# Appendix for "Who Puts a Price on Carbon, Why and How? A Global Empirical Analysis of Carbon Pricing Policies"

## Supplemental Online material

**Abstract**

Technical documentation of the article "Who Puts a Price on Carbon, Why and How? A Global Empirical Analysis of Carbon Pricing Policies" submitted to *Climate Policy*.

## Contents

# 1 Data description

Figure 1 presents the temporal dynamic of diffusion for carbon pricing policies. The left figure shows the absolute number of countries adopting a carbon pricing policy each year, whereas the right figure shows the proportion they represent over the total countries.

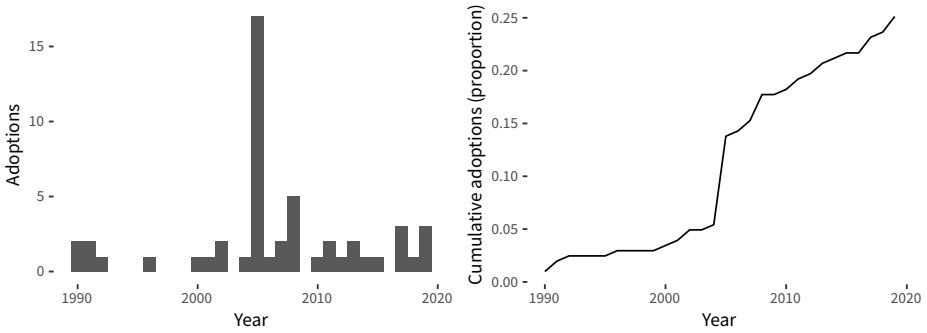


Figure 1: Carbon pricing policy diffusion: temporal distribution of adoptions and cumulative proportion of adopters.

