	356.70	2813.35	⇑	2.26	7.43	⇑
North America	21.81	16.14	⇓	5050.28	5870.12	⇑	32.01	15.49	⇓
South Asia	0.37	1.63	⇑	261.43	2958.00	⇑	1.66	7.81	⇑
Sub-Saharan Africa	0.73	0.80	⇑	270.75	860.82	⇑	1.72	2.27	⇑
International shipping and aviation				565.14	1565.15	⇑	3.58	4.13	⇑
World's top emitters and oil producers									
China	1.10	7.95	⇑	905.87	11255.88	⇑	5.74	29.71	⇑
US	22.37	16.14	⇓	4688.52	5275.48	⇑	29.72	13.92	⇓
India	0.42	1.94	⇑	232.12	2621.92	⇑	1.47	6.92	⇑
Russia	10.10	12.14	⇑	1314.17	1748.35	⇑	8.33	4.61	⇓
Japan	8.18	9.42	⇑	857.80	1198.55	⇑	5.44	3.16	⇓
Germany	13.77	9.15	⇓	1082.02	752.65	⇓	6.86	1.99	⇓
Iran	2.79	8.87	⇑	79.47	727.81	⇑	0.50	1.92	⇑
South Korea	1.94	13.59	⇑	62.58	695.36	⇑	0.40	1.84	⇑
Saudi Arabia	8.06	18.63	⇑	47.02	624.99	⇑	0.30	1.65	⇑
Canada	16.86	16.08	⇓	361.59	594.20	⇑	2.29	1.57	⇓
Brazil	1.16	2.37	⇑	110.16	500.09	⇑	0.70	1.32	⇑
UAE	82.54	22.44	⇓	19.44	214.11	⇑	0.12	0.57	⇑
Iraq	2.34	4.78	⇑	23.19	188.10	⇑	0.15	0.50	⇑
Kuwait	51.34	23.91	⇓	38.34	100.34	⇑	0.24	0.26	⇑

Notes: The table reports total and per capita fossil CO2 emissions (in MTCO2) and contribution to global emissions for 1970 and 2018 by region as well as for the countri accounting for highest emissions and oil production. Data on emissions come from EDGAR.

Table 2. Sectoral contributions to emissions by top emitters

Country	Power Industry	Transport	Buildings	Other industrial combustion	Other sectors
Brazil	13.81%	40.49%	7.48%	22.27%	15.94%
Canada	14.99%	29.61%	15.93%	32.87%	6.60%
China	40.74%	8.37%	6.92%	27.00%	16.97%
Germany	38.41%	20.76%	18.15%	14.66%	8.03%
India	46.26%	11.03%	7.43%	25.63%	9.65%
Iran	23.82%	19.13%	22.67%	20.57%	13.81%
Iraq	50.72%	14.20%	5.71%	12.74%	16.63%
Japan	46.35%	16.46%	9.52%	20.20%	7.48%
Kuwait	39.81%	12.56%	0.65%	32.28%	14.70%
Russia	46.37%	14.02%	10.28%	15.10%	14.23%
Saudi Arabia	39.52%	20.77%	0.75%	21.98%	16.98%
South Korea	48.72%	14.39%	9.33%	19.08%	8.49%
United Arab Emirates	42.03%	15.62%	0.35%	30.42%	11.57%
United States	35.23%	34.54%	11.39%	13.86%	4.98%
World	36.59%	21.50%	9.29%	20.85%	11.76%

Notes: The table reports sectoral contributions to fossil CO2 emissions for 2018 among the countries accounting for highest emissions and oil production. Data on fossil CO2 emissions come from EDGAR.

There is clearly an important sectoral dimension to emissions. The main contributing sector to both greenhouse gas and fossil CO2 emissions is the power and energy sector, according to the data for both fossil CO2 emissions for 2018 and GHG emissions for 2014. Table 2 provides the sectoral decomposition for fossil CO2 emissions in 2018 for the top emitters in Table 1.

3. Climate Agreements and Actions

This Section provides an overview of the emission reduction pledges, how we construct comparable targets across countries for the pledges made under three international agreements, and the progress made in terms of achieving these targets. After discussing the three pledges, we move to specific climate-change related laws and policies adopted around the world.

3.1. Emission pledges

The first international agreement signed was the Kyoto Protocol, which was accorded in 1997 but came into force in 2005, with the round ending in 2012. The second was the Copenhagen Accord, which came into effect in December 2009 with targets for 2020. The third treaty was the Paris Agreement, which entered into force in November 2016 with targets for 2030.[10]

3.1.1. Comparable targets. To compute comparable targets across countries, we examine the emission reduction targets declared by each country. Among the countries that are party to each pledge, we start with the set of countries that have specified a numerical target for emission reduction. Different countries have different baseline years against which reductions in emissions are benchmarked. To facilitate comparability across countries, we use these quantified targets to compute the targeted emissions reductions (in MTCO2 eq) relative to the level of emissions in the starting year of the pledge for all countries; this allows us to compare the magnitudes of the targets on a given pledge across the various countries. Some countries specify their targets relative to a particular sector rather than total emissions (e.g., emission reductions in the energy sector alone) or based on their activity projections; again, for comparability, we translate these emission targets (based on sectors or

10. The Doha Amendment to the Kyoto Protocol was adopted for a second commitment period from 2013 to 2020 but it has not yet entered into force.

projections) into reductions relative to the aggregate level of emissions in the starting year of the pledge. To do so, we need information on baseline emission levels, in some cases for specific sectors (for example, energy), as well as Business-As-Usual (BAU) scenario emission projections for future years. For a few countries that specify targets in terms of carbon intensity of their gross domestic product (GDP), we also need GDP projections. Using publicly available information from several sources (as described in Section 2), we compute comparable targets for the majority of countries making quantified target reduction pledges. For many countries setting their pledges based on reductions from future BAU scenarios, the targeted emission level by the end year of the pledge is actually higher than that recorded in the start year.

As the explanation above suggests, the computation of comparable targets across countries varied widely in terms of complexity. We can further illustrate this using some examples of pledges made under the Paris Agreement. First, consider the Canadian pledge of a 30% reduction in emissions from 2005 levels by 2030. Computing a comparable target for this pledge required only data on emissions for Canada in 2005 and emissions in the starting year of the pledge, making it a relatively easy target to quantify. The targets for individual EU countries were slightly more involved - even though the EU made a collective pledge of a 40% reduction from 1990 levels, the targeted reductions were distributed unevenly amongst member countries so that this additional layer of information was required to compute individual country targets. China pledged to reduce CO2 emissions per unit of GDP to below 60%-65% of the 2005 level by 2030, so computing the comparable target required data on emissions and GDP in 2005, projected GDP for 2030, and emissions in the start year. The most difficult pledges to quantify were those which specified reductions for specific sub-sectors under a Business-As-Usual scenario. For example, Trinidad and Tobago pledged a 30% reduction in emissions in the transportation sector from the BAU scenario for 2030. This meant we needed data on projected BAU emissions for the transport sector for 2030, and total and transport sector emissions for the start year of the pledge.

Table 3 summarises the main aspects of the pledges made under the three agreements. The full set of computed target reductions by country is given in Appendix A.

The quantification of total emission reductions from the year in which the agreement was signed provides a measure of how ambitious (or not) targets are at the time at which they were set. While the targets established in the Kyoto Protocol are the most straightforward to compute, it appears that when compared to emission levels in 2005 (the year in which the Protocol came into effect), the targets allow an overall increase in emissions. This in large part owes to the extremely high emissions in Russia in 1990, which is the baseline year from which emission reductions are computed.[11] Indeed, excluding Russia,

11. The Kyoto Protocol allowed Russia to increase emissions substantially relative to its 2005 levels.

Table 3. Summary of targeted emission reductions

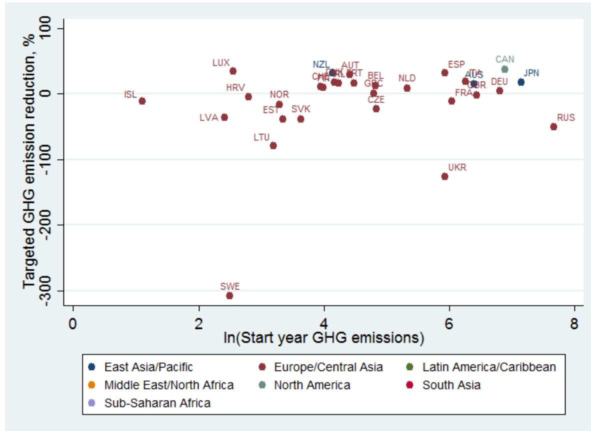
	Kyoto	Kyoto (without Russia)	Copenhagen	Paris
No. of signatories proposing targets or NAMAs (excluding EU28 in total)	37	36	100	188
Start year considered	2005	2005	2010	2014[a]
Countries with quantified emission reduction targets	37	36	59	151
Countries with quantifiable objectives	30[b]	29	54[c]	117[d]
Contribution to world GHG emissions by signatories with quantifiable objectives in starting year (%)	22.95	17.73	75.48	83.39
Contribution to world GHG emissions by all signatories	24.44	19.22	81.93	98.85
Total emissions by signatories with quantifiable objectives in start year	9442.768	7295.786	33418.17	39474.53
Targeted reduction from starting year (conditional)	-679.83	400.4885	3397.412	5402.837
Targeted reduction from starting year (unconditional)	-679.83	400.4885	1427.219	2839.568
Targeted % reduction from starting year (conditional)	-7.2	5.49	10.17	13.69
Targeted % reduction from starting year (unconditional)	-7.2	5.49	4.27	7.19

Notes: [a]To calculate the targeted reduction in emissions from the start date of the pledge, we need sector specific emissions data for the baseline year as well as for the starting year. 2014 is taken as the starting year for the Paris Agreement because this is the last year for which sector specific GHG emissions data are available.
[b]No data for emissions pre-1990 for 5 Eastern European countries and no total emissions data for Liechtenstein and Monaco for 1990.
[c]No total emissions data for Liechtenstein and Monaco for 1990. BAU estimates missing for the rest.
[d]Emissions target expressed in carbon intensity of GDP for Chile, Malaysia and Singapore - GDP projections are also necessary for computing targeted emissions. No total emissions data for Liechtenstein and Monaco for 1990. BAU estimates missing for the rest.
Targeted reduction in emissions is computed as the difference between targeted emissions and starting emissions in the sectors covered by the pledge.

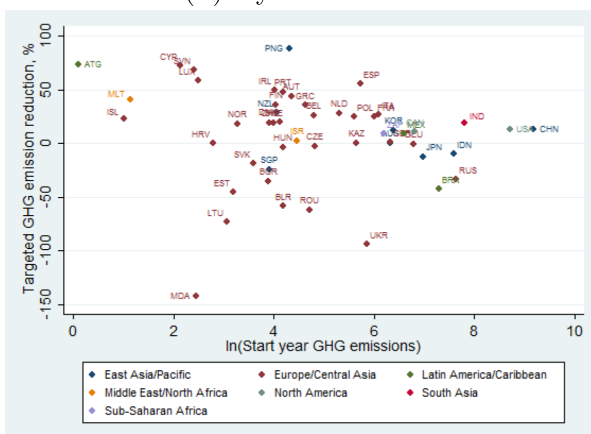
the total targeted emissions involve a reduction of 400 MTCO2 eq., which is a 5.5% reduction in emissions from 2005.

The targets set in the Copenhagen and Paris agreements appear more ambitious overall in terms of the targeted reduction in emissions from the starting year of the agreement. This is true for both absolute and relative reductions, though comparisons between pledges are not as straightforward given that the implementation timelines became longer in Copenhagen and Paris. Moreover, unlike the Kyoto Protocol in which the targets were fixed and unconditional, the two latter agreements allow countries to specify both unconditional targets as well as targets that are conditional on assistance and action from other, generally developed, countries. There is considerable variation between the unconditional and conditional targeted reductions with the total unconditional target amounting to less than half of the total conditional target under the Copenhagen Accord and just over a half in the Paris Agreement. Figures 6a, 6b and 6c plot the targeted unconditional emission reductions as a percentage of the total GHG emissions in the starting year against total GHG emissions in the starting year. Countries without quantifiable targets are excluded. The figures show significant dispersion in the pledges made by different countries across the three treaties, spanning a wide quantitative range from large targeted reductions to large targeted increases in emissions.

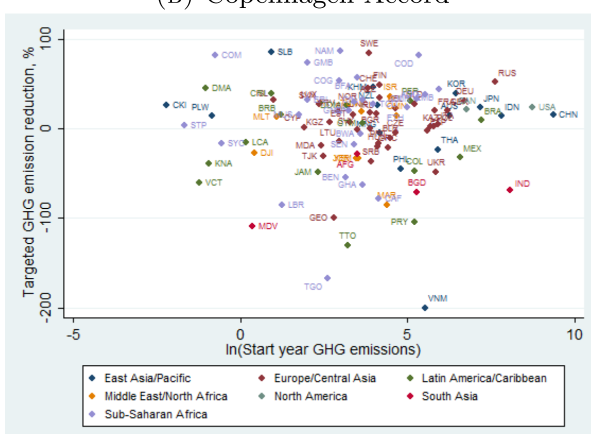
3.1.2. Target achievements. Given that the commitment periods under the Kyoto Protocol and Copenhagen Accord have come to an end, we are in a good position to examine how well countries adhered to their emission-reduction targets. We start by examining emission reductions in signatory and non-signatory countries. For the Kyoto Protocol, we compute the decrease in GHG emissions from the starting year of 2005 to 2012 as a percentage of the 2005 emissions level. Given that we only have data running till 2018, for the Copenhagen Accord, we use fossil CO2 emissions to assess the progress that has been made so far under this agreement and compute the decrease in fossil CO2 emissions from the starting year of 2010 to 2018 as a percentage of the 2010 emissions level. Table 4 presents some summary statistics of observed



(A) Kyoto Protocol



(B) Copenhagen Accord



(C) Paris Agreement

FIGURE 6. Targeted reductions and total emissions

Note: The figures plot the targeted unconditional reduction in emissions as a percentage of the emissions in the starting year against the log of start year emissions for the Kyoto, Copenhagen and Paris Agreements. The graphs in Panel (B) and (C) exclude outliers: Latvia, Kiribati and Madagascar. Note that the axis plots targeted reductions so negative values refer to pledges which involve an increase in emissions from the start year of the pledge.

