The Inequality-Emission Dilemma:

Pre-distribution vs. Redistribution

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September 27th, 2024

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Research Background & Question

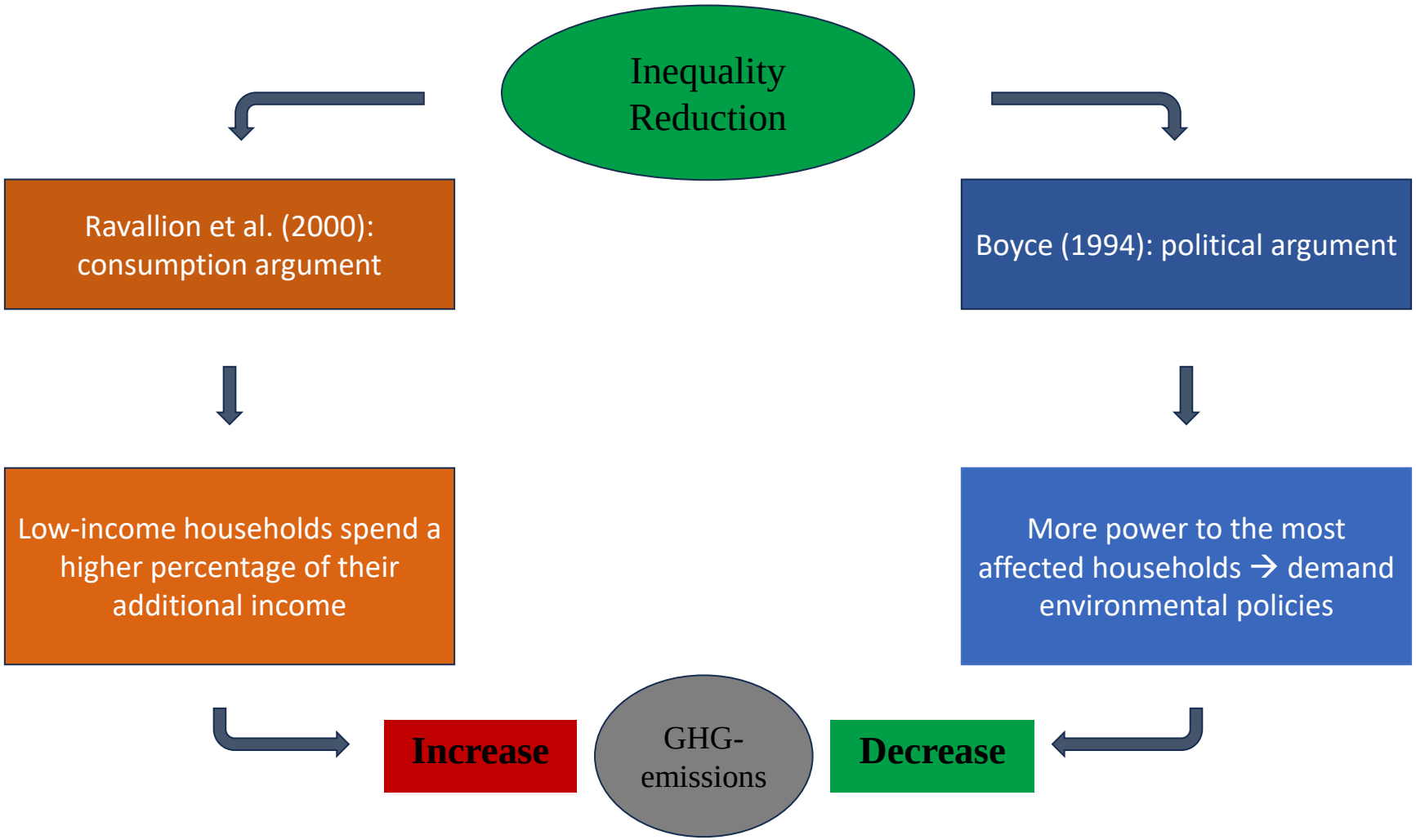
Main challenge of the green transition:

- Joint inequality and CO_2-emission reduction
  $\rightarrow$ conflicting goals

How do distinct ways of reducing inequality (predistribution and redistribution) influence CO_2-emissions globally?

