DATA DESCRIPTION DOCUMENT: CARBON PRICING INDEX

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OVERVIEW

This project was initially part of the COGEM project, aiming at estimating GHG emissions from corporates using statistical algorithms. Literature on this subject (see [1] and [2]) used State and Trends of Carbon Pricing Dashboard to get relevant data to feed the model, especially on the existence of an Emission Trading System (ETS) or a carbon tax, and the carbon price(s) that could be associated to a given country. Yet, it quickly appears that:

1. The data that can be downloaded from State and Trends of Carbon Pricing Dashboard is an Excel file with multiple sheets on several topics (Revenues, prices, carbon credits, etc.), that is usually not usable as this and thus require some preparation.
2. The data does not allow for an immediate comparison between countries. Indeed,
    a. Some countries have several pricing instruments (ETS and/or Carbon Tax), from different regional levels (subnational, national and supranational).
    b. Some instruments have their tied prices and/or covered emissions that vary depending on the sector, greenhouse gas, fossil fuel...
    c. Some instruments are "too specific" and require the use of additional sources.

Thus, the Pladifes Team considered there was value in **creating and sharing a preprocessed version** of the carbon pricing data, **focused on easing the countries' comparison**. To this end, we developed a so-called **carbon pricing index**, **derived for each couple (country, year) where the country has implemented a carbon pricing mechanism in the considered year**.

Please note that there could be a one year delay, explained by the fact that the carbon prices from the State and Trends of Carbon Pricing Dashboard are nominal prices as of April 1 of the relevant year. These are generally based on the exchange-traded, auction or government-set prices of April 1, or the most recent prices available. Thus, a country implementing a new instrument between April and December of year *n* would see it appear only in year *n+1*.

METHODOLOGY DESCRIPTION

Raw data

From State and Trends of Carbon Pricing Dashboard, one can download "data-latest.xlsx", and Excel file with several sheets. We based our methodology on the "Compliance_Gen Info" and "Compliance_Price" sheets.

Moreover, some additional sources were used when necessary:

- European Environment Agency data [3,4] was used to determine national jurisdictions coverages for EU countries, for the EU ETS.
- Checks were made using OECD and UNFCCC data [5,6], which allowed for some outliers correction.
- National reports were also used to perform some corrections, Norway for example [7].

- Countries with subnational carbon pricing instruments usually required a custom-made analysis, based on specific sources (see [9 to 19]).

Definition of the national Carbon Price Index (CPI)

For each country c, for each year t such that it exists at least one carbon pricing mechanism, we define the Carbon Pricing Index as follows:

$$CPI_{c,t} = \sum_{instruments} coverage_{instrument} \times carbon\_price_{instrument}$$

where *coverage* refers to the proportion of the total emissions of the country affected by the taxation and *carbon price* the price tied to the instruments, usually based on the prices on the first of April.

The narrative for such formula comes from the fact that a country is usually considered more stringent on carbon taxation if it has both a large amount of its emissions covered as well as a high enough price level. Compliance and compensation arrangements could also be considered but significantly increase the complexity of the calculations.

For subnational instruments on a given region, we use the following formula to derive the coverage:

$$coverage_{sub\_nat\_instrument} = coverage_{instrument} * \frac{total\_emissions_{region}}{total\_emissions_{country}}$$

so that the influence of a given mechanism will always be proportionate to the emissions of the region. This formula applies for both subnational ETS and carbon taxes.

Used choices/current limitations

For instruments that have several carbon prices, we use the "main" one, *ie*. the one corresponding to the largest volume of emissions in the jurisdiction. When prices vary depending on the greenhouse gases, the retained one is usually the CO_2 one. When prices vary depending on the used fossil fuel, the retained one is the one tied to the fuel linked to the largest number of emissions for the country/region.

Most coverages are considered constant through time due to a lack of precise data. Yet, this source of variation is arguably limited for most instruments in the time range considered.

Different sources have been used and are not all based on the same year. Some inconsistencies have been detected (such as coverages summing to more than 100%) and external data has then been used to correct suspicious values.

Completion of the final Excel file

To allow for a better understanding of the methodology and the following choices, the calculations are split into several sheets. The "final_sheet" corresponds to the preprocessed version of the data, "ready to use" by other users. All other sheets present intermediary data used to derive the carbon prices index. All sheets are inventoried in the section Dataset Variables.

Most carbon pricing indexes are based on sum products based on "jurisdictions_covered_XXX" and "carbon_price_XXX" sheets data, which are filled using mostly the raw "Compliance_Gen Info" for the coverages and "Compliance_Price" for the prices.

The only Supranational ETS is the EU one. It has a dedicated sheet for the country coverages calculation. Derived values are then copy pasted to the "jurisdictions_covered_SupETS" sheet.

USA, China, Canada, Mexico and Japan are dealt with in the "Federated cases" sheet.

If you notice a value you disagree with/have questions on, please feel free to contact us at pladifes@institutlouisbachelier.org. We thank you very much for your feedback! The Institut Louis Bachelier thanks Jérémy VILCOSQUI, Kenza TAZI et Thibaud BARREAU for their implication on this project.

DATASET VARIABLES

Final sheet

Variable/Variable type	Description	Unit	Missing values	Type
Country identifiers*	The name/identifier of the country, according to different sources/standards (ISO, Thomson Reuters, IEA…)	-	-	String or int
Region	The region that the country belongs to	-	-	string
EU list	A Boolean indicating countries covered by EU ETS	-	-	bool
CO2 law	A Boolean indicating countries having implemented at least one instrument	-	-	bool
Implemented mechanisms	The list of the implemented mechanisms, with "No" for countries without any	-	-	string
CO2 status	An indicator of the implementation status of the instrument(s): "Implemented" or "Under consideration"	-	77%	string
Start year	The year when the first data on an instrument is available	-	79%	int
Year*	A Boolean indicating if at least one instrument was implemented for year "year". Years ranging from 1990 to 2024	-	-	bool
Carbon pricing index (year)*	The value of the carbon pricing index for year "year". Years ranging from 2000 to 2023. Value is 0 by default	-	-	float64

* Elements with an asterisk are variable types, referring to several columns

Other sheets

Index	The carbon pricing index calculation based on the other sheets
Total Jurisdiction covered	The total percentage of the emissions covered by all instruments for a given country
Federated cases	A sheet dedicated to handling countries with sub national carbon pricing mechanisms (*ie.* USA, China, Canada, Mexico and Japan)
Jurisdiction covered NCT	The percentage of the emissions covered by National Carbon Taxes for a given jurisdiction
Jurisdiction covered NETS	The percentage of the emissions covered by National ETS for a given jurisdiction
Jurisdiction covered SupETS	The percentage of the emissions covered by Supranational ETS for a given jurisdiction

Carbon price NCT	The carbon prices tied to the National Carbon Taxes for a given jurisdiction (in US$/tCO2e)
Carbon price NETS	The carbon prices tied to the National ETS for a given jurisdiction (in US$/tCO2e)
Carbon price SupETS	The carbon prices tied to the Supranational ETS for a given jurisdiction (in US$/tCO2e)
EU calculations	The calculations for the EU coverages

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