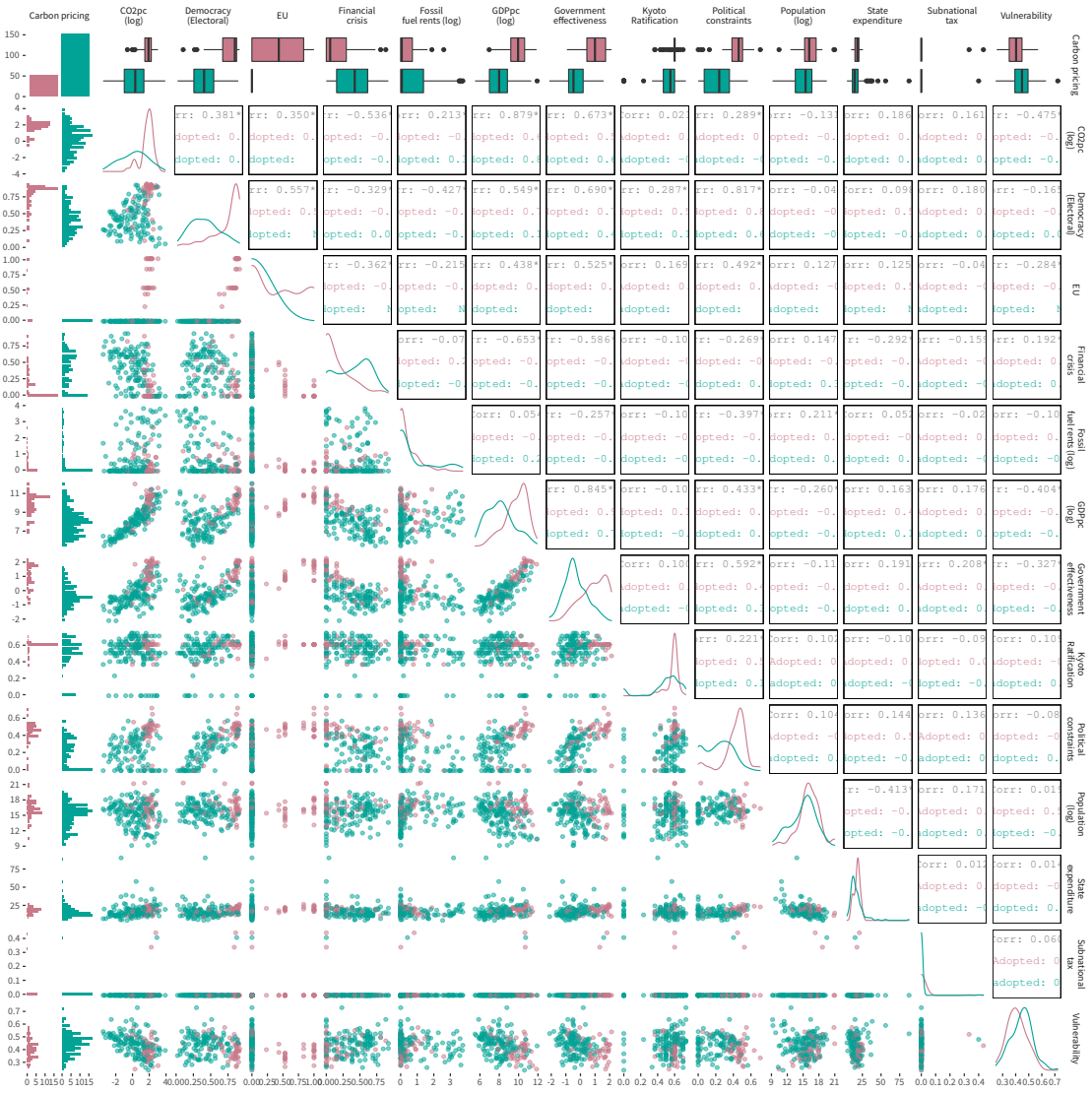


Figure 2: Distribution of the values of covariates, by carbon pricing adoption. Values represent country means for the period considered. Carbon adoption is taken on the last year considered.

Figure 2 shows the distribution of the explanatory variables considered, by carbon pricing adoption. Values represent country means for the period considered. Carbon adoption is taken on the last year.

## 2 Expected effect sizes

Table 1 presents the expected effect sizes of each covariate on the adoption of carbon pricing, in terms of odds ratios.

| Covariate | Odds Ratio | Expected effect |
|---|---|---|
| Interdependence (Trade competition) | 5.83 | △ 480% |
| Population (log) | 5.59 | △ 460% |
| EU | 5.59 | △ 460% |
| GDPpc (log) | 4.73 | △ 370% |
| Democracy (Electoral) | 3.84 | △ 280% |
| Kyoto Ratification | 3.41 | △ 240% |
| Financial crisis | 3.03 | △ 200% |
| CO2pc (log) | 2.85 | △ 190% |
| Subnational tax | 0.61 | ▽ 39% |
| Fossil fuel rents (log) | 0.72 | ▽ 28% |
| State expenditure | 1.15 | △ 15% |
| Vulnerability | 1.05 | △ 4.7% |

Table 1: Odds ratios of expected effect sizes, by magnitude.

## 3 Variable selection

Table 2 presents the probabilities of the variables being selected to be present as explanatory factors of the adoption of carbon pricing policies, in the penalized regression model.

| Outcome | Covariate | Probability being selected |
|---|---|---|
| Carbon pricing | (Intercept) | 1.00 |
| Carbon pricing | Financial crisis | 1.00 |
| Carbon pricing | Democracy (Electoral) | 0.83 |
| Carbon pricing | EU | 0.81 |
| Carbon pricing | GDPpc (log) | 0.79 |
| Carbon pricing | Population (log) | 0.66 |
| Carbon pricing | Kyoto Ratification | 0.64 |
| Carbon pricing | CO2pc (log) | 0.63 |
| Carbon pricing | Interdependence (Trade competition) | 0.57 |
| Carbon pricing | Subnational tax | 0.50 |
| Carbon pricing | Vulnerability | 0.42 |
| Carbon pricing | State expenditure | 0.36 |
| Carbon pricing | Fossil fuel rents (log) | 0.36 |

Table 2: Probability of the variable being selected.

# 4 Cluster analysis

Figure 3 shows dendrogram of the classification of countries with carbon pricing policies. The policies to classify the countries are the coverage, price and revenue use of both taxes and ETS, as well as caps and their reduction in the last policy.

Gower distances between the units are calculated and hierarchical clustering is employed.

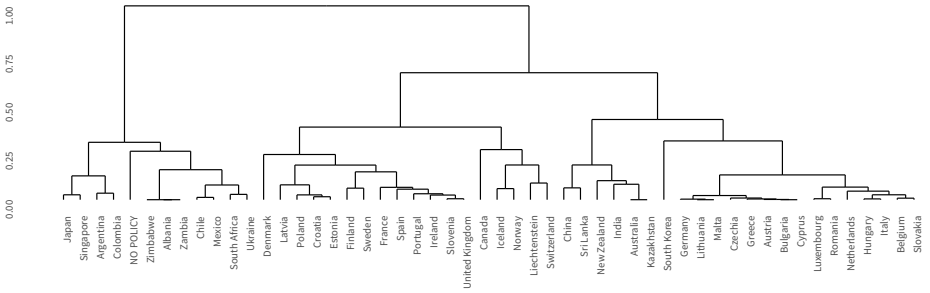


Figure 3: Dendrogram of characteristics of carbon pricing policies (coverage, price, revenue -Taxes and ETS- and cap and cap reduction for ETS).