Table 4. Summary of emission reductions

Pledge	Summary statistic	% reduction in emissions Non-signatory	Signatory
Kyoto Protocol	Mean	-18.19	7.67
	25th percentile	-57.90	-1.78
	Median	-13.50	7.43
	75th percentile	4.63	15.06
Copenhagen Accord	Mean	-23.59	-10.30
	25th percentile	-34.93	-23.33
	Median	-27.68	-5.03
	75th percentile	-16.19	5.04

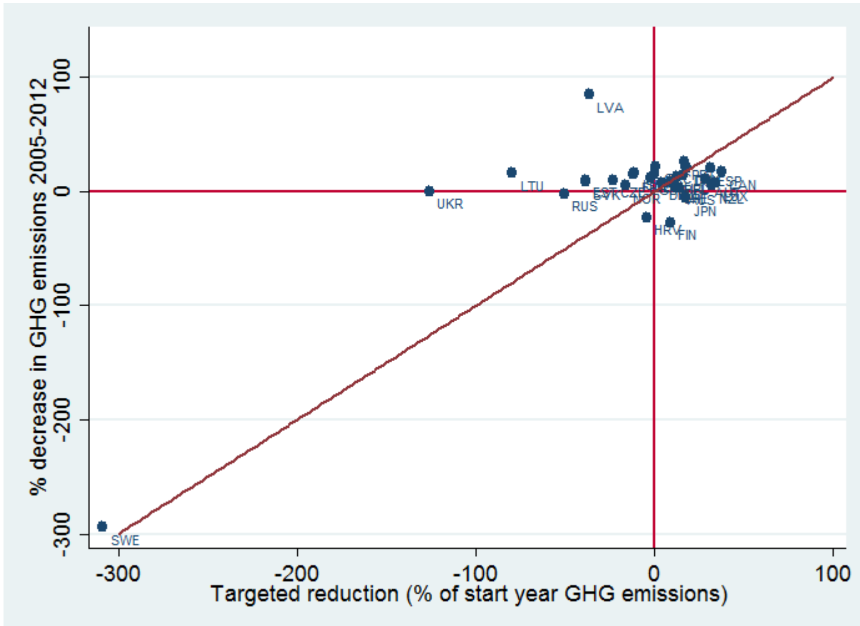
Notes: The table reports summary statistics for the reduction in GHG emissions between 2005 and 2012 for signatories and non-signatories of the Kyoto Protocol and the reduction in fossil CO2 emissions between 2010 and 2018 for signatories and non-signatories of the Copenhagen Accord. All summary statistics are weighted by emissions in the starting year. Note that a positive value indicates a reduction in emissions while a negative value indicates an increase

emission reductions weighted by start year emissions levels. Note that a positive value indicates a reduction in emissions whereas a negative value indicates an increase.

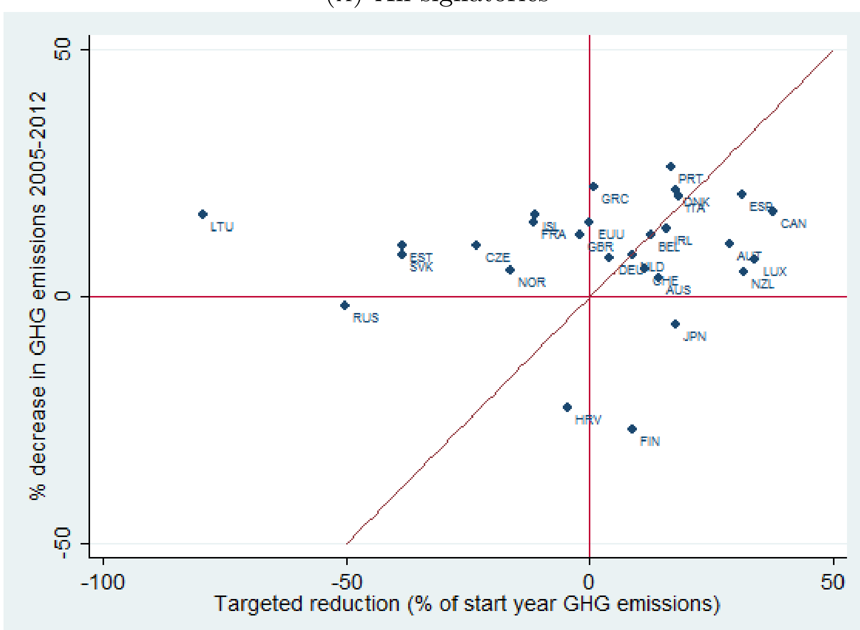
Table 4 shows that GHG emissions increased, on average, among non-signatories of the Kyoto Protocol over the commitment period of 2005-2012, while emissions fell among signatories. The Copenhagen Accord appears to have been less effective by comparison, with fossil CO2 emissions increasing, on average, among both signatory and non-signatory countries though the increase is significantly smaller among the signatories to the pledge. While these numbers provide a crude indication of the effect of signing the pledges, the impact of the pledges on emissions is examined in more detail in Section 4.

Next, we explore, at country level, how well the targets set under these two pledges were achieved. Figure 7a plots the decrease in GHG emissions from the starting year of 2005 until 2012 (as a percentage of the 2005 emissions level) against the targeted reduction as a percentage of the emission levels in 2005. By comparing these two values for each country, we can see which countries reached their targets. The actual reduction in emissions is larger than or equal to the targeted reduction for countries to the left of the 45 degree line and the reduction in emissions fall short of the target for countries to the right of the 45 degree line.

When examining success by country, there is wide variation in both the achievement and ambitiousness of targets. Countries to the left of the 45 degree line (in red) represent the countries that met their target, with countries further from the line having significantly over-achieved their target. Countries to the right of the 45 degree line are those that failed to achieve their targeted emission reduction. The graph indicates that while there are some clear outliers in terms of over-achievement of targets (e.g. Latvia and Ukraine, which pledged increases in emissions), only a few countries actually set targets to reduce emissions from the 2005 emission level (recall that most countries used 1990 as their baseline year) and then met this target (these are the countries in the area to the right of the Y-axis and above the 45 degree line). All of the countries that specified a target involving an increase in emissions from the 2005 level, with the exception



(A) All signatories



(B) All signatories excluding Sweden, Ukraine and Latvia

Figure 7. Achievement of targets under the Kyoto Protocol

Note: The figure plots the decrease in GHG emissions from the starting year of 2005 to 2012 (as a percentage of the 2005 GHG emissions level) against the targeted reduction as a percentage of the emissions in the start year for the Kyoto Agreement. The red line is the Y=X line. The graph is plotted with (Fig 7a) and without (Fig 7b) Sweden, Ukraine and Latvia.

of Croatia, achieved their target.[12] The EU15 countries also collectively over-achieved their target – the target reduction was 258 MTCO2 eq. and actual reduction was 462 MTCO2 eq. Though there is huge variation in compliance across countries, adding the emissions and targets of all countries, the group of thirty countries for which targets are quantified actually met the required emissions reduction. Total emissions by these countries as a whole amounted to 8,864 MTCO2 eq. in 2012, compared to a targeted emissions level of 10,057.11 MTCO2 eq.

The Copenhagen Accord specified GHG emission reduction targets for 2020. We undertake a similar comparison to that used for the Kyoto Protocol by contrasting targeted unconditional emission reductions with emission reductions recorded to date (2018). Note that the targeted reductions are as a percentage of GHG emissions in the starting year of the pledge, whereas the reduction to date is as a share of fossil CO2 emissions in the starting year. As said, GHG and CO2 are highly correlated. For this comparison to reflect the true progress under the Accord, we are implicitly assuming that GHG emissions and fossil CO2 emissions change at the same rate.

As Figure 8 illustrates, twenty-one countries had reached or exceeded the targeted emission reduction (countries to the left of the 45 degree line) by 2018,

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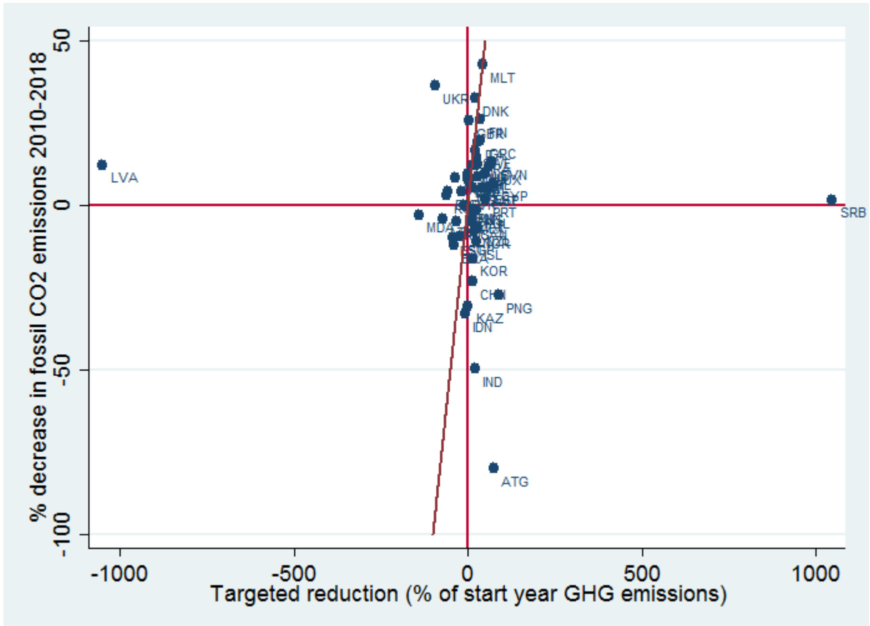
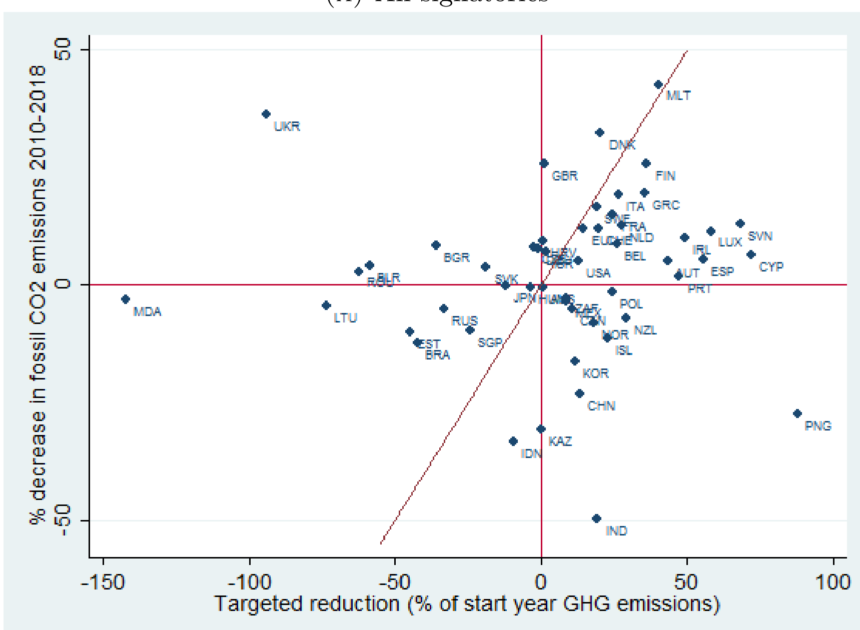
12. Sweden appears as an outlier in the Kyoto Protocol. It is clear why: by the time the Protocol was signed, Sweden, which fell under the EU umbrella, was actually allowed a 4% increase in emissions relative to its 1990 levels. Since we compute the targeted reduction in emissions from the start year of the pledge, which was 2005, when emissions in Sweden had already reduced substantially, the resulting target becomes a very large targeted increase.



(A) All signatories



(B) All signatories excluding Latvia and Serbia

FIGURE 8. Progress made under the Copenhagen Accord

Note: The figure plots the decrease in fossil CO2 emissions from the starting year of 2010 to 2018 (as a percentage of the 2010 emissions level) against the targeted unconditional GHG emission reduction as a percentage of the GHG emissions in the start year for the Copenhagen Accord. The red line is the Y=X line. The graph is plotted with (Fig 8a) and without (Fig 8b) Latvia and Serbia.

while thirty-five had not, though countries close to the 45 degree line are those that were reasonably close to achieving their targets. As was the case with the Kyoto Protocol, the vast majority of countries that had already achieved their targets by 2018 were those that specified an increase in emissions from the starting year of 2010 (in the official pledges, many countries continued to specify their baseline year as 1990 under the Copenhagen Accord), with only a few countries, such as Denmark and Malta, having achieved more ambitious targets. Germany, Japan and Russia were the only countries among the top-10 emitters that had already achieved their target level of emissions as of 2018. It is conceivable that with the Covid-19 pandemic and the implied reduction in emissions caused by lower activity, many more countries would have met the targets.

3.2. Climate-change actions

Aside from the signing of international climate-change related pledges, and often as part of those pledges, many countries have adopted a range of laws, policies and instruments to mitigate the impact of climate change. Using the Climate Change Laws of the World database, which records information on 1,809 laws and policies in 200 countries which were in implementation up to the end of 2019, we measure the number of climate-related laws and policies that are in force in a given country and year.[13] The database also provides keywords for each of these actions, which we use to gauge the number of policies or actions related to various aspects of climate-change actions including measures for adaptation to climate change, management of energy demand and energy supply, transportation, land use and forestry, and R&D. We combine this information with data from the Carbon Pricing Dashboard, which contains information on carbon taxes and emissions trading schemes (ETS) implemented by country and year.

Table 5 summarises the number of climate-related laws and policies by decade and the number of countries with at least one climate-related law or policy. The number and distribution of policies or laws by sector are listed in Table 6.

TABLE 5. Laws and policies related to climate change

	Number of laws passed	Number of policies passed	Countries with at least one law	Countries with at least one policy
Pre 1970	8	1	6	1
1970-79	6	0	10	1
1980-89	17	2	18	3
1990-99	78	31	62	23
2000-09	272	276	119	135
2010-19	394	724	156	176
Total to date	**775**	**1034**	**156**	**176**

Notes: Computed using data from the Climate Laws of the World Database.

13. The database does not include laws or policies that were abolished, so the numbers for some years could be underestimated. However, the World Bank's Carbon Pricing Dashboard, which lists all carbon taxes and emission-trading schemes ever implemented, shows that very few (just three, of which only one was a national-level action) carbon taxes or emission-trading schemes have been abolished to date. As such, it is unlikely that underestimation of the number of laws and policies is large.

Table 6. Climate-related laws and policies by sector

		Number of policies/laws in action by sector							
		Adaptation	Energy demand	Energy supply	Institutions	Transport	LULUCF	R&D	**Total**
Pre 1970	No.	7	0	1	4	1	0	0	**9**
	%	77.8	0.0	11.1	44.4	11.1	0.0	0.0	
1970-79	No.	1	4	2	3	1	0	0	**6**
	%	16.7	66.7	33.3	50.0	16.7	0.0	0.0	
1980-89	No.	5	6	8	11	1	2	3	**19**
	%	26.3	31.6	42.1	57.9	5.3	10.5	15.8	
1990-99	No.	32	37	41	64	11	11	14	**109**
	%	29.4	33.9	37.6	58.7	10.1	10.1	12.8	
2000-09	No.	139	236	299	271	108	99	136	**548**
	%	25.4	43.1	54.6	49.5	19.7	18.1	24.8	
2010-19	No.	466	396	535	561	205	241	215	**1118**
	%	41.7	35.4	47.9	50.2	18.3	21.6	19.2	

Notes: Computed using data from the Climate Laws of the World Database. The sum of the sector columns can add up to more than the total number of laws/policies as some laws and policies cover multiple sectors.

Table 5 shows that most climate-related actions (executive or legislative) were taken over the past few decades. While laws were relatively more common in the earlier decades, policies become more common from the 2000s such that as of 2019 there were 1,034 climate-related policies and 775 climate-related laws that had been enacted across the world.

As shown in Table 6, the areas covered by climate-related laws and policies vary over the years. Most of the earliest laws and policies are related to climate-change adaptation or energy demand, while in the later years policies and laws related to energy supply and institutions have become more common. There has also been an increase in the number of laws and policies related to land use, land use change and forestry (LULUCF), as well as R&D over the last few decades.

Table 7 lists out the number of national and sub-national carbon taxes and emissions trading schemes being implemented over the years as well as the number of countries where at least one carbon tax or ETS is implemented.