$\Rightarrow$ Green New Deal, UN Sustainable Developments Goals, International Labour Organization, etc.

Figure: Literature Review: Transmission Mechanisms



⇒ Empirical studies are inconclusive, but nexus might be negative in low and middle-income countries & positive in high-income countries (Grunewald et al., 2017; Jorgenson et al., 2017; Rojas-Vallejos and Lastuka, 2020; Dorn et al., 2024).

Hypotheses and Novelties

⇒ **Theoretical elements and transmission channel missing!**

Based on Blanchet et al. (2022), Veblen (1992 [1899]) + the current literature the first hypothesis of this work is:

- *(1) Pre-distribution is better aligned with the goal of carbon emission reduction than redistribution.*

In addition, we use two types of emission indicators, production and consumption-based emissions. Based on Hickel et al., 2022 & Althouse et al. (2023) + the current literature we formulate the second hypothesis:

- *(2) Producers of polluting commodities face higher challenges regarding joint inequality and emission reduction.*

Data and Novelties

⇒ New inequality and emission estimates for 156 low- to high-income countries

Table 2: Descriptive Statistics of the main variables (1995-2020)

Variable	Mean	Standard Deviation	Min.	Max.	N.obs.	Source	Studies utilizing similar indicators[1]
Consumption-based CO_2-emissions (CBE)[2]	5.829	7.890	0.016	92.075	N = 4056	WID	Dorn et al. (2024)
Production-based CO_2-emissions (PBE)[2]	4.642	5.821	0.022	47.657	N = 4056	WDI	Jorgenson et al. (2017), Grunewald et al. (2017), Rojas-Vallejos and Lastuka (2020)
pre-tax Gini	0.571	0.091	0.322	0.781	N = 4056	WID	Hailemariam et al. (2020), Andersson (2023), Safar (2022)
red. Gini	0.054	0.049	-0.002	0.267	N = 4051	WID	-
GDP per capita[2]	18629.4	20092.07	459.9	120647.8	N = 4027	WDI	Jorgenson et al. (2017), Grunewald et al. (2017), Rojas-Vallejos and Lastuka (2020)
pop. Urban (%)	56.917	22.486	7.211	100.000	N = 4056	WDI	Jorgenson et al. (2017), Grunewald et al. (2017), Dorn et al. (2024)
Renewable Energy Consumption (%)	34.83	30.735	0.00	98.34	N = 4041	WDI	Demir et al. (2019), Baloch and Danish (2022)
Civil Liberties	3.414	1.769	1.000	7.000	N = 4034	Freedom House Index	Torras and Boyce (1998), Grunewald et al. (2017), Rojas-Vallejos and Lastuka (2020)
Industry VA (%)	27.949	11.469	3.243	86.670	N = 3914	WDI	Grunewald et al. (2017), Hübler (2017), Dorn et al. (2024)
Agriculture VA (%)	12.173	11.801	0.030	79.042	N = 3956	WDI	Grunewald et al. (2017), Hailemariam et al. (2020), Dorn et al. (2024)
Services VA (%)	52.33	11.621	10.86	93.63	N = 3891	WDI	Grunewald et al. (2017), Dorn et al. (2024)

[1] The source and definition might differ.
[2] Logarithm taken for the subsequent analysis.