# 5 Measurement model

The model is a mixed factor analysis based on Quinn (2004) and adapted to the nature of our data. It consists of one part for the binary variables, based on a two-parameter item-response model (Curtis, 2010) and another part for continuous variables, as a classic factor analysis. The combination of the two is possible using Bayesian inference, as it allows our parameters of interest, the carbon pricing intensity, to be modelled as latent. Similar applications can be found for measuring complex institutional arrangements, for instance, political independence of regulatory agencies (Jordana, Fernández-i-Marín, and Bianculli, 2018).

Figures 4 and 5 present the relative importance that each variable poses on the generation of the score of policy intensity for each country. They correspond, respectively, to the variable discrimination for the item-response model part (Figure 4) and to the factor loadings of the continuous part (Figure 5).

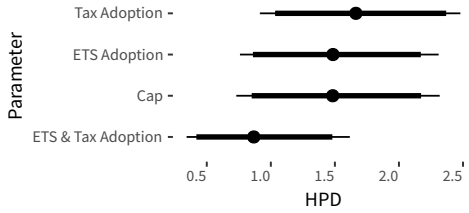


Figure 4: Discrimination of binary variables.

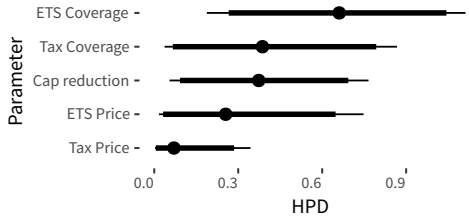


Figure 5: Factor loadings of continuous variables.

# 6 Fiscal crises

Data for fiscal crises comes from Medas et al. (2018). The authors identify 4 different types of crises and their summary value for each pair (Country * Year) is based on whether at least one of the 4 types of crises has happened. Figure 6 shows the number of fiscal crises over time for all the countries considered in our sample.

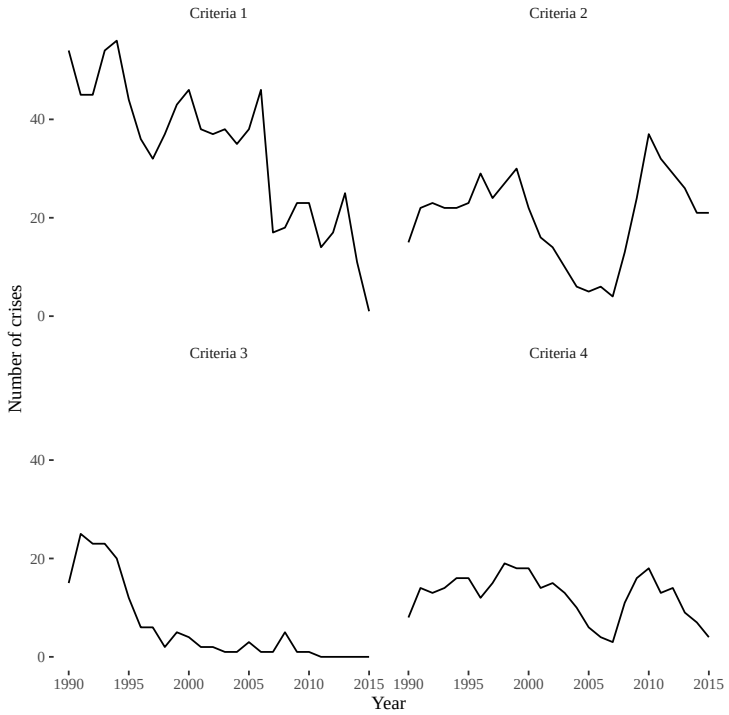


Figure 6: Temporal evolution of the number of fiscal crises in the countries considered.

# 7 Environmental Kurznets Curve - Results

This section contains the results of a model that varies with that reported in the paper in the sense that the variable capturing the effect of carbon emmissions (CO2pc (log)) is introduced as a series of 4 binary indicators at the different quartiles of the original variable. This allows us to capture whether the effect of carbon emmissions on the likelihood of adopting a policy is linear (as in the model reported in the paper) or not. Figure 7 shows the results of including 4 different dummies in the model to account for non-linearity in the variable capturing the effect of carbon emmissions.

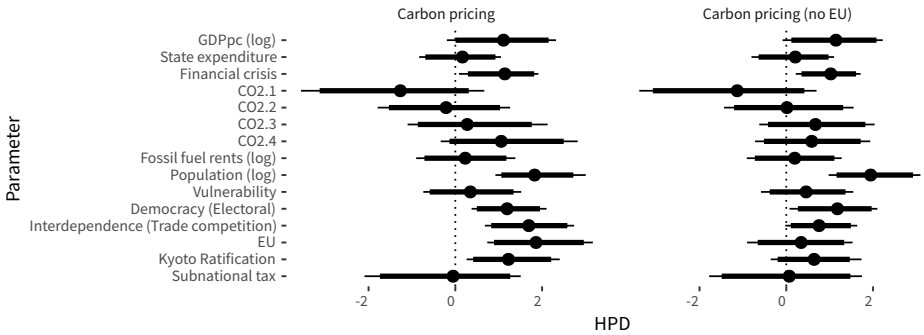


Figure 7: Effects of covariates in the adoption of carbon policies, for the model that allows carbon emmissions to have a non-linear effect on the likelihood of policy adoption.