TABLE 7. Carbon taxes and Emission Trading Schemes

	No. of carbon taxes		No. of ETS		No. of countries with	
	National/ regional	Sub-national	National/ Regional	Sub-national	Carbon tax	ETS
Pre-1990	0	0	0	0	0	0
1990-99	6	0	0	0	6	0
2000-09	10	1	3	2	9	31
2010-19	25	5	7	20	23	34

Notes: Computed using data from the Carbon Pricing Dashboard.

The first carbon-pricing initiatives in the database are the Polish and Finnish Carbon Taxes implemented in 1990. Since then, there has been a gradual increase in the number of carbon pricing initiatives implemented around the world. While most of the carbon taxes are enacted at a national level, most of the ETS are implemented at the sub-national level in the United States, Canada, China and Japan. Only two initiatives in the dataset have been abolished as of 2019 – the Australian national level ETS, which was introduced in 2012 and abolished in 2015, and the Ontario ETS, which was implemented in 2017 and abolished in 2019. Note that while the EU ETS counts as a single initiative, its jurisdiction spans all the EU countries as well as Norway, Iceland and Liechtenstein.

4. Impact of climate agreements and actions

In this Section we combine our datasets on emissions and pledges with information on climate-related laws and policies to examine the relation between total fossil CO2 emissions (for which data are available until 2018) and the climate change pledges and actions. The analysis is based on a panel of 186 countries.

4.1. Static specification: controls and endogeneity correction

Our baseline specification controls for per capita GDP, population, share of urban population, and, for a smaller sample, oil rents as a percentage of GDP, as summarised in Table 8.

TABLE 8. Covariates of emissions

	Total Fossil CO2 emissions (in logs)			
	(1)	(2)	(3)	(4)
GDP per capita (in logs)	0.843***	0.707***	0.848***	0.696***
	[0.010]	[0.061]	[0.010]	[0.060]
Population (in logs)	1.106***	1.250***	1.109***	1.219***
	[0.006]	[0.176]	[0.006]	[0.158]
Urban population (% of total)	0.011***	0.008*	0.009***	0.008*
	[0.001]	[0.004]	[0.001]	[0.005]
Oil rents (% of GDP)			0.020***	0.002
			[0.001]	[0.004]
Country and Year FE	No	Yes	No	Yes
N	7991	7991	7189	7189
R-sq	0.903	0.884	0.907	0.885

Notes: The table reports the results of regressing total fossil CO2 emissions (in logs) on GDP per capita (in constant 2010 US$) and population (in logs), urban population as a percentage of the total and oil rents as a percentage of GDP. Columns (1) and (3) do not control for country and year fixed effects. All regressions include a constant term.
The values in brackets are robust standard errors. *, **, and *** indicate significance at 10%, 5%, and 1% levels, respectively.

As expected, the main control variables, GDP per capita and population, show statistically significant positive associations with total emissions, with the estimated coefficient on population increasing in magnitude when country- and year-fixed effects are controlled for. The magnitudes are large. A 1% increase in GDP per capita is associated with a 0.84% increase in emissions, while a 1% increase in population is associated with a 1.1% increase in emissions. The share of urban population has a smaller correlation with emissions, with the effect becoming less significant when controlling for country- and year-fixed effects. While oil rents have a much smaller quantitative impact on emissions than the other factors, the association between emissions and oil rents also becomes insignificant once country- and year-fixed effects, along with income and population have been controlled for. This is because most of the oil-production effect on emissions is absorbed in the country-specific effect. Since its inclusion also results in a smaller sample size, we exclude it from the following regressions.

To this set of controls, we add variables that capture the effects of climate-change pledges and actions. The first set of regressions examines the effect of the climate-change pledges on emissions. We start with three indicator variables that take the value one when the corresponding agreements has been signed (0 before and 1 thereafter) with a one-year lag to allow for time between the signature of the agreement and its implementation. To distinguish whether simply signing the agreement has a different effect from having a quantifiable target for emission reduction, we include an indicator that takes a value 1 when the target is quantifiable.[14]

The second set of regressions explores the impact of specific climate-related actions undertaken by different countries. We generate indicator variables for the implementation of a carbon tax and of ETS at the national level.[15] A second variable (or set of variables) aims at capturing other specific climate-related laws and policies. We use two specifications for modelling the effect of climate laws and policies on emissions: the first simply uses the total number of climate laws and policies that are in place, while the second uses the number of laws or policies disaggregated by area of implementation. As with the indicators for signing climate agreements, the number of climate-related laws and policies are included in the model with a one-year lag. All the regressions include country and year fixed effects.

To address potential endogeneity in the decision to sign a climate-pledge, we use inverse probability weighted (IPW) regression estimation. In the first stage, we estimate the probability of signing each climate pledge as a function of GDP per capita, population, share of urban population, and emissions observed in the

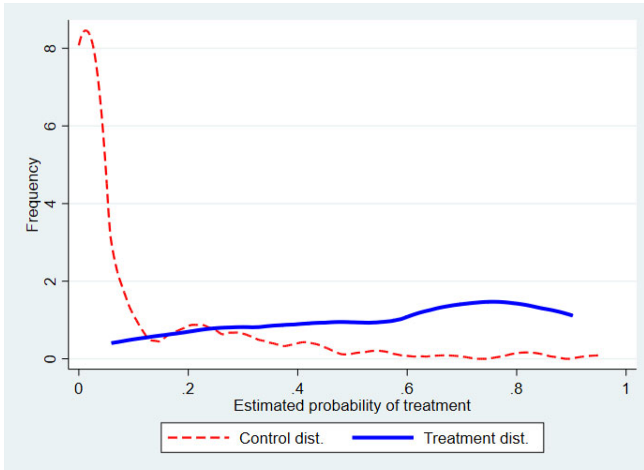
14. The relationship between covariates and emissions appears to be relatively stable in the pre-agreement period (1970-2000), except for a slight change in the relationship with GDP per capita in the 1990s. Similarly, the effects are more or less homogeneous across levels of development, especially in the pre-agreement period. See Appendix Tables B.1 and B.2 for more details.

15. The database mentions that the carbon prices are not necessarily comparable between initiatives due to differences in sectors covered, specific exemptions and compensation methods. Given these limitations, we do not use the carbon prices in the analysis.

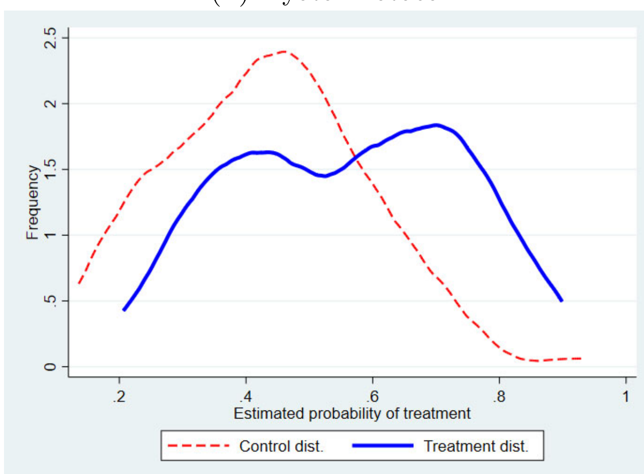
previous year to obtain a propensity score, the inverse of which is used to weigh the regressions described previously. As discussed in Jordà and Taylor (2016), the idea behind this method is that it focuses the estimator on a rebalanced sample in parts of the treatment and control group that are similar to each other.

Given that for each pledge, a country only faced the decision of whether to sign and not when to sign it (the years in which the pledges are ratified are fixed), we use cross-sections of the data from the year of each pledge being ratified to estimate these propensities using a probit model. Figures 9a, 9b, and 9c show the smooth kernel density estimates of the distribution of the propensity scores for signing for countries adopting (treatment) and not adopting (control) each pledge. These figures check for overlap between the two groups, which allows for the proper identification of the average treatment effect (ATE).

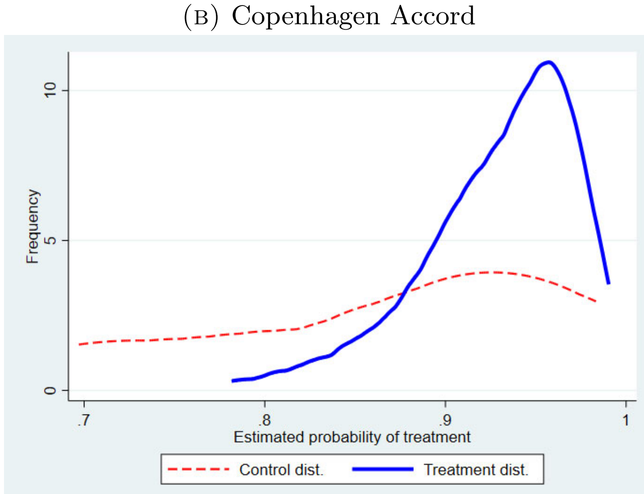
The distribution of propensity scores for treated and untreated groups show considerable overlap, though it appears that a few observations are likely to get very high weights (in the case of the Kyoto Protocol, which was signed by just 36 countries in our sample), while some others are likely to get very low weights (in the case of the Paris Agreement, which was signed by 176 countries in our sample). For this reason, we truncate the minimum and maximum weights to 1.11 and 10, respectively. The computed weights for each of the pledges are then compiled as a panel, assuming that the propensities prior to signing each pledge



(A) Kyoto Protocol



(B) Copenhagen Accord



(C) Paris Agreement

Figure 9. Overlap check: Distribution of treatment propensity score

Note: The figure plots the smooth kernel density estimates of the distribution of the propensity scores for signing for treatment and control countries.

are fixed. These weights are then used for the four regression models discussed earlier, assuming that the propensities for signing climate pledges are similar to the propensities for adopting different climate-related actions.[16] The results of the regressions examining the impact of signing climate agreements and adopting climate-changed related laws and policies, with and without weighting by inverse probabilities are given in Table 9 and Table 10.

Table 9. Emissions and climate agreements

	ln(Total fossil CO2 emissions)			
	(1)	(2)	(3)	(4)
Signed Kyoto	-0.438***	-0.423***	-0.349***	-0.344***
	[0.023]	[0.023]	[0.029]	[0.029]
Signed Copenhagen	-0.166***	-0.156***	-0.137***	-0.129***
	[0.025]	[0.028]	[0.026]	[0.028]
Signed Paris	0.049	0.078	0.111	0.13
	[0.291]	[0.120]	[0.291]	[0.120]
Have quantified objectives			-0.118***	-0.103***
			[0.027]	[0.027]
Using IPW	No	Yes	No	Yes
N	7870	7870	7870	7870

Notes: The table reports the results of regressing total fossil CO2 emissions (in logs) on lagged indicators for signing different climate-related pledges. All regressions include a constant and control for country and year fixed effects as well as real GDP per capita (in constant 2010 US$), population (in logs), and urban population as a percentage of the total. Columns (1) and (3) report the unweighted OLS estimates, while the results in the remaining columns are estimated using inverse probability weighting.
The values in brackets are robust standard errors. *, **, and *** indicate significance at 10%, 5%, and 1% levels, respectively.

The regression outcomes in Table 9 indicate that the results from weighted and unweighted regressions are very similar. Columns (1) and (2) show that signing the Kyoto and Copenhagen agreements are associated with significantly

16. In the subsequent Section where we estimate the dynamic effects of one policy option at a time, we relax this assumption, estimating the propensity for adoption of each option separately.

lower emissions, holding population and income constant. However, being a signatory to the Paris agreement does not show any impact on emissions; this could be of course because we have only two years of data post-Paris (recall that the agreement came into force in November of 2016). The magnitude of these estimated effects are large: The results from Column (2) in the table indicate that signing the Kyoto agreement results in 34% lower fossil CO2 emissions when compared with countries that did not sign the agreement.

How do we reconcile this large estimated fall with the rather unambitious targets set in Kyoto? The answer is in the counterfactual or control group: countries that did not sign the Kyoto Protocol recorded a steep rise in emissions. Hence, signing Kyoto had an effect, not so much in reducing emissions but in preventing countries from increasing emissions too rapidly. Signing the Copenhagen Accord led to a reduction in emissions in the order of 14%.[17] [18] Having quantified objectives for the pledges show a further negative effect on emissions (columns (3) and (4)). This effect is much larger for the Copenhagen Accord, where more than 40% of signatory countries did not specify numerical targets. On the other hand, all countries had numerical targets under the Kyoto

17. As a placebo check, we also re-estimate the model in Column (1) including leads of the indicators for signing the pledges to verify whether emissions started falling in the year prior to the agreements. The results show that emissions reductions are observed in the year before the agreement in the case of the Kyoto Protocol but not for the other two agreements. This can be explained by the fact that while the Kyoto protocol, came into force legally in 2005, it was accorded in 1997; that is, in 1997, countries accorded that the commitment period would be from 2005 to 2012. See Appendix Table C.1 for these results.

18. We also estimate the regressions again, leaving out the outliers observed in Figures 7b and 8b. The results in Table 9 and 10 are not sensitive to their exclusion. See Appendix D for these results.

Protocol - accordingly, the sum of the coefficients on signing the agreement and having a quantified objective in the Copenhagen Accord is very similar to the coefficient on signing the Kyoto Protocol in the regressions where having a quantified target is not controlled for.

Table 10. Emissions and climate actions

	ln(Total fossil CO2 emissions)			
	(1)	(2)	(3)	(4)
Number of climate related laws	-0.036***	-0.036***		
	[0.003]	[0.003]		
Number of climate related policies	-0.001	0.000		
	[0.003]	[0.004]		
Have national level carbon tax	-0.215***	-0.208***	-0.222***	-0.211***
	[0.021]	[0.022]	[0.022]	[0.022]
Have national level ETS	-0.325***	-0.309***	-0.342***	-0.332***
	[0.020]	[0.020]	[0.021]	[0.021]
Number of policies by sector				
Adaptation			0.016***	0.018***
			[0.006]	[0.006]
Demand management			-0.020***	-0.019***
			[0.005]	[0.005]
Supply management			-0.026***	-0.026***
			[0.004]	[0.005]
Transport			-0.012*	-0.003
			[0.007]	[0.007]
LULUCF			0.014**	0.006
			[0.006]	[0.007]
R&D			-0.008	-0.011*
			[0.005]	[0.006]
Using IPW	No	Yes	No	Yes
N	7870	7870	7870	7870

Notes: The table reports the results of regressing total fossil CO2 emissions (in logs) on the lagged number of climate related laws and policies implemented as well as indicators for having a national carbon tax and ETS. All regressions include a constant and control for country and year fixed effects as well as real GDP per capita (in constant 2010 US$), population (in logs), and urban population as a percentage of the total. Columns (1) and (3) report the unweighted OLS estimates, while the results in the remaining columns are estimated using inverse probability weighting.
The values in brackets are robust standard errors. *, **, and *** indicate significance at 10%, 5%, and 1% levels, respectively.

Table 10 shows the estimated effects of climate-related laws and policies on emissions. These estimates suggest that the number of climate-related laws and the presence of nation-wide carbon taxes and emission trading schemes are significantly associated with lower emissions. Given the inclusion of country and time effects, the figures in the table should be read as relative to the emissions in countries that did not implement such policies. In terms of magnitudes, the regressions suggest a reduction of emissions in the order of 19% due to carbon taxes, relative to countries without a national carbon tax. The presence of a national level ETS also shows a negative correlation with emissions, with the effect in the order of 27%.