Methods

(1) Fixed effects panel regression model:

- mitigating potential biases due to unobserved time-invariant factors (cultural norms, institutional frameworks and social infrastructure).

$$\ln(c_{it}) = \beta_0 + \beta_1 \alpha_{it} + \beta_2 \sigma_{it} + \beta_3 \ln(y_{it}) + X\beta + \delta_i + \lambda_t + \epsilon_{it} \quad [1]$$

(2) Quantile regression model

- addresses proposed non-linearities without selecting the relevant condition ex ante.

$$\ln(c_{it}) = \beta_0 + \beta_1 \alpha_{it} + \beta_2 \sigma_{it} + \beta_3 \ln(y_{it}) + X\beta + u_{it} \quad [2]$$

$$y_q(x_i) = x_i' \beta_q \quad [3]$$

Results

Table: The impact of pre-distribution/ redistribution on CBE (FE Model)

	Naive Model	Base Model	Bench. Model	IV Model
	(log of consumtion-based emissions per capita)			
Pre-tax Gini	−0.990**	−0.586	−0.686	−0.662*
	(0.406)	(0.423)	(0.440)	(0.347)
Red. Gini	1.355*	0.877	1.010	1.234**
	(0.758)	(0.632)	(0.664)	(0.579)
GDP pc	0.731***	0.607***	0.596***	0.650***
	(0.107)	(0.113)	(0.117)	(0.120)
Pop. Urban		0.004	0.005	0.006
		(0.006)	(0.005)	(0.005)
Rnew. energy		−0.016***	−0.014***	−0.012***
		(0.004)	(0.005)	(0.004)
Civil liberties			−0.013	−0.021
			(0.016)	(0.018)
Industry VA			−0.006	−0.005
			(0.005)	(0.005)
Agri. VA			−0.016*	−0.026***
			(0.009)	(0.010)
Services VA			−0.0003	−0.002
			(0.004)	(0.005)
Tariffs				0.019
				(0.027)
Observations	4,022	4,009	3,848	2,951
Adjusted R^2	0.171	0.272	0.301	0.340
F Statistic	337.1***	336.6***	204.7***	171.1***
	(df=3; 3838)	(df=5; 3823)	(df=9; 3658)	(df=10; 2761)
Note:				*p<0.1; **p<0.05; ***p<0.01

Table: The impact of pre-distribution/ redistribution on PBE (FE Model)

	Naive Model	Base Model	Bench. Model	IV Model
	(log of production-based emissions per capita)			
Pre-tax Gini	−1.238***	−0.512	−0.279	−0.532*
	(0.465)	(0.332)	(0.311)	(0.290)
Red. Gini	1.850**	0.987*	0.948*	1.294**
	(0.804)	(0.558)	(0.544)	(0.519)
GDP pc	0.642***	0.421***	0.382***	0.442***
	(0.097)	(0.068)	(0.073)	(0.066)
Pop. Urban		0.008**	0.007*	0.008**
		(0.004)	(0.004)	(0.003)
Rnew. Energy		−0.028***	−0.027***	−0.025***
		(0.002)	(0.002)	(0.002)
Civil Liberties			−0.022*	−0.010
			(0.012)	(0.011)
Industry VA			−0.001	0.001
			(0.003)	(0.003)
Agri. VA			−0.010***	−0.012**
			(0.003)	(0.005)
Services VA			−0.004*	−0.004
			(0.002)	(0.003)
Tariffs				−0.017
				(0.013)
Observations	4,022	4,009	3,848	2,951
Adjusted R^2	0.168	0.560	0.582	0.597
F Statistic	332.0***	1,058.9***	615.7***	455.5***
	(df=3; 3838)	(df=5; 3823)	(df=9; 3658)	(df=10; 2761)
Note:				*p<0.1; **p<0.05; ***p<0.01

Figure: The effect of pre-distribution and redistribution on CBE and PBE across quantiles