# 8 Simplified calculation of carbon pricing intensity - Results

This section includes the results of the carbon pricing intensity model that only considers ETS and Tax (Coverage * Price, respectively) as the sources of intensity. Figure 8 presents the relative importance that each variable poses on the generation of the score of policy intensity for each country. It corresponds to the factor loadings of the two continuous variables. Figure 9 presents the scores estimated for each country, that are passed to the explanatory model, whose results are shown in Figure 10.

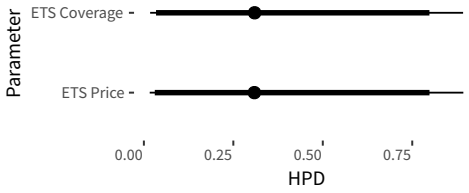


Figure 8: Factor loadings of continuous variables.

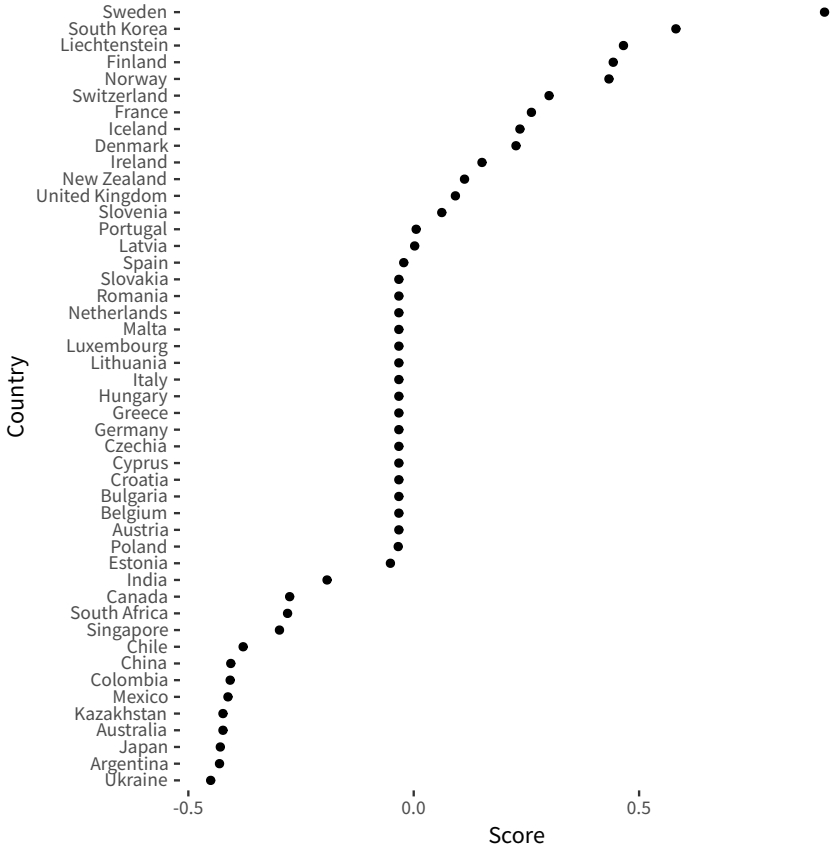


Figure 9: Country scores.

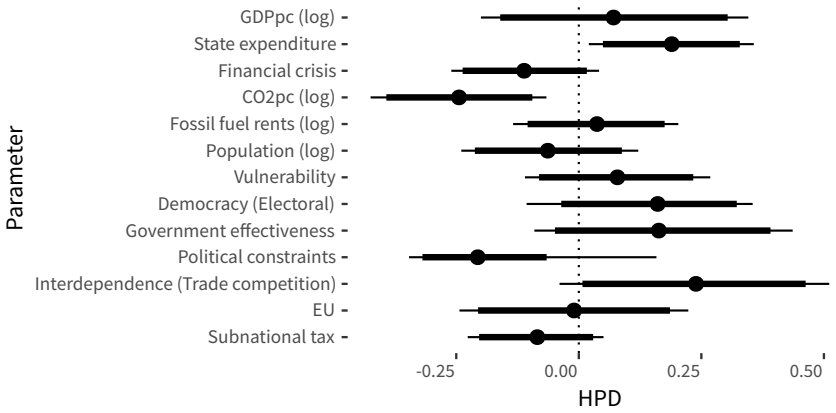


Figure 10: Covariate effects on carbon pricing intensity.

# References

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