The number of climate-related policies shows no association with emissions, while the number of laws passed appear to affect emissions negatively. More specifically, emissions appear to decrease by 4% for each additional climate-related law that is enacted. This suggests that the distinction between executive and legislative actions is important. Legal steps can have an important role alongside specific policies, like carbon taxes or ETS. When examining the number of laws or policies by area, a few areas appear to be significantly associated with emissions - for instance the number of policies related to demand and supply management, and research and development are negatively correlated with emissions, while the number of policies related to adaptation is positively correlated. The magnitude of the effects of such laws and policies are quantitatively much smaller than the effects of a carbon tax or ETS.

Therefore, for the analysis of dynamic effects that follows, we focus specifically on being signatory to the Kyoto and Copenhagen pledges, and on the two most (statistically) significant policies, national carbon taxes and ETS.

4.2. Dynamic effects on emissions

The previous sections provided evidence on the relationships between emissions and international climate-change agreements and specific climate-change actions by accounting for selection into the treatments based on observable variables. However, causal inference might be further affected by potential feedback from emission levels to climate-change actions or to the willingness to sign international agreements. For instance, a country with a low level of emissions may find it easier to sign a climate agreement than a country with a high level of emissions (or, with a different sign, a country with high level of emissions might face more international peer pressure to join the agreement). To address this reverse-causality problem, we estimate the dynamic effect of climate-change actions on emissions using the Jordà (2005) local projection method with IPW, adapted to panel data as in Jordà and Taylor (2016).

The identifying assumption implicit in the estimation of local projections is that once past emissions, and current and past international shocks (captured by time fixed effects) are controlled for, the estimation is only left with the exogenous component of climate interventions. By applying IPW regression adjusted estimation within this framework, we are further facilitating comparability between treatment and control groups. As such, we estimate the following set of equations weighted by inverse propensities:

$$
\begin{aligned}
ln(emissions_{i,t+h}) = \gamma(L)ln(emissions_{i,t-1}) + \rho(L)X_{i,t-1} + \theta_h\tau_{i,t} \\
+ \delta(L)\tau_{i,t-1} + \alpha_i + W_t + \varepsilon_{i,t}, \qquad h = 0, 1, 2, ..., 7
\end{aligned}
\tag{1}
$$

where $X_{i,t-1}$ contains a set of controls, including GDP, population and urbanization, $\tau_{i,t}$ is the policy variable of interest (the treatment), and we allow for lags of up to three years for all regressors. α_i and W_t are country and time fixed effects and $\varepsilon_{i,t}$ is the random error term. The coefficient θ_h captures the effect of a change in the climate action policy in year t on emissions, h periods in the future.

Equation 1 is estimated separately for each value of h and for each of the following climate-change actions separately: being a signatory to the Kyoto protocol, being a signatory to the Copenhagen accord, having a national level carbon tax, and having a national level ETS. As such, the propensities for each of these actions are also estimated separately and applied to each set of regressions. As explained in the previous Section, the propensity for signing a pledge is estimated using data only for the specific year of the pledge being ratified. However, in the case of carbon taxes or ETS, since a country is able to decide both whether and when they enact such a policy, the propensities for enacting a nation-wide carbon tax or ETS are estimated using the full panel dataset.[19]

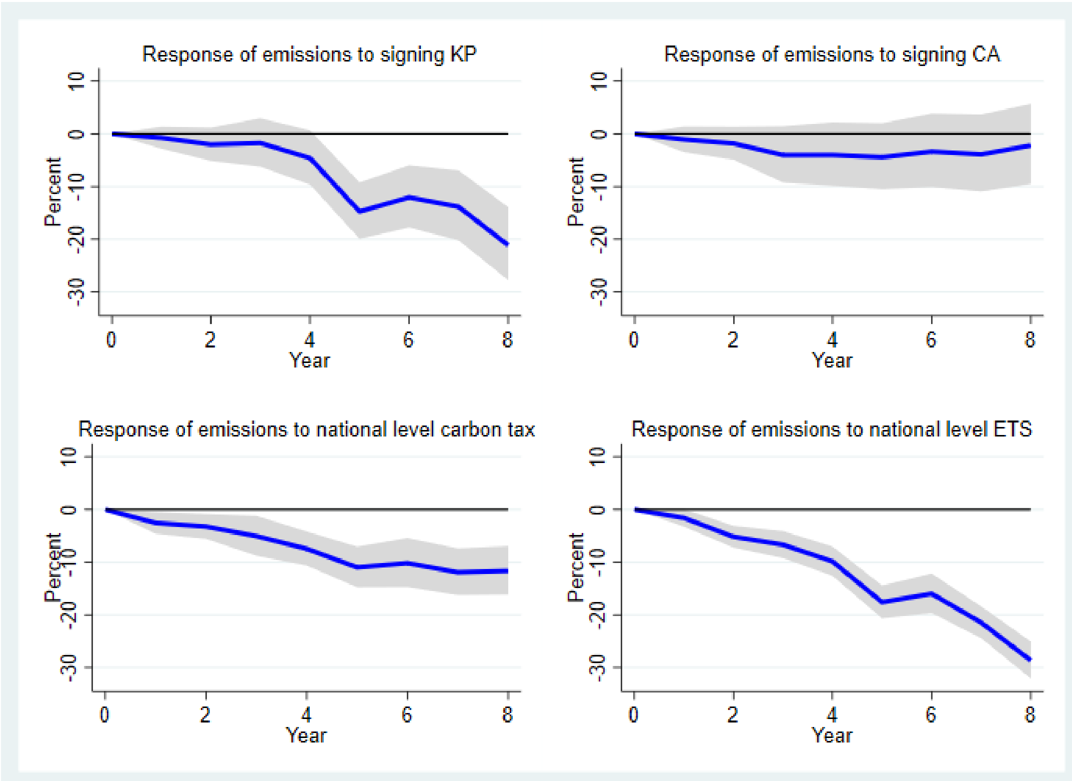


FIGURE 10. Dynamic effects of pledges, carbon taxes and emission-trading schemes on emissions

Note: The figure plots the estimated effect of a change in the climate action policy in year t on emissions, h periods in the future, for each of the policies considered.

Figure **??** plots the values of θ_h against h for each of the climate-change actions considered. The effect on emissions from each of the four interventions builds up gradually over time. By the fourth and fifth year, the estimated dynamic effects are broadly similar to the results shown in the previous sections,

19. While inflation rates are not significantly correlated with the probability of signing the Kyoto or Copenhagen agreements, they are correlated with the implementation of an ETS. Therefore, for the propensity estimation in this Section, we also include inflation rates as a control. The updated graphs for checking overlap for these treatments are in Appendix E.

with all policies considered aside from the signing of the Copenhagen agreement demonstrating significant and persistent negative effects on emissions. As before, these numbers should be interpreted relative to the counterfactual provided by countries that did not put in place similar interventions. As already hinted at in Table 4, in the case of the Kyoto Protocol, the dynamic effects are driven by both falling emissions in the treatment group and continued increase in emissions in the control group (relative to the pre-agreement period). The effect of the Copenhagen Accord is to a larger extent driven by the continued rise in the control. To the extent that countries in that control group recorded significant increases in emissions, the actual reductions in global emissions is of course much more modest.

4.3. Dynamic effects on other economic variables

Motivated by the pubic debate on the potential spillovers of climate-change pledges and actions to the rest of the economy, we extend the analysis to study the impact of pledges and actions on other macroeconomic variables, specifically GDP growth and inflation.

For this purpose, we estimate a set of IPW regressions similar to those specified in Equation 1 using GDP growth and inflation rates as dependent variables, with a few modifications. First, in keeping with the differenced specification of the dependent variables, we use the differences of all controls specified in Equation 1. Second, as there are several countries experiencing episodes of hyper-inflation in the time period considered (for example, 35 countries record consumer price inflation in excess of 100% over the sample), we exclude the top 6% of the inflation distribution, such that the highest inflation rate observed in our sample is 30%.[20] Third, given that the timing of the Kyoto Protocol and the enactment of the EU-ETS coincide with the global financial crisis and EU debt crisis, we further augment the specification of fixed effects to allow for region-specific trends in growth and inflation.[21] Accordingly, we estimate the following set of equations weighted by inverse propensities:

$$\Delta Y_{i,t+h} = \gamma_{11}(L)\Delta Y_{i,t-1} + \gamma_{21}(L)\Delta P_{i,t-1} + \rho_1(L)\Delta X_{i,t-1} + \theta_{h1}\tau_{i,t} + \delta_1(L)\tau_{i,t-1} + \alpha_i + \rho_g + W_t + \rho_g * W_t + \varepsilon_{i,t}, \qquad h = 0, 1, 2, ..., 7 \tag{2}$$

$$\Delta P_{i,t+h} = \gamma_{12}(L)\Delta Y_{i,t-1} + \gamma_{22}(L)\Delta P_{i,t-1} + \rho_2(L)\Delta X_{i,t-1} + \theta_{h2}\tau_{i,t} + \delta_2(L)\tau_{i,t-1} + \alpha_i + \rho_g + W_t + \rho_g * W_t + \varepsilon_{i,t}, \qquad h = 0, 1, 2, ..., 7 \tag{3}$$

where ΔY refers to GDP growth and ΔP refers to inflation, $\Delta X_{i,t-1}$ includes controls such as emissions, population, and urbanization in first differences, $\tau_{i,t}$ is the policy variable, and lags of upto three years are included for all regressors.

20. The high inflation or hyperinflation does not appear correlated with the signature of pledges or the adoption of climate-change actions.

21. Using this same augmented specification for the emissions equation gives very similar results to those reported in Section 4.2.

α_i, ρ_g and W_t are country, region and time fixed effects and $\varepsilon_{i,t}$ is the random error term. θ_h is the effect of a change in the climate action policy in year t on emissions, h periods in the future.

The estimated effects on GDP growth and inflation are illustrated in Figures 11 and 12.

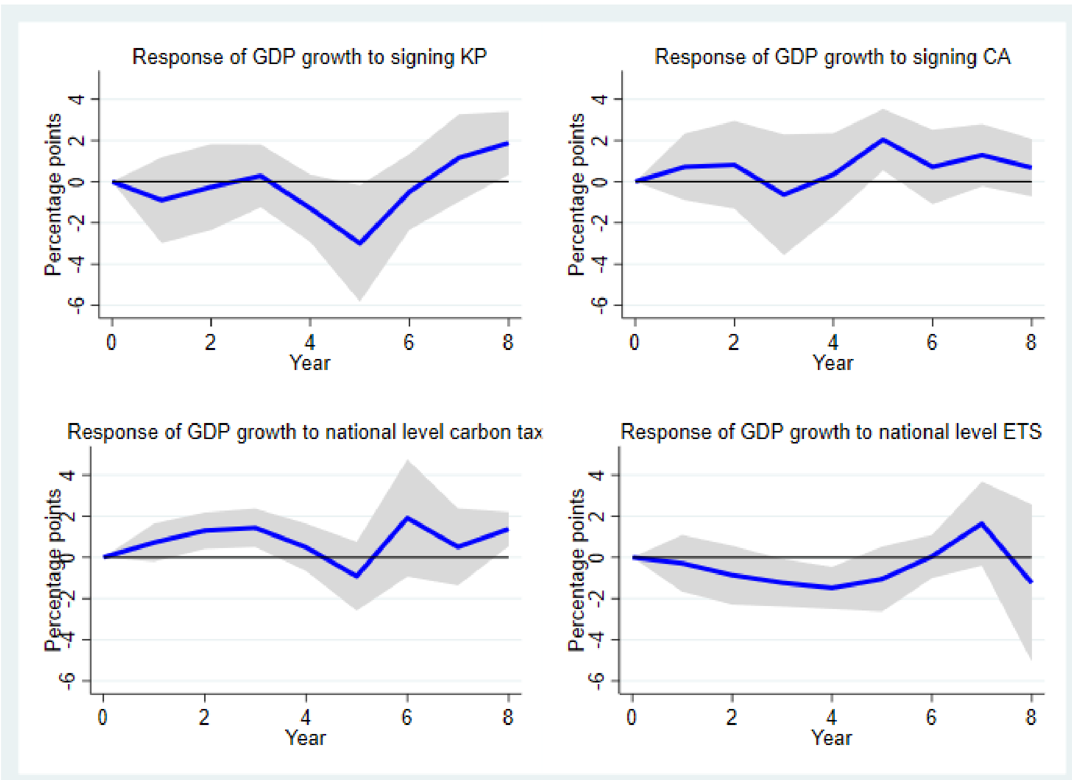


FIGURE 11. Dynamic effects of pledges, carbon taxes and emission-trading schemes on GDP growth

Note: The figure plots the estimated effect of a change in the climate action policy in year t on GDP growth, h periods in the future, for each of the policies considered.

As shown in Figures 11 and 12, the impact of the climate-change pledges and policies on GDP growth and inflation are largely insignificant. These results are consistent with Metcalf and Stock (2020), who do not find any significant negative impact of carbon taxes on GDP growth. They are also in line with

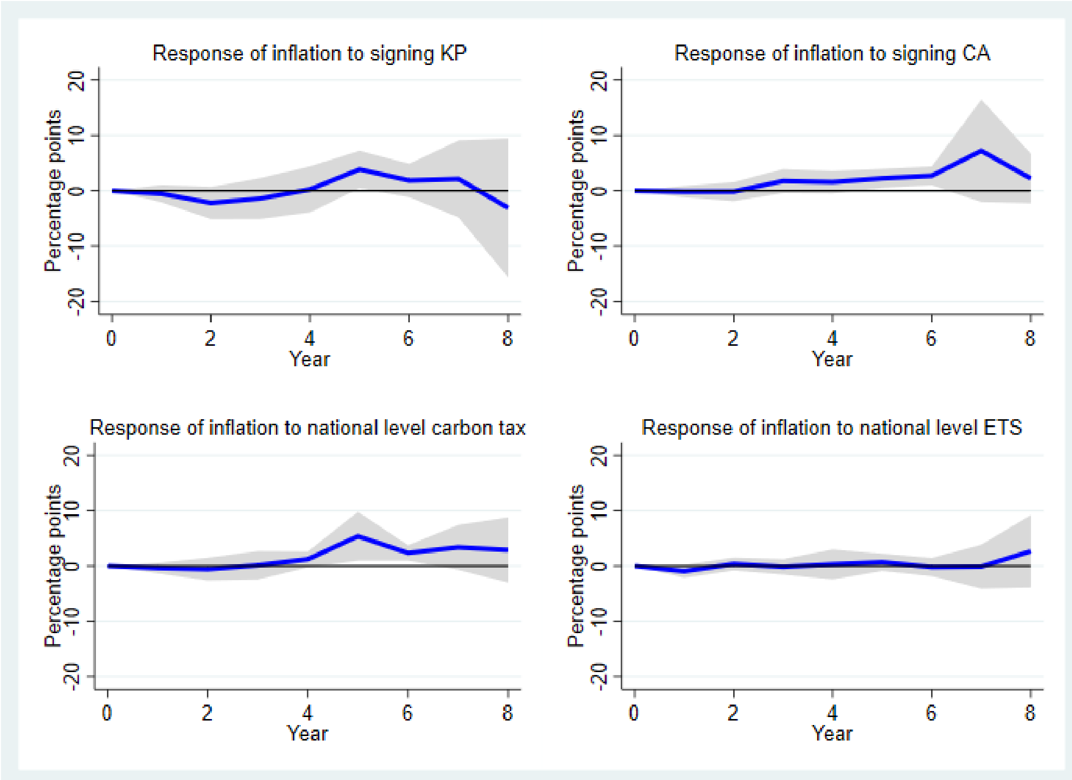


FIGURE 12. Dynamic effects of pledges, carbon taxes and emission-trading schemes on inflation

Note: The figure plots the estimated effect of a change in the climate action policy in year t on inflation, h periods in the future, for each of the policies considered.