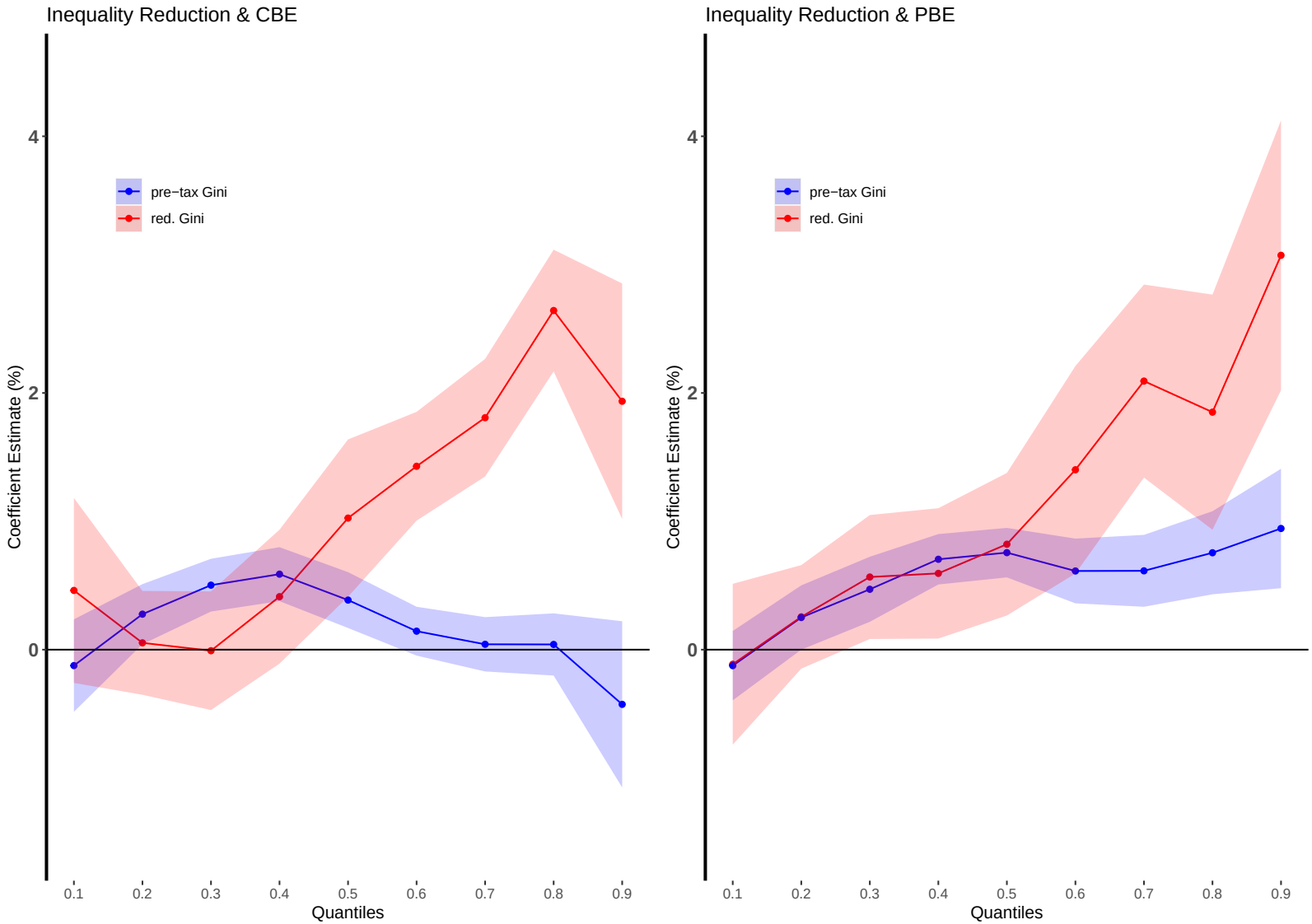


Figure: Comparing the effect of pre-distribution and redistribution on CBE and PBE