Kanzig (2021), who finds that the tightening of the carbon pricing regime within the European carbon market has had persistent negative effects on emissions, but less persistent effects on real GDP.

5. Conclusion

The paper computes comparable emission targets set in the context of the three main international climate-action treaties; it studies compliance with those targets across countries; and it assesses the overall impact of the international treaties, as well as specific climate-change actions, on the level of emissions.

The paper finds that countries' compliance with emission-reduction targets has been highly heterogeneous, with many countries undershooting their targets. Signing the Kyoto Protocol and the Copenhagen Accord has led to significant reductions in emissions when compared with countries that did not sign in the treaties. In contrast, the Paris Agreement has not appeared to have led (yet) to any material reduction. Having quantifiable goals in the context of the Copenhagen Accord has been helpful in further reducing emissions.

In terms of specific actions, the paper finds that carbon taxes and ETS have led to material reductions in emissions. Other climate-related laws and policies appear to have, individually, smaller impacts on emissions. However, the number of climate-related laws is associated with significant reductions in GHG emissions. The impact of climate-related pledges and actions on economic variables such as GDP growth and inflation appear largely insignificant.

Overall, more ambitious targets and stricter compliance would be needed to offset the large impact of economic and population growth on the flow of emissions and contain a further damaging expansion in the stock of greenhouse gases.

Appendix A

Table A.1. Targeted emission reduction by country and agreement

Country	Pledge	Party to the pledge	Quantified objective specified	Can quantify target	Start year emissions (MTCO2 eq)	Targeted reduction from starting year of pledge: Absolute (MTCO2 eq.) Cond	Absolute (MTCO2 eq.) Uncond	Relative (% of start emissions) Cond	Relative (% of start emissions) Uncond	Progress with Kyoto Copen (%)
Afghanistan	Kyoto	No	No		18.98					
Afghanistan	Cope	Yes	No		30.63					
Afghanistan	Paris	Yes	Yes	Yes	32.99	-9.29	-9.29	-27.86	-27.86	
Albania	Kyoto	No	No		9.14					
Albania	Cope	No	No		8.10					
Albania	Paris	Yes	Yes	No	5.57					
Algeria	Kyoto	No	No		135.12					
Algeria	Cope	Yes	No							
Algeria	Paris	Yes	Yes	No	201.69					
Andorra	Kyoto	No	No		0.59					
Andorra	Cope	No	No		0.53					
Andorra	Paris	Yes	Yes	Yes	0.52	0.18	0.18	37.11	37.11	
Angola	Kyoto	No	No		221.04					
Angola	Cope	No	No		252.04					
Angola	Paris	Yes	Yes	Yes	218.82	124.51	96.21	49.39	38.17	
Antigua & Barbuda	Kyoto	No	No		0.79					
Antigua & Barbuda	Cope	Yes	Yes	Yes	1.11	0.82	0.82	73.87	73.87	-80.0529
Antigua & Barbuda	Paris	Yes	No							
Argentina	Kyoto	No	No		394.32					
Argentina	Cope	Yes	No		418.67					
Argentina	Paris	Yes	Yes	No	443.26					
Armenia	Kyoto	No	No		6.99					
Armenia	Cope	Yes	No							
Armenia	Paris	Yes	Yes	No	7.11					
Australia	Kyoto	Yes	Yes	Yes	603.39	85.50	85.50	14.17	14.17	3.6781
Australia	Cope	Yes	Yes	Yes	561.95	120.72	3.06	21.48	0.54	-0.6015
Australia	Paris	Yes	Yes	Yes	523.21	88.77	76.71	16.97	14.66	
Austria	Kyoto	Yes	Yes	Yes	81.97	23.57	23.57	28.76	28.76	10.6217
Austria	Cope	Yes	Yes	Yes	105.03	42.99	34.13	54.65	43.39	5.1495
Austria	Paris	Yes	No							
Azerbaijan	Kyoto	No	No		55.51					
Azerbaijan	Cope	No	No		49.95					

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Country	Pledge	Party to the pledge	Quantified objective specified	Can quantify target	Start year emissions (MTCO2 eq)	Targeted reduction from starting year of pledge: Absolute (in MTCO2 eq.) Cond	Absolute (in MTCO2 eq.) Uncond	Relative (% of start emissions) Cond	Relative (% of start emissions) Uncond	Progress with Kyoto Copen (%)
Azerbaijan	Paris	Yes	Yes	Yes	70.79	22.45	22.45	35.01	35.01	
Bahamas, The	Kyoto	No	No		1.11					
Bahamas, The	Cope	No	No		6.86					
Bahamas, The	Paris	Yes	Yes	No	2.80					
Bahrain	Kyoto	No	No		24.69					
Bahrain	Cope	No	No		30.43					
Bahrain	Paris	Yes	No							
Bangladesh	Kyoto	No	No		152.96					
Bangladesh	Cope	No	No		173.47					
Bangladesh	Paris	Yes	Yes	Yes	83.19	-115.71	-139.11	-58.76	-70.64	
Barbados	Kyoto	No	No		3.32					
Barbados	Cope	No	No		3.60					
Barbados	Paris	Yes	Yes	Yes	3.36	0.52	0.52	15.37	15.37	
Belarus	Kyoto	No	No		64.83					
Belarus	Cope	Yes	Yes	Yes	102.46	-30.77	-38.17	-47.32	-58.70	3.9131
Belarus	Paris	Yes	Yes	Yes	89.58	-8.74	-8.74	-9.79	-9.79	
Belgium	Kyoto	Yes	Yes	Yes	125.05	15.69	15.69	12.55	12.55	12.5092
Belgium	Cope	Yes	Yes	Yes	151.71	46.86	31.88	38.23	26.01	8.7483
Belgium	Paris	Yes	Yes	Yes	104.87	23.59	23.59	22.50	22.50	
Belize	Kyoto	No	No		15.01					
Belize	Cope	No	No		14.23					
Belize	Paris	Yes	No							
Benin	Kyoto	No	No		20.27					
Benin	Cope	Yes	No							
Benin	Paris	Yes	Yes	Yes	12.71	-8.13	-12.88	-34.54	-54.70	
Bhutan	Kyoto	No	No		-3.38					
Bhutan	Cope	Yes	No							
Bhutan	Paris	Yes	No							
Bolivia	Kyoto	No	No		120.22					
Bolivia	Cope	No	No		153.17					
Bolivia	Paris	Yes	No		134.18					
Bosnia & Herzegovina	Kyoto	No	No		22.84					
Bosnia & Herzegovina	Cope	No	No		27.54					
Bosnia & Herzegovina	Paris	Yes	Yes	Yes	28.80	8.76	4.42	30.42	15.35	
Botswana	Kyoto	No	No		58.92					
Botswana	Cope	Yes	No							
Botswana	Paris	Yes	Yes	Yes	13.99	-1.87	-1.87	-5.11	-5.11	
Brazil	Kyoto	No	No		1939.66					
Brazil	Cope	Yes	Yes	Yes	1440.25	-536.95	-627.56	-36.19	-42.29	-12.3165
Brazil	Paris	Yes	Yes	Yes	1357.18	135.20	135.20	9.96	9.96	

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Country	Pledge	Party to the pledge	Quantified objective specified	Can quantify target	Start year emissions (MTCO2 eq)	Targeted reduction from starting year of pledge: Absolute (in MTCO2 eq.) Cond	Absolute (in MTCO2 eq.) Uncond	Relative (% of start emissions) Cond	Relative (% of start emissions) Uncond	Progress with Kyoto Copen (%)
Brunei	Kyoto	No	No							
Brunei	Cope	No	No							
Brunei	Paris	Yes	No							
Bulgaria	Kyoto	Yes	Yes	No	47.97					-3.3014
Bulgaria	Cope	Yes	Yes	Yes	67.02	-7.02	-17.60	-14.24	-35.68	8.3237
Bulgaria	Paris	Yes	Yes	Yes	47.89	-0.08	-0.08	-0.17	-0.17	
Burkina Faso	Kyoto	No	No		28.96					
Burkina Faso	Cope	Yes	No		33.06					
Burkina Faso	Paris	Yes	Yes	Yes	32.60	19.43	18.59	59.60	57.04	
Burundi	Kyoto	No	No		6.85					
Burundi	Cope	No	No		1.34					
Burundi	Paris	Yes	Yes	No	5.10					
Cabo Verde	Kyoto	No	No		0.62					
Cabo Verde	Cope	No	No		0.72					
Cabo Verde	Paris	Yes	No		0.48					
Cambodia	Kyoto	No	No		53.11					
Cambodia	Cope	Yes	No							
Cambodia	Paris	Yes	Yes	Yes	33.26	24.79	24.79	47.12	47.12	
Cameroon	Kyoto	No	No		196.41					
Cameroon	Cope	Yes	No							
Cameroon	Paris	Yes	Yes	Yes	137.85	67.13	67.13	34.15	34.15	
Canada	Kyoto	Yes	Yes	Yes	975.74	366.46	366.46	37.56	37.56	17.1222
Canada	Cope	Yes	Yes	Yes	906.01	96.15	96.15	10.61	10.61	-5.0093
Canada	Paris	Yes	Yes	Yes	867.00	183.98	183.98	21.22	21.22	
Central African Rep.	Kyoto	No	No		61.13					
Central African Rep.	Cope	Yes	No							
Central African Rep.	Paris	Yes	Yes	Yes	61.89	-48.58	-48.58	-78.49	-78.49	
Chad	Kyoto	No	No		36.74					
Chad	Cope	Yes	No							
Chad	Paris	Yes	Yes	Yes	52.55	39.20	14.88	74.41	28.26	
Chile	Kyoto	No	No		68.91					
Chile	Cope	Yes	Yes	No	83.48					-26.7034
Chile	Paris	Yes	Yes	No	97.15					
China	Kyoto	No	No		6927.72					
China	Cope	Yes	Yes	Yes	9712.78	1983.91	1281.37	20.43	13.19	-23.3258
China	Paris	Yes	Yes	Yes	11600.63	3060.49	1840.32	26.38	15.86	
Colombia	Kyoto	No	No		309.04					
Colombia	Cope	Yes	No							
Colombia	Paris	Yes	Yes	Yes	182.39	-85.61	-85.61	-46.94	-46.94	
Comoros	Kyoto	No	No		0.42					

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Country	Pledge	Party to the pledge	Quantified objective specified	Can quantify target	Start year emissions (MTCO2 eq)	Targeted reduction from starting year of pledge: Absolute (in MTCO2 eq.) Cond	Absolute Uncond	Relative (% of start emissions) Cond	Relative Uncond	Progress with Kyoto Copen (%)
Comoros	Cope	No	No		0.45					
Comoros	Paris	Yes	Yes	Yes	0.46	0.38	0.38	81.99	81.99	
Congo, Dem. Rep.	Kyoto	No	No		203.27					
Congo, Dem. Rep.	Cope	No	No		208.45					
Congo, Dem. Rep.	Paris	Yes	Yes	Yes	195.42	170.52	170.52	82.48	82.48	
Congo, Rep.	Kyoto	No	No		21.30					
Congo, Rep.	Cope	Yes	No		17.78					
Congo, Rep.	Paris	Yes	Yes	Yes	19.29	10.45	10.45	54.18	54.18	
Cook Islands (the)	Kyoto	No	No		0.10					
Cook Islands (the)	Cope	Yes	No							
Cook Islands (the)	Paris	Yes	Yes	Yes	0.07	0.06	0.03	52.45	26.40	
Costa Rica	Kyoto	No	No		3.87					
Costa Rica	Cope	Yes	No		5.23					
Costa Rica	Paris	Yes	Yes	Yes	2.53	1.01	1.01	39.81	39.81	
Cote d'Ivoire	Kyoto	No	No		17.36					
Cote d'Ivoire	Cope	Yes	No							
Cote d'Ivoire	Paris	Yes	Yes	Yes	37.57	12.91	12.91	32.92	32.92	
Croatia	Kyoto	Yes	Yes	Yes	16.40	-0.73	-0.73	-4.42	-4.42	22.6812
Croatia	Cope	Yes	Yes	Yes	31.62	0.08	0.08	0.52	0.52	9.3506
Croatia	Paris	Yes	Yes	Yes	18.84	3.59	3.59	19.04	19.04	
Cuba	Kyoto	No	No		7.38					
Cuba	Cope	No	No		86.81					
Cuba	Paris	Yes	No							
Cyprus	Kyoto	No	No		8.66					
Cyprus	Cope	Yes	Yes	Yes	11.04	6.69	6.07	79.45	72.07	6.4685
Cyprus	Paris	Yes	Yes	Yes	6.72	0.14	0.14	2.08	2.08	
Czech Republic	Kyoto	Yes	Yes	Yes	125.93	-29.08	-29.08	-23.10	-23.10	10.2714
Czech Republic	Cope	Yes	Yes	Yes	147.11	15.50	-3.30	12.53	-2.67	8.0768
Czech Republic	Paris	Yes	Yes	Yes	104.27	-4.02	-4.02	-3.86	-3.86	
Denmark	Kyoto	Yes	Yes	Yes	64.56	11.41	11.41	17.68	17.68	21.7233
Denmark	Cope	Yes	Yes	Yes	74.31	20.42	12.72	32.80	20.43	32.4705
Denmark	Paris	Yes	Yes	Yes	48.28	8.90	8.90	18.43	18.43	
Djibouti	Kyoto	No	No		1.17					
Djibouti	Cope	No	No		1.28					
Djibouti	Paris	Yes	Yes	Yes	1.51	0.23	-0.41	15.24	-27.15	
Dominica	Kyoto	No	No		0.23					
Dominica	Cope	Yes	No		0.77					
Dominica	Paris	Yes	Yes	Yes	0.36	0.16	0.16	45.00	45.00	
Dominican Rep.	Kyoto	No	No		19.51					
Dominican Rep.	Cope	No	No		23.73					