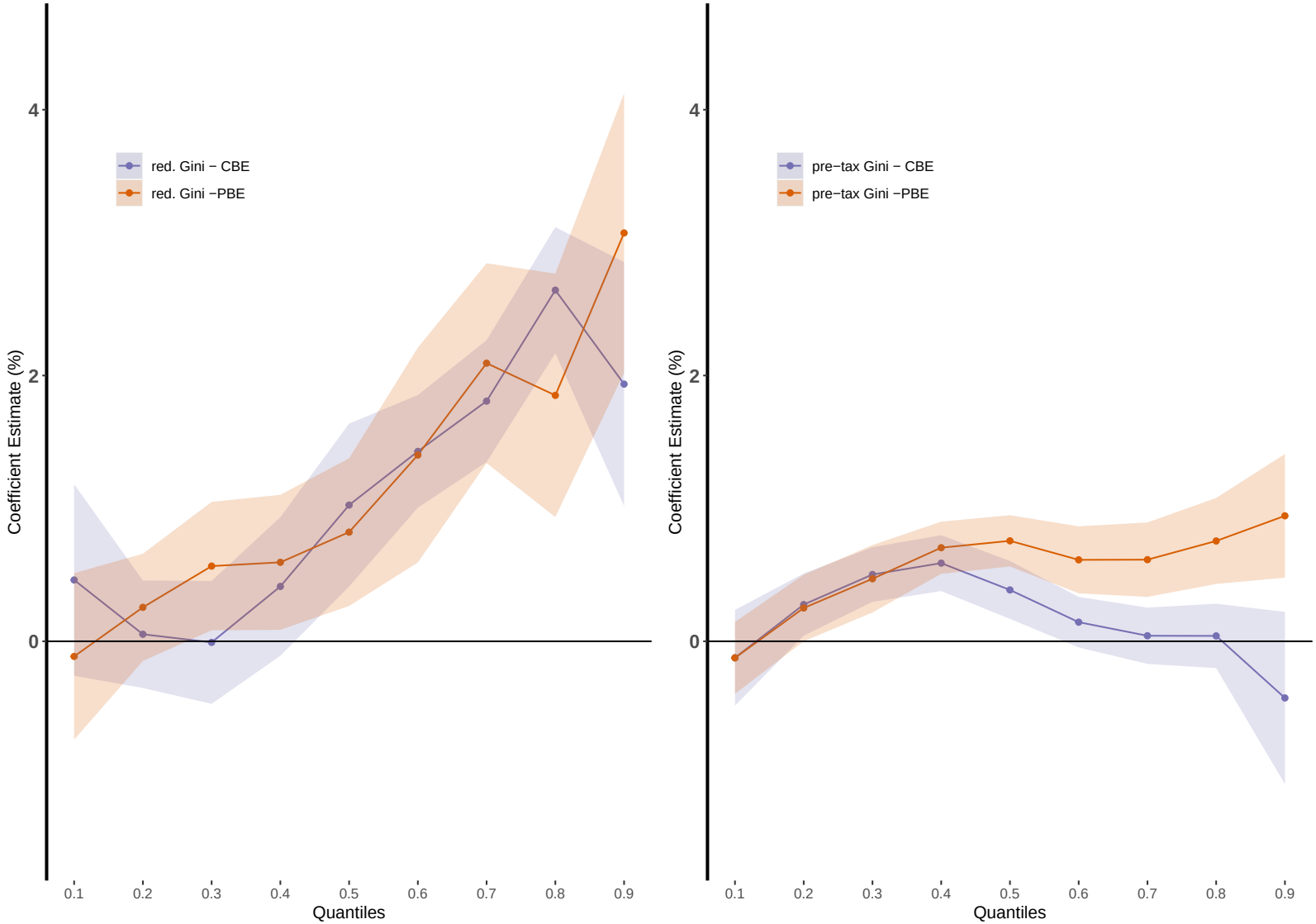


Figure: Benchmark Model (CBE) - Control Variables