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Country	Pledge	Party to the pledge	Quantified objective specified	Can quantify target	Start year emissions (MTCO2 eq)	Targeted reduction from starting year of pledge: Absolute (in MTCO2 eq.) Cond	Absolute (in MTCO2 eq.) Uncond	Relative (% of start emissions) Cond	Relative (% of start emissions) Uncond	Progress with Kyoto Copen (%)
Dominican Rep.	Paris	Yes	Yes	Yes	24.41	6.61	6.61	27.09	27.09	
EU28	Kyoto	Yes	Yes	Yes	4556.48	2.69	2.69	0.06	0.06	15.0156
EU28	Cope	Yes	Yes	Yes	5407.85	606.94	606.94	14.61	14.61	11.8595
EU28	Paris	Yes	Yes	Yes	3624.82	654.95	654.95	18.07	18.07	
Ecuador	Kyoto	No	No		77.95					
Ecuador	Cope	No	No		87.66					
Ecuador	Paris	Yes	Yes	No	41.65					
Egypt, Arab Rep.	Kyoto	No	No		226.98					
Egypt, Arab Rep.	Cope	Yes	No							
Egypt, Arab Rep.	Paris	Yes	No							
El Salvador	Kyoto	No	No		13.04					
El Salvador	Cope	No	No		12.91					
El Salvador	Paris	Yes	No							
Equatorial Guinea	Kyoto	No	No		24.92					
Equatorial Guinea	Cope	No	No		25.72					
Equatorial Guinea	Paris	Yes	Yes	Yes	25.94	5.36	5.36	20.67	20.67	
Eritrea	Kyoto	No	No		7.08					
Eritrea	Cope	Yes	No							
Eritrea	Paris	Yes	Yes	Yes	7.42	5.82	2.41	78.55	32.55	
Estonia	Kyoto	Yes	Yes	Yes	28.20	-10.83	-10.83	-38.39	-38.39	10.3018
Estonia	Cope	Yes	Yes	Yes	25.29	-6.40	-10.93	-26.41	-45.09	10.0857
Estonia	Paris	Yes	Yes	Yes	26.43	1.89	1.89	7.16	7.16	
Ethiopia	Kyoto	No	No		123.49					
Ethiopia	Cope	Yes	No		146.06					
Ethiopia	Paris	Yes	Yes	Yes	147.73	36.13	36.13	24.46	24.46	
Micronesia	Kyoto	No	No		0.15					
Micronesia	Cope	No	No		0.14					
Micronesia	Paris	Yes	Yes	Yes	0.16	0.07	0.06	48.17	42.22	
Fiji	Kyoto	No	No		0.07					
Fiji	Cope	No	No		2.87					
Fiji	Paris	Yes	Yes	Yes	1.07	-0.68	-0.68	88.11	88.11	
Finland	Kyoto	Yes	Yes	Yes	53.90	4.77	4.77	8.85	8.85	-27.0559
Finland	Cope	Yes	Yes	Yes	88.68	28.90	20.36	51.53	36.31	25.8883
Finland	Paris	Yes	Yes	Yes	65.24	32.36	32.36	49.60	49.60	
France	Kyoto	Yes	Yes	Yes	420.04	-48.87	-48.87	-11.63	-11.63	
France	Cope	Yes	Yes	Yes	585.95	161.64	101.02	39.47	24.67	
France	Paris	Yes	Yes	Yes	334.28	69.65	69.65	20.84	20.84	
Gabon	Kyoto	No	No		6.36					
Gabon	Cope	Yes	No							
Gabon	Paris	Yes	Yes	No	-86.90					

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Country	Pledge	Party to the pledge	Quantified objective specified	Can quantify target	Start year emissions (MTCO2 eq)	Targeted reduction from starting year of pledge: Absolute (in MTCO2 eq.) Cond	Absolute (in MTCO2 eq.) Uncond	Relative (% of start emissions) Cond	Relative (% of start emissions) Uncond	Progress with Kyoto Copen (%)
Gambia, The	Kyoto	No	No		5.60					
Gambia, The	Cope	No	No							
Gambia, The	Paris	Yes	Yes	Yes	7.69	5.49	5.49	73.72	73.72	
Georgia	Kyoto	No	No		8.18					
Georgia	Cope	Yes	No							
Georgia	Paris	Yes	Yes	Yes	16.38	-16.27	-16.27	-99.30	-99.30	
Germany	Kyoto	Yes	Yes	Yes	909.69	37.89	37.89	4.17	4.17	7.8030
Germany	Cope	Yes	Yes	Yes	1040.28	121.40	-9.87	13.82	-1.12	7.8080
Germany	Paris	Yes	Yes	Yes	816.64	252.63	252.63	30.94	30.94	
Ghana	Kyoto	No	No		59.85					
Ghana	Cope	Yes	No							
Ghana	Paris	Yes	Yes	Yes	38.57	-2.10	-24.29	-5.45	-62.97	
Greece	Kyoto	Yes	Yes	Yes	120.62	1.17	1.17	0.97	0.97	22.1107
Greece	Cope	Yes	Yes	Yes	125.33	47.44	36.31	46.21	35.37	19.5498
Greece	Paris	Yes	Yes	Yes	83.44	-17.88	-17.88	-21.43	-21.43	
Grenada	Kyoto	No	No		2.19					
Grenada	Cope	No	No		1.76					
Grenada	Paris	Yes	Yes	No						
Guatemala	Kyoto	No	No		40.60					
Guatemala	Cope	No	No		40.10					
Guatemala	Paris	Yes	Yes	Yes	38.40	7.14	2.27	18.60	5.92	
Guinea	Kyoto	No	No		26.86					
Guinea	Cope	Yes	No							
Guinea	Paris	Yes	Yes	Yes	28.33	9.21	9.21	30.51	30.51	
Guinea-Bissau	Kyoto	No	No		3.64					
Guinea-Bissau	Cope	No	No		3.31					
Guinea-Bissau	Paris	Yes	No							
Guyana	Kyoto	No	No		16.74					
Guyana	Cope	No	No		12.22					
Guyana	Paris	Yes	No							
Haiti	Kyoto	No	No		7.61					
Haiti	Cope	No	No		8.00					
Haiti	Paris	Yes	Yes	No	8.45					
Honduras	Kyoto	No	No		47.76					
Honduras	Cope	No	No		47.30					
Honduras	Paris	Yes	Yes	No	21.47					
Hungary	Kyoto	Yes	Yes	No	78.73					21.1097
Hungary	Cope	Yes	Yes	Yes	74.77	7.14	-2.53	10.78	-3.82	-0.3911
Hungary	Paris	Yes	Yes	Yes	61.00	-12.22	-12.22	-20.03	-20.03	
Iceland	Kyoto	Yes	Yes	Yes	3.03	-0.34	-0.34	-11.10	-11.10	16.6735

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Country	Pledge	Party to the pledge	Quantified objective specified	Can quantify target	Start year emissions (MTCO2 eq)	Targeted reduction from starting year of pledge: Absolute (in MTCO2 eq.) Cond	Absolute Uncond	Relative (% of start emissions) Cond	Relative Uncond	Progress with Kyoto Copen (%)
Iceland	Cope	Yes	Yes	Yes	2.78	0.64	0.64	22.95	22.95	11.2264
Iceland	Paris	Yes	Yes	Yes	2.73	0.90	0.90	32.85	32.85	
India	Kyoto	No	No		1805.11					
India	Cope	Yes	Yes	Yes	2469.01	603.38	479.03	24.44	19.40	49.7757
India	Paris	Yes	Yes	Yes	3202.31	-2036.93	-2198.14	-63.61	-68.64	
Indonesia	Kyoto	No	No		1748.60					
Indonesia	Cope	Yes	Yes	Yes	1994.78	-188.22	-188.22	-9.44	-9.44	33.2902
Indonesia	Paris	Yes	Yes	Yes	2471.64	778.93	348.58	31.51	14.10	
Iran, Islamic Rep.	Kyoto	No	No		565.91					
Iran, Islamic Rep.	Cope	No	No		670.47					
Iran, Islamic Rep.	Paris	Yes	Yes	No	800.68					
Iraq	Kyoto	No	No		172.41					
Iraq	Cope	No	No		229.62					
Iraq	Paris	Yes	Yes	No	294.90					
Ireland	Kyoto	Yes	Yes	Yes	68.84	10.80	10.80	15.69	15.69	13.8135
Ireland	Cope	Yes	Yes	Yes	74.31	33.31	27.45	59.85	49.32	9.8481
Ireland	Paris	Yes	Yes	Yes	58.27	10.08	10.08	17.30	17.30	
Israel	Kyoto	No	No		74.83					
Israel	Cope	Yes	Yes	Yes	87.19	1.59	1.59	1.82	1.82	
Israel	Paris	Yes	Yes	Yes	90.74	31.49	31.49	36.02	36.02	
Italy	Kyoto	Yes	Yes	Yes	523.18	96.11	96.11	18.37	18.37	
Italy	Cope	Yes	Yes	Yes	588.26	177.31	118.60	39.86	26.66	
Italy	Paris	Yes	Yes	Yes	368.82	18.29	18.29	4.96	4.96	
Jamaica	Kyoto	No	No		13.26					
Jamaica	Cope	No	No		9.76					
Jamaica	Paris	Yes	Yes	Yes	7.36	-4.68	-4.94	-45.97	-48.60	
Japan	Kyoto	Yes	Yes	Yes	1264.30	222.41	222.41	17.59	17.59	-5.6496
Japan	Cope	Yes	Yes	Yes	1083.31	-132.95	-132.95	-12.27	-12.27	-0.0939
Japan	Paris	Yes	Yes	Yes	1322.05	314.83	314.83	23.81	23.81	
Jordan	Kyoto	No	No		24.48					
Jordan	Cope	Yes	No							
Jordan	Paris	Yes	Yes	Yes	32.40	-4.27	-10.51	-13.19	-32.44	
Kazakhstan	Kyoto	No	No		213.25					
Kazakhstan	Cope	Yes	Yes	Yes	283.68	0.35	0.35	0.12	0.12	-30.6793
Kazakhstan	Paris	Yes	Yes	Yes	286.86	39.47	6.48	13.52	2.22	
Kenya	Kyoto	No	No		-6.30					
Kenya	Cope	No	No		27.85					
Kenya	Paris	Yes	Yes	No	29.29					
Kiribati	Kyoto	No	No		0.07					
Kiribati	Cope	No	No		0.08					

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Country	Pledge	Party to the pledge	Quantified objective specified	Can quantify target	Start year emissions (MTCO2 eq)	Targeted reduction from starting year of pledge: Absolute (in MTCO2 eq.) Cond	Absolute (in MTCO2 eq.) Uncond	Relative (% of start emissions) Cond	Relative (% of start emissions) Uncond	Progress with Kyoto Copen (%)
Kiribati	Paris	Yes	Yes	Yes	0.06	-68.52	-68.52	-86515.27	-86515.27	
Korea, DPR	Kyoto	No	No		114.18					
Korea, DPR.	Cope	No	No		108.22					
Korea, DPR	Paris	No	No		83.02					
Korea, Rep.	Kyoto	No	No		504.45					
Korea, Rep.	Cope	Yes	Yes	Yes	596.94	70.47	70.47	11.81	11.81	-16.3333
Korea, Rep.	Paris	Yes	Yes	Yes	671.19	251.52	251.52	39.82	39.82	
Kosovo	Kyoto	No	No							
Kosovo	Cope	No	No							
Kosovo	Paris	No	No							
Kuwait	Kyoto	No	No		173.95					
Kuwait	Cope	No	No		187.25					
Kuwait	Paris	Yes	No							
Kyrgyz Republic	Kyoto	No	No		7.55					
Kyrgyz Republic	Cope	Yes	Yes	No	26.18					54.5647
Kyrgyz Republic	Paris	Yes	Yes	Yes	14.35	4.00	1.08	27.89	7.51	
Lao PDR	Kyoto	No	No		27.63					
Lao PDR	Cope	No	No		32.91					
Lao PDR	Paris	Yes	No							
Latvia	Kyoto	Yes	Yes	Yes	11.23	-4.12	-4.12	-36.73	-36.73	84.6417
Latvia	Cope	Yes	Yes	Yes	16.52	-3.99	-6.92	-605.36	-1049.91	12.1852
Latvia	Paris	Yes	Yes	Yes	1.84	-8.71	-8.71	-472.36	-472.36	
Lebanon	Kyoto	No	No		19.33					
Lebanon	Cope	No	No		23.82					
Lebanon	Paris	Yes	Yes	No	28.59					
Lesotho	Kyoto	No	No		3.96					
Lesotho	Cope	No	No		4.14					
Lesotho	Paris	Yes	Yes	No	4.35					
Liberia	Kyoto	No	No		16.60					
Liberia	Cope	No	No		16.91					
Liberia	Paris	Yes	Yes	Yes	1.52	-2.98	-2.98	-85.01	-85.01	
Libya	Kyoto	No	No		121.14					
Libya	Cope	No	No		139.58					
Libya	Paris	No	No		133.67					
Liechtenstein	Kyoto	Yes	Yes	No						
Liechtenstein	Cope	Yes	Yes	No	0.08					
Liechtenstein	Paris	Yes	Yes	No	0.07					
Lithuania	Kyoto	Yes	Yes	Yes	24.33	-19.32	-19.32	-79.40	-79.40	16.5011
Lithuania	Cope	Yes	Yes	Yes	25.03	-10.55	-15.63	-49.42	-73.24	-4.3121
Lithuania	Paris	Yes	Yes	Yes	19.47	-2.67	-2.67	-13.71	-13.71	

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Country	Pledge	Party to the pledge	Quantified objective specified	Can quantify target	Start year emissions (MTCO2 eq)	Targeted reduction from starting year of pledge: Absolute (in MTCO2 eq.) Cond	Absolute (in MTCO2 eq.) Uncond	Relative (% of start emissions) Cond	Relative (% of start emissions) Uncond	Progress with Kyoto Copen (%)
Luxembourg	Kyoto	Yes	Yes	Yes	12.76	4.34	4.34	34.00	34.00	7.4252
Luxembourg	Cope	Yes	Yes	Yes	18.64	8.50	7.05	70.23	58.26	11.4585
Luxembourg	Paris	Yes	Yes	Yes	10.81	3.16	3.16	29.20	29.20	
Macedonia (FYR)	Kyoto	No	No		13.67					
Macedonia (FYR)	Cope	Yes	No							
Macedonia (FYR)	Paris	Yes	Yes	Yes	9.33	-1.97	-3.03	-16.82	-25.87	
Madagascar	Kyoto	No	No		51.71					
Madagascar	Cope	Yes	No							
Madagascar	Paris	Yes	Yes	Yes	48.33	-135.89	-135.89	-280.17	-280.17	
Malawi	Kyoto	No	No		14.54					
Malawi	Cope	Yes	No							
Malawi	Paris	Yes	No							
Malaysia	Kyoto	No	No		392.85					
Malaysia	Cope	No	No		263.37					
Malaysia	Paris	Yes	Yes	No	187.89					
Maldives	Kyoto	No	No		0.67					
Maldives	Cope	Yes	No		1.02					
Maldives	Paris	Yes	Yes	Yes	1.41	-1.09	-1.56	-76.74	-109.16	
Mali	Kyoto	No	No		31.12					
Mali	Cope	No	No		34.65					
Mali	Paris	Yes	Yes	No	38.32					
Malta	Kyoto	No	No		3.16					
Malta	Cope	Yes	Yes	Yes	3.65	1.55	1.25	49.92	40.29	42.6689
Malta	Paris	Yes	Yes	Yes	2.97	0.41	0.41	13.67	13.67	
Marshall Islands	Kyoto	No	No		0.11					
Marshall Islands	Cope	Yes	Yes	Yes	0.14	0.05	0.05	40.34	40.34	
Marshall Islands	Paris	Yes	Yes	Yes	0.14	0.06	0.05	45.46	32.89	
Mauritania	Kyoto	No	No		10.31					
Mauritania	Cope	Yes	No							
Mauritania	Paris	Yes	Yes	No	9.68					
Mauritius	Kyoto	No	No		4.71					
Mauritius	Cope	Yes	No							
Mauritius	Paris	Yes	Yes	Yes	5.83	0.93	0.93	15.92	15.92	
Mexico	Kyoto	No	No		701.59					
Mexico	Cope	Yes	Yes	Yes	737.04	65.04	65.04	8.83	8.83	-3.4563
Mexico	Paris	Yes	Yes	Yes	729.10	-227.90	-227.90	-31.26	-31.26	
Moldova	Kyoto	No	No		11.24					
Moldova	Cope	Yes	Yes	Yes	11.48	-16.32	-16.32	-142.23	-142.23	-3.0865
Moldova	Paris	Yes	Yes	Yes	11.20	3.05	-2.14	27.19	-19.14	

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Country	Pledge	Party to the pledge	Quantified objective specified	Can quantify target	Start year emissions (MTCO2 eq)	Targeted reduction from starting year of pledge: Absolute (in MTCO2 eq.) Cond	Absolute (in MTCO2 eq.) Uncond	Relative (% of start emissions) Cond	Relative (% of start emissions) Uncond	Progress with Kyoto Copen (%)
Monaco	Kyoto	Yes	Yes	No						
Monaco	Cope	Yes	Yes	No						
Monaco	Paris	Yes	Yes	No						
Mongolia	Kyoto	No	No		49.46					
Mongolia	Cope	Yes	No							
Mongolia	Paris	Yes	Yes	Yes	40.86	-3.17	-3.17	-4.84	-4.84	
Montenegro	Kyoto	No	No		2.53					
Montenegro	Cope	No	No		-13.24					
Montenegro	Paris	Yes	Yes	Yes	3.89	2.29	2.29	66.73	66.73	
Morocco	Kyoto	No	No		53.65					
Morocco	Cope	Yes	No							
Morocco	Paris	Yes	Yes	Yes	80.22	-35.92	-68.37	-44.77	-85.22	
Mozambique	Kyoto	No	No		60.71					
Mozambique	Cope	No	No		59.19					
Mozambique	Paris	Yes	No							
Myanmar	Kyoto	No	No		170.48					
Myanmar	Cope	No	No		186.70					
Myanmar	Paris	Yes	No							
Namibia	Kyoto	No	No		19.47					
Namibia	Cope	No	No		20.42					
Namibia	Paris	Yes	Yes	Yes	19.66	17.17	17.17	87.33	87.33	
Nauru	Kyoto	No	No		0.07					
Nauru	Cope	No	No		0.05					
Nauru	Paris	Yes	No							
Nepal	Kyoto	No	No		60.63					
Nepal	Cope	No	No		39.14					
Nepal	Paris	Yes	No							
Netherlands	Kyoto	Yes	Yes	Yes	205.78	18.14	18.14	8.82	8.82	8.5798
Netherlands	Cope	Yes	Yes	Yes	234.37	78.08	55.75	38.79	27.70	12.5209
Netherlands	Paris	Yes	Yes	Yes	181.33	49.64	49.64	27.37	27.37	
New Zealand	Kyoto	Yes	Yes	Yes	62.93	19.98	19.98	31.75	31.75	4.9136
New Zealand	Cope	Yes	Yes	Yes	57.54	16.74	16.74	29.09	29.09	-7.1173
New Zealand	Paris	Yes	Yes	Yes	60.34	16.29	16.29	26.99	26.99	
Nicaragua	Kyoto	No	No		42.21					
Nicaragua	Cope	No	No		42.74					
Nicaragua	Paris	No	No		14.74					
Niger	Kyoto	No	No		21.26					
Niger	Cope	No	No		26.00					
Niger	Paris	Yes	Yes	No	29.52					
Nigeria	Kyoto	No	No		443.65					

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Country	Pledge	Party to the pledge	Quantified objective specified	Can quantify target	Start year emissions (MTCO2 eq)	Targeted reduction from starting year of pledge: Absolute (in MTCO2 eq.)		Relative (% of start emissions)		Progress with Kyoto Copen (%)
						Cond	Uncond	Cond	Uncond	
Nigeria	Cope	No	No		461.16					
Nigeria	Paris	Yes	Yes	No	492.44					
Niue	Kyoto	No	No		0.08					
Niue	Cope	No	No		0.04					
Niue	Paris	Yes	No							
Norway	Kyoto	Yes	Yes	Yes	27.03	-4.44	-4.44	-16.41	-16.41	5.1873
Norway	Cope	Yes	Yes	Yes	26.62	7.93	4.81	29.78	18.08	-7.9505
Norway	Paris	Yes	Yes	Yes	24.94	6.25	6.25	25.05	25.05	
Oman	Kyoto	No	No		64.88					
Oman	Cope	No	No		84.60					
Oman	Paris	Yes	Yes	Yes	104.73	16.01	16.01	15.06	15.06	
Pakistan	Kyoto	No	No		284.63					
Pakistan	Cope	No	No		329.18					
Pakistan	Paris	Yes	No							
Palau	Kyoto	No	No		0.14					
Palau	Cope	No	No		0.27					
Palau	Paris	Yes	Yes	Yes	0.28	0.06	0.06	14.09	14.09	
Palestine	Kyoto	No	No							
Palestine	Cope	No	No							
Palestine	Paris	No	No							
Panama	Kyoto	No	No		22.03					
Panama	Cope	No	No		24.00					
Panama	Paris	No	No		26.31					
Papua New Guinea	Kyoto	No	No		65.66					
Papua New Guinea	Cope	Yes	Yes	Yes	74.24	65.24	65.24	87.88	87.88	-27.3768
Papua New Guinea	Paris	Yes	No							
Paraguay	Kyoto	No	No		102.75					
Paraguay	Cope	No	No		163.57					
Paraguay	Paris	Yes	Yes	Yes	183.23	-149.57	-191.17	-81.63	-104.33	
Peru	Kyoto	No	No		110.98					
Peru	Cope	Yes	No							
Peru	Paris	Yes	Yes	Yes	161.51	64.00	50.07	39.62	31.00	
Philippines	Kyoto	No	No		155.70					
Philippines	Cope	No	No		184.56					
Philippines	Paris	Yes	Yes	Yes	68.17	-54.80	-54.80	-45.16	-45.16	
Poland	Kyoto	Yes	Yes	No	343.81					0.6898
Poland	Cope	Yes	Yes	Yes	423.56	111.01	66.36	41.22	24.64	-1.6672
Poland	Paris	Yes	Yes	Yes	327.80	8.05	8.05	2.46	2.46	
Portugal	Kyoto	Yes	Yes	Yes	88.42	14.71	14.71	16.63	16.63	26.2474
Portugal	Cope	Yes	Yes	Yes	83.94	37.68	31.07	57.49	47.40	1.7068

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Country	Pledge	Party to the pledge	Quantified objective specified	Can quantify target	Start year emissions (MTCO2 eq)	Targeted reduction from starting year of pledge: Absolute (in MTCO2 eq.) Cond	Absolute Uncond	Relative (% of start emissions) Cond	Relative Uncond	Progress with Kyoto Copen (%)
Portugal	Paris	Yes	Yes	Yes	63.35	-10.04	-10.04	-15.85	-15.85	
Qatar	Kyoto	No	No		45.07					
Qatar	Cope	No	No		69.54					
Qatar	Paris	Yes	No							
Republic of Serbia	Kyoto	No	No		59.90					
Republic of Serbia	Cope	Yes	Yes	Yes	-5.78	-60.47	-60.47	1046.67	1046.67	
Republic of Serbia	Paris	Yes	Yes	Yes	50.10	-18.42	-18.42	-36.77	-36.77	
Romania	Kyoto	Yes	Yes	No	134.88					132.4512
Romania	Cope	Yes	Yes	Yes	129.73	-44.85	-69.79	-40.10	-62.39	2.9181
Romania	Paris	Yes	Yes	Yes	-54.98	-187.16	-187.16	340.44	340.44	
Russian Federation	Kyoto	Yes	Yes	Yes	2146.98	-1080.32	-1080.32	-50.32	-50.32	-1.7815
Russian Federation	Cope	Yes	Yes	Yes	2056.75	-363.73	-686.46	-17.68	-33.38	-5.0269
Russian Federation	Paris	Yes	Yes	Yes	2030.14	1223.31	1061.95	60.26	52.31	
Rwanda	Kyoto	No	No		-4.12					
Rwanda	Cope	No	No		5.94					
Rwanda	Paris	Yes	No							
Samoa	Kyoto	No	No		0.31					
Samoa	Cope	No	No		-0.09					
Samoa	Paris	Yes	No							
San Marino	Kyoto	No	No							
San Marino	Cope	Yes	No							
San Marino	Paris	Yes	Yes	No						
Sao Tome & Principe	Kyoto	No	No		0.14					
Sao Tome & Principe	Cope	No	No		0.46					
Sao Tome & Principe	Paris	Yes	Yes	Yes	0.19	0.01	0.01	4.16	4.16	
Saudi Arabia	Kyoto	No	No		350.70					
Saudi Arabia	Cope	No	No		482.79					
Saudi Arabia	Paris	Yes	No							
Senegal	Kyoto	No	No		28.32					
Senegal	Cope	No	No		31.02					
Senegal	Paris	Yes	Yes	Yes	30.45	0.75	-5.27	2.46	-17.30	
Seychelles	Kyoto	No	No		0.75					
Seychelles	Cope	No	No		0.51					
Seychelles	Paris	Yes	Yes	Yes	0.56	-0.09	-0.09	-16.25	-16.25	
Sierra Leone	Kyoto	No	No		10.27					
Sierra Leone	Cope	Yes	No							
Sierra Leone	Paris	Yes	No							
Singapore	Kyoto	No	No		42.64					
Singapore	Cope	Yes	Yes	Yes	50.01	-12.15	-12.15	-24.28	-24.28	-9.6313
Singapore	Paris	Yes	Yes	No	52.42					

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Country	Pledge	Party to the pledge	Quantified objective specified	Can quantify target	Start year emissions (MTCO2 eq)	Targeted reduction from starting year of pledge: Absolute (in MTCO2 eq.) Cond	Absolute (in MTCO2 eq.) Uncond	Relative (% of start emissions) Cond	Relative (% of start emissions) Uncond	Progress with Kyoto Copen (%)
Slovak Republic	Kyoto	Yes	Yes	Yes	37.69	-14.56	-14.56	-38.64	-38.64	8.5027
Slovak Republic	Cope	Yes	Yes	Yes	49.84	0.29	-6.79	0.79	-18.72	3.8865
Slovak Republic	Paris	Yes	Yes	Yes	33.02	-0.14	-0.14	-0.43	-0.43	
Slovenia	Kyoto	Yes	Yes	No	8.94					37.6560
Slovenia	Cope	Yes	Yes	Yes	24.24	9.70	7.63	86.87	68.28	13.0695
Slovenia	Paris	Yes	Yes	Yes	10.46	2.86	2.86	27.38	27.38	
Solomon Islands	Kyoto	No	No		2.15					
Solomon Islands	Cope	No	No		2.15					
Solomon Islands	Paris	Yes	Yes	Yes	2.18	2.18	2.18	85.53	85.53	
Somalia	Kyoto	No	No		42.12					
Somalia	Cope	No	No		37.98					
Somalia	Paris	Yes	No							
South Africa	Kyoto	No	No		453.34					
South Africa	Cope	Yes	Yes	Yes	492.05	43.32	43.32	8.80	8.80	-2.6623
South Africa	Paris	Yes	No							
South Sudan	Kyoto	No	No							
South Sudan	Cope	No	No							
South Sudan	Paris	Yes	No							
Spain	Kyoto	Yes	Yes	Yes	377.20	118.35	118.35	31.38	31.38	
Spain	Cope	Yes	Yes	Yes	438.39	203.97	170.48	66.45	55.54	
Spain	Paris	Yes	Yes	Yes	272.67	-6.46	-6.46	-2.37	-2.37	
Sri Lanka	Kyoto	No	No		41.60					
Sri Lanka	Cope	No	No		39.51					
Sri Lanka	Paris	Yes	Yes	No	39.42					
St. Kitts & Nevis	Kyoto	No	No		0.26					
St. Kitts & Nevis	Cope	No	No		0.42					
St. Kitts & Nevis	Paris	Yes	Yes	Yes	0.39	-0.15	-0.15	-39.07	-39.07	
St. Lucia	Kyoto	No	No		1.05					
St. Lucia	Cope	No	No		1.34					
St. Lucia	Paris	Yes	Yes	Yes	0.41	-0.17	-0.17	-14.84	-14.84	
St. Vincent	Kyoto	No	No		0.24					
and the	Cope	No	No		0.47					
Grenadines	Paris	Yes	Yes	Yes	0.29	-0.17	-0.17	-59.71	-59.71	
Sudan	Kyoto	No	No		412.79					
Sudan	Cope	No	No		344.83					
Sudan	Paris	Yes	No							
Suriname	Kyoto	No	No		6.96					
Suriname	Cope	No	No		6.96					
Suriname	Paris	Yes	No							
Swaziland	Kyoto	No	No		2.90					

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Country	Pledge	Party to the pledge	Quantified objective specified	Can quantify target	Start year emissions (MTCO2 eq)	Targeted reduction from starting year of pledge Absolute (in MTCO2 eq.) Cond	Absolute (in MTCO2 eq.) Uncond	Relative (% of start emissions) Cond	Relative (% of start emissions) Uncond	Progress with Kyoto Copen (%)
Swaziland	Cope	Yes	No							
Swaziland	Paris	Yes	No							
Sweden	Kyoto	Yes	Yes	Yes	12.16	-37.51	-37.51	-308.47	-308.47	-294.3839
Sweden	Cope	Yes	Yes	Yes	80.42	19.17	10.42	35.15	19.11	-16.4064
Sweden	Paris	Yes	Yes	Yes	46.91	39.62	39.62	84.45	84.45	
Switzerland	Kyoto	Yes	Yes	Yes	51.88	5.94	5.94	11.44	11.44	
Switzerland	Cope	Yes	Yes	Yes	49.61	14.65	9.66	29.53	19.46	
Switzerland	Paris	Yes	Yes	Yes	46.15	21.18	21.18	45.90	45.90	
Syria	Kyoto	No	No		87.58					
Syria	Cope	No	No		88.24					
Syria	Paris	No	No		62.20					
Taiwan, China	Kyoto	No	No							
Taiwan, China	Cope	No	No							
Taiwan, China	Paris	No	No							
Tajikistan	Kyoto	No	No		7.13					
Tajikistan	Cope	Yes	No							
Tajikistan	Paris	Yes	Yes	Yes	11.96	0.64	-3.71	5.35	-31.06	
Tanzania	Kyoto	No	No		317.43					
Tanzania	Cope	No	No		299.83					
Tanzania	Paris	Yes	Yes	No	286.49					
Thailand	Kyoto	No	No		311.04					
Thailand	Cope	Yes	Yes	No	296.48					-14.5617
Thailand	Paris	Yes	Yes	Yes	358.42	-57.83	-85.58	-15.45	-22.86	
Timor-Leste	Kyoto	No	No							
Timor-Leste	Cope	No	No							
Timor-Leste	Paris	No	No							
Togo	Kyoto	No	No		12.15					
Togo	Cope	Yes	No							
Togo	Paris	Yes	Yes	Yes	11.86	-14.95	-22.73	-110.20	-167.48	
Tonga	Kyoto	No	No		0.29					
Tonga	Cope	No	No		-0.19					
Tonga	Paris	Yes	No							
Trinidad & Tobago	Kyoto	No	No		21.37					
Trinidad & Tobago	Cope	No	No		25.73					
Trinidad & Tobago	Paris	Yes	Yes	Yes	3.20	-32.42	-32.42	-130.08	-130.08	
Tunisia	Kyoto	No	No		30.26					
Tunisia	Cope	Yes	No							
Tunisia	Paris	Yes	Yes	Yes	37.88	17.07	7.20	45.07	19.00	
Turkey	Kyoto	No	No		286.24					
Turkey	Cope	No	No		320.08					