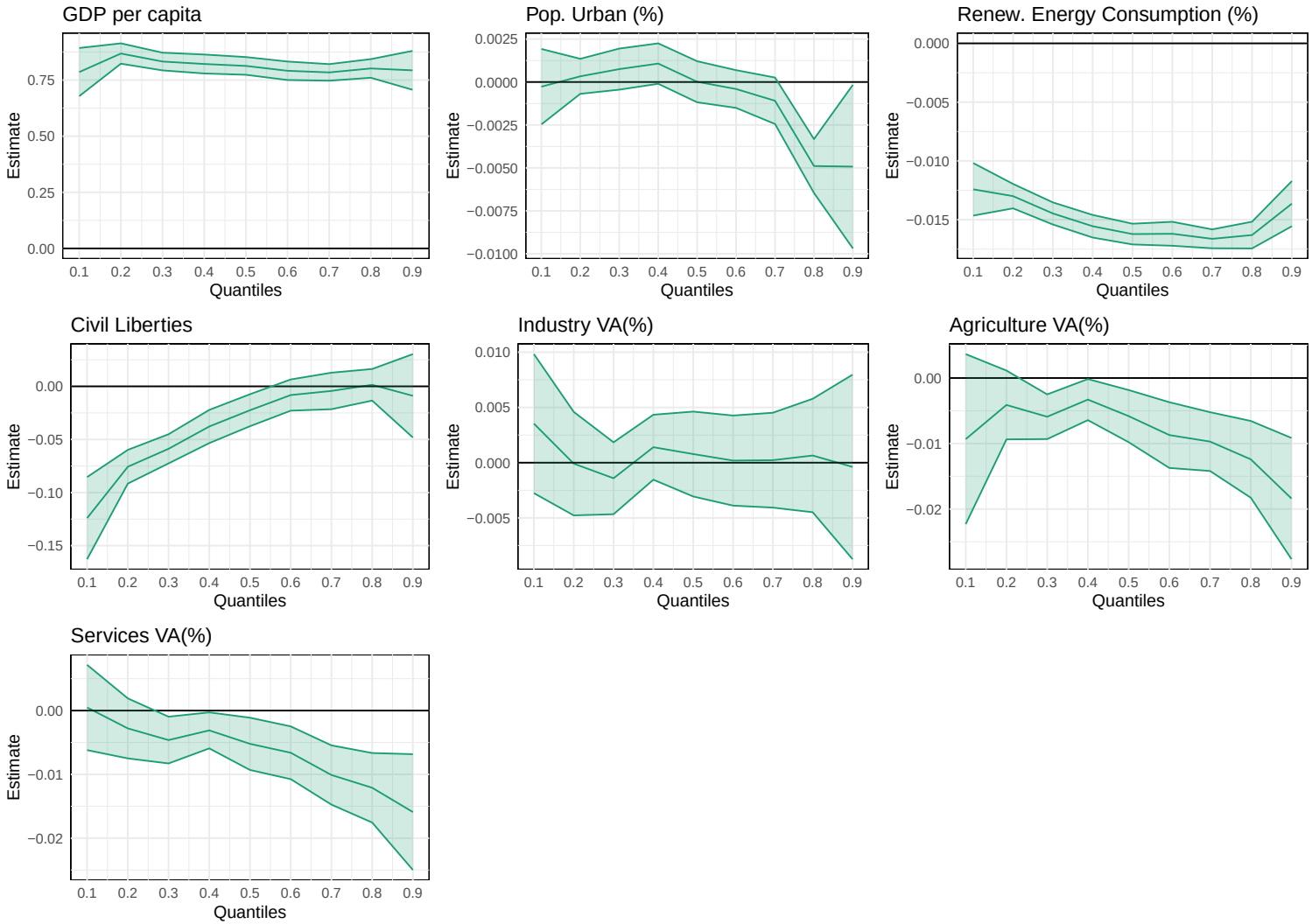
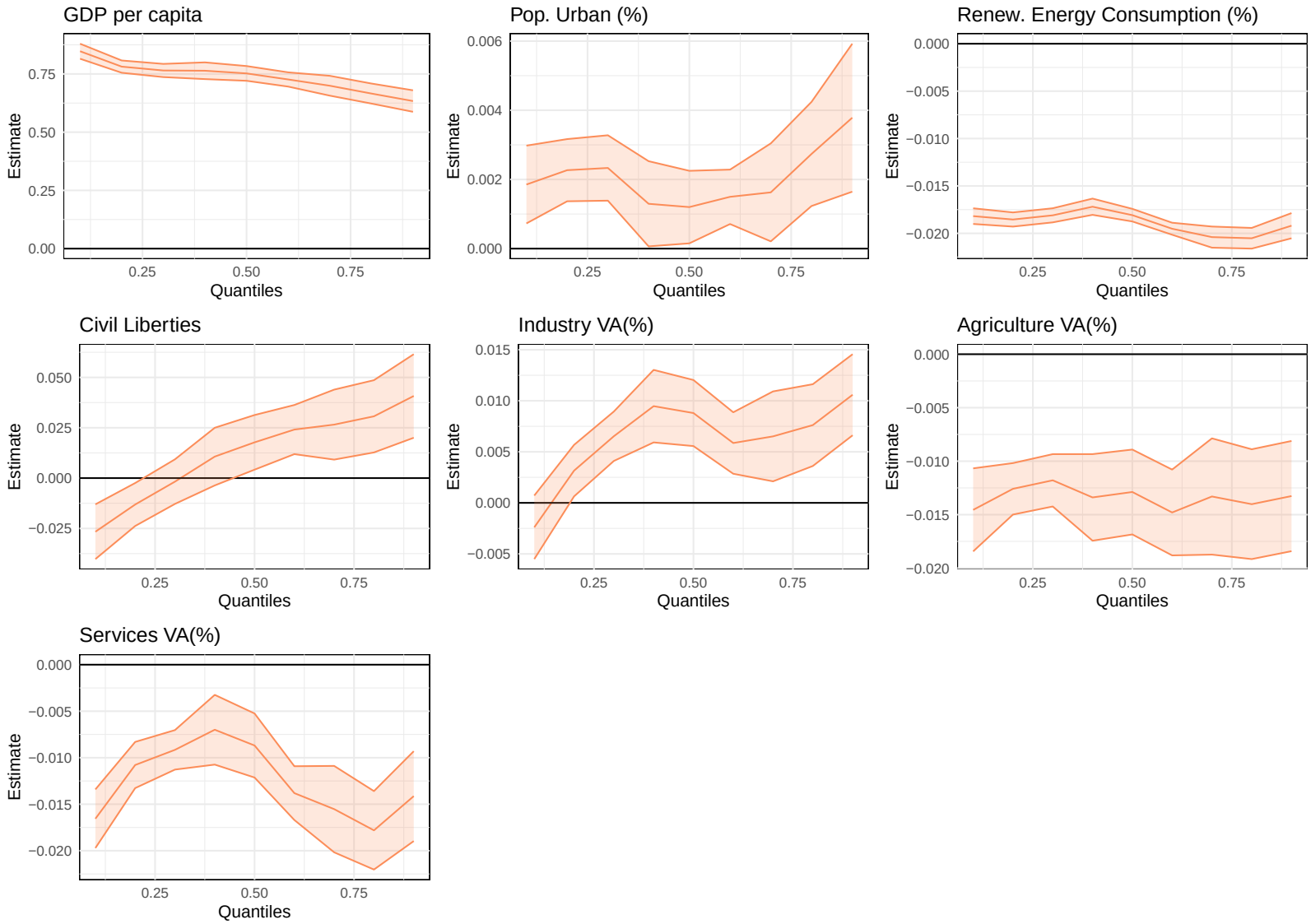


Figure: Benchmark Model (PBE) - Control Variables



Robustness checks

Figure: The effect of pre-distribution and redistribution on CBE and PBE across quantiles