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Country	Pledge	Party to the pledge	Quantified objective specified	Can quantify target	Start year emissions (MTCO2 eq)	Targeted reduction from starting year of pledge: Absolute (in MTCO2 eq.) Cond	Absolute (in MTCO2 eq.) Uncond	Relative (% of start emissions) Cond	Relative (% of start emissions) Uncond	Progress with Kyoto Copen (%)
Turkey	Paris	Yes	Yes	No	366.61					
Turkmenistan	Kyoto	No	No		85.93					
Turkmenistan	Cope	No	No		98.91					
Turkmenistan	Paris	Yes	Yes	No						
Tuvalu	Kyoto	No	No		0.02					
Tuvalu	Cope	No	No		0.02					
Tuvalu	Paris	Yes	Yes	Yes	0.01	0.01	0.01	44.86	44.86	
Uganda	Kyoto	No	No		43.70					
Uganda	Cope	No	No		56.42					
Uganda	Paris	Yes	Yes	No						
Ukraine	Kyoto	Yes	Yes	Yes	377.17	-474.47	-474.47	-125.80	-125.80	0.2602
Ukraine	Cope	Yes	Yes	Yes	351.38	-329.93	-329.93	-93.89	-93.89	36.2688
Ukraine	Paris	Yes	Yes	Yes	344.13	-166.85	-166.85	-48.48	-48.48	
UAE	Kyoto	No	No		147.12					
UAE	Cope	No	No		196.05					
UAE	Paris	Yes	No							
United Kingdom	Kyoto	Yes	Yes	Yes	622.37	-12.51	-12.51	-2.01	-2.01	12.3712
United Kingdom	Cope	Yes	Yes	Yes	688.82	91.94	6.67	16.41	1.19	25.6896
United Kingdom	Paris	Yes	Yes	Yes	493.90	101.80	101.80	20.61	20.61	
United States	Kyoto	No	No		6429.55					
United States	Cope	Yes	Yes	Yes	6115.68	779.15	779.15	12.74	12.74	5.0395
United States	Paris	Yes	Yes	Yes	6319.02	1689.75	1561.16	26.74	24.71	
Uruguay	Kyoto	No	No		18.15					
Uruguay	Cope	No	No		13.45					
Uruguay	Paris	Yes	No							
Vanuatu	Kyoto	No	No		0.51					
Vanuatu	Cope	No	No		0.63					
Vanuatu	Paris	Yes	Yes	No	0.18					
Venezuela, RB	Kyoto	No	No		353.01					
Venezuela, RB	Cope	No	No		272.54					
Venezuela, RB	Paris	Yes	Yes	No	11.35					
Vietnam	Kyoto	No	No		165.26					
Vietnam	Cope	No	No		242.12					
Vietnam	Paris	Yes	Yes	Yes	220.76	-369.79	-503.64	-146.77	-199.90	
Western Sahara	Kyoto	No	No							
Western Sahara	Cope	No	No							
Western Sahara	Paris	No	No							
Yemen, Rep.	Kyoto	No	No		27.37					
Yemen, Rep.	Cope	No	No		33.26					
Yemen, Rep.	Paris	Yes	Yes	Yes	32.31	-5.37	-11.07	-15.79	-32.54	

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Country	Pledge	Party to the pledge	Quantified objective specified	Can quantify target	Start year emissions (MTCO2 eq)	Targeted reduction from starting year of pledge: Absolute (in MTCO2 eq.) Cond	Absolute Uncond	Relative (% of start emissions) Cond	Relative Uncond	Progress with Kyoto Copen (%)
Zambia	Kyoto	No	No		476.86					
Zambia	Cope	No	No		399.41					
Zambia	Paris	Yes	Yes	Yes	378.72	167.36	167.36	44.06	44.06	
Zimbabwe	Kyoto	No	No		62.88					
Zimbabwe	Cope	No	No		63.14					
Zimbabwe	Paris	Yes	Yes	No	14.85					

Notes: The table provides a summary of the agreements made under the Kyoto Protocol, Copenhagen Accord and Paris Agreement by country. The quantified objective refers to whether the country provided a numerical objective for emissions reduction whereas the column specifying whether the target can be quantified refers to whether there is sufficient information to convert the aforementioned numerical objective into a targeted reduction in emissions from the starting year of the pledge.
The targeted reductions are provided for the countries for which this calculation is carried out as described in Section 3. Start year GHG emissions are measured in millions of metric tons of carbon dioxide equivalent and the start years for the Kyoto, Copenhagen and Paris agreements are taken as 2005, 2009 and 2014, respectively.
The last column reports progress made to date on the Kyoto and Copenhagen agreements. Progress is defined as the decrease in emissions from the start year to the end year as a percentage of start year emissions. It is measured in GHG emissions for the Kyoto protocol and fossil CO2 emissions for the Copenhagen accord. The end year for the Kyoto protocol is 2012 and the end year for the Copenhagen accord is the last year for which data is available, 2018.

Appendix B

In this section, we examine the stability of the estimated coefficients across different levels of development as well as over time. We do so by interacting all variables with, correspondingly, development group indicators and time effects. The overall conclusion, given the insignificance of most interactions, is that the estimated coefficients shown earlier are generally stable.

Table B.1. Relationship between covariates and emissions at different levels of development

	Full-period (1970-2018)	Pre-period (1970-2000)
ln(GDP per capita)	0.551***	0.712***
	[0.121]	[0.135]
Low income*ln(GDP per capita)	0.316	0.243
	[0.203]	[0.228]
Lower middle income*ln(GDP per capita)	0.225	0.02
	[0.157]	[0.195]
Upper middle income*ln(GDP per capita)	0.23	0.277
	[0.153]	[0.187]
ln(Population)	1.000***	1.067***
	[0.172]	[0.215]
Low income*ln(Population)	0.115	0.742
	[0.244]	[0.514]
Lower middle income*ln(Population)	-0.25	-0.276
	[0.231]	[0.336]
Upper middle income*ln(Population)	0.328	0.294
	[0.257]	[0.315]
% urban population	-0.003	-0.007
	[0.007]	[0.006]
Low income*Urban pop	0.028*	0.004
	[0.015]	[0.028]
Lower middle income*Urban pop	0.025**	0.033*
	[0.011]	[0.017]
Upper middle income*Urban pop	0	0.012
	[0.010]	[0.010]
Country FE	Yes	Yes
Year FE	Yes	Yes
N	7893	4375
R-square	0.194	0.021

Notes: The table reports the results of regressing total fossil CO_2 emissions (in logs) on GDP per capita (in constant 2010 US$) and population (in logs), and urban population as a percentage of the total, where each covariate is interacted with a dummy variable to indicate the income group of the country as classified by the World Bank. All regressions include a constant term and country and year fixed effects.
The values in brackets are robust standard errors. *, **, and *** indicate significance at 10%, 5%, and 1% levels, respectively.

Table B.2. Relationship between covariates and emissions over time

	Full-period (1970-2018) (1970-2018)	Pre-period (1970-2000)
Base=1970s		
1980s	0.387	0.276
	[0.315]	[0.297]
1990s	1.222***	1.006**
	[0.408]	[0.403]
2000s	1.758***	
	[0.593]	
2010s	3.010***	
	[0.740]	
ln(GDP per capita)	0.774***	0.873***
	[0.064]	[0.076]
1980s*ln(GDP per capita)	-0.048	-0.037
	[0.040]	[0.036]
1990s*ln(GDP per capita)	-0.108**	-0.086*
	[0.046]	[0.046]
2000s*ln(GDP per capita)	-0.072	
	[0.054]	
2010s*ln(GDP per capita)	-0.116*	
	[0.061]	
ln(Population)	1.040***	1.071***
	[0.128]	[0.152]
1980s*ln(Population)	0.002	0.005
	[0.013]	[0.011]
1990s*ln(Population)	-0.026	-0.02
	[0.016]	[0.016]
2000s*ln(Population)	-0.064**	
	[0.029]	
2010s*ln(Population)	-0.112***	
	[0.040]	
% urban population	0.013***	0.007
	[0.004]	[0.005]
1980s*Urban pop	-0.002	-0.003
	[0.002]	[0.002]
1990s*Urban pop	0	-0.002
	[0.003]	[0.003]
2000s*Urban pop	-0.005	
	[0.003]	
2010s*Urban pop	-0.007*	
	[0.004]	
Country FE	Yes	Yes
Year FE	No	No
N	7991	4435
R-square	0.905	0.906

Notes: The table reports the results of regressing total fossil CO_2 emissions (in logs) on GDP per capita (in constant 2010 US$) and population (in logs), and urban population as a percentage of the total, where each covariate is interacted with a dummy variable to indicate the decade. All regressions include a constant term. The values in brackets are robust standard errors. *, **, and *** indicate significance at 10%, 5%, and 1% levels, respectively.

Appendix C

TABLE C.1. Placebo check for impact of signing agreements

	ln(Total emissions)
F1.Signed Kyoto	-0.305***
	[0.084]
L0.Signed Kyoto	-0.012
	[0.013]
L1.Signed Kyoto	-0.127***
	[0.042]
F1.Signed Copenhagen	-0.087
	[0.071]
L0.Signed Copenhagen	-0.013
	[0.015]
L1.Signed Copenhagen	-0.075**
	[0.031]
F1.Signed Paris	-0.040
	[0.248]
L0.Signed Paris	0.003
	[0.012]
L1.Signed Paris	.
	[.]
.	
Controls	Yes
Country and Year FE	Yes
N	7687
R-square	0.645

Notes: The table reports the results of regressing total fossil CO2 emissions (in logs) on the lead, contemporaneous and lagged indicators for signing different climate-related pledges. All regressions include a constant and control for country and year fixed effects as well as real GDP per capita (in constant 2010 US$), population (in logs), and urban population as a percentage of the total.
The values in brackets are robust standard errors. *, **, and *** indicate significance at 10%, 5%, and 1% levels, respectively.

Appendix D

In this section, we re-estimate the impact of signing the climate agreements and adopting different climate-change related actions after excluding the outlier countries identified in Figures 7b and 8b. The results in Tables D.1 and D.2 below indicate that our main results in Table 9 and Table 10 are not sensitive to the inclusion of these outliers.

TABLE D.1. Emissions and climate agreements: excluding outliers

	ln(Total fossil CO2 emissions)			
	(1)	(2)	(3)	(4)
Signed Kyoto	-0.432***	-0.420***	-0.345***	-0.344***
	[0.023]	[0.023]	[0.030]	[0.030]
Signed Copenhagen	-0.168***	-0.155***	-0.138***	-0.128***
	[0.025]	[0.028]	[0.026]	[0.029]
Signed Paris	0.057	0.085	0.118	0.136
	[0.290]	[0.120]	[0.290]	[0.120]
Have quantified objectives			-0.115***	-0.099***
			[0.028]	[0.028]
Using IPW	No	Yes	No	Yes
N	7741	7741	7741	7741

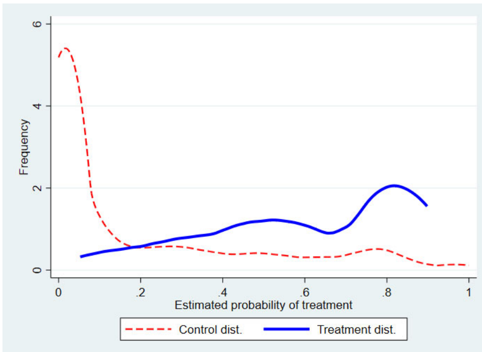
Notes: The table reports the results of regressing total fossil CO2 emissions (in logs) on lagged indicators for signing different climate-related pledges excluding the outlier countries identified in Figure 7b and 8b. All regressions include a constant and control for country and year fixed effects as well as real GDP per capita (in constant 2010 US$), population (in logs), and urban population as a percentage of the total. Columns (1) and (3) report the unweighted OLS estimates, while the results in the remaining columns are estimated using inverse probability weighting.
The values in brackets are robust standard errors. *, **, and *** indicate significance at 10%, 5%, and 1% levels, respectively.

Table D.2. Emissions and climate actions: excluding outliers

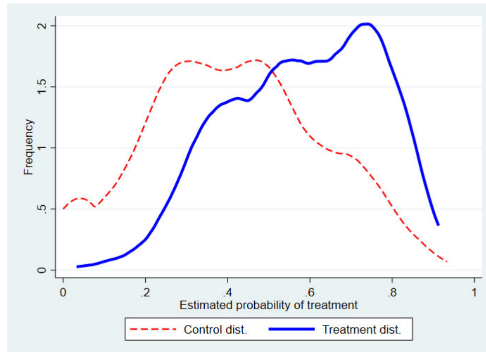
	ln(Total fossil CO2 emissions)			
	(1)	(2)	(3)	(4)
Number of climate related laws	-0.035***	-0.034***		
	[0.003]	[0.003]		
Number of climate related policies	-0.002	-0.001		
	[0.003]	[0.004]		
Have national level carbon tax	-0.156***	-0.146***	-0.170***	-0.158***
	[0.020]	[0.020]	[0.021]	[0.021]
Have national level ETS	-0.339***	-0.332***	-0.353***	-0.351***
	[0.021]	[0.021]	[0.021]	[0.022]
Number of policies by sector				
Adaptation			0.013**	0.013**
			[0.006]	[0.006]
Demand management			-0.022***	-0.021***
			[0.005]	[0.005]
Supply management			-0.026***	-0.024***
			[0.005]	[0.005]
Transport			-0.011	-0.001
			[0.007]	[0.007]
LULUCF			0.015**	0.005
			[0.006]	[0.008]
R&D			0	0
			[0.006]	[0.006]
Using IPW	No	Yes	No	Yes
N	7741	7741	7741	7741

Notes: The table reports the results of regressing total fossil CO2 emissions (in logs) on the lagged number of climate related laws and policies implemented as well as indicators for having a national carbon tax and ETS, excluding the outlier countries identified in Figure 7b and 8b. All regressions include a constant and control for country and year fixed effects as well as real GDP per capita (in constant 2010 US$), population (in logs), and urban population as a percentage of the total. Columns (1) and (3) report the unweighted OLS estimates, while the results in the remaining columns are estimated using inverse probability weighting.
The values in brackets are robust standard errors. *, **, and *** indicate significance at 10%, 5%, and 1% levels, respectively.

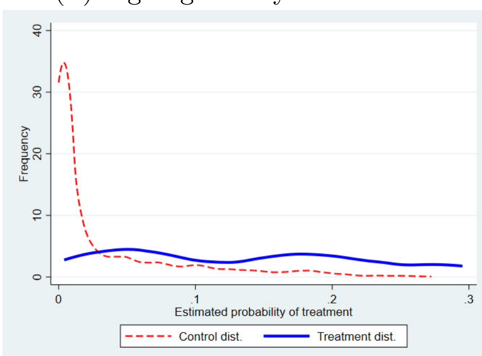
Appendix E



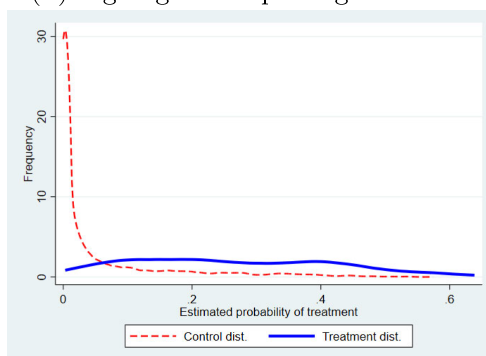
(A) Signing the Kyoto Protocol



(B) Signing the Copenhagen Accord



(C) Having a national level carbon tax



(D) Having a national level ETS

FIGURE E.1. Distribution of propensity scores used for local projections

Note: The figure plots the smooth kernel density estimates of the distribution of the propensity scores for the four treatments considered in Section 4.2 and 4.3.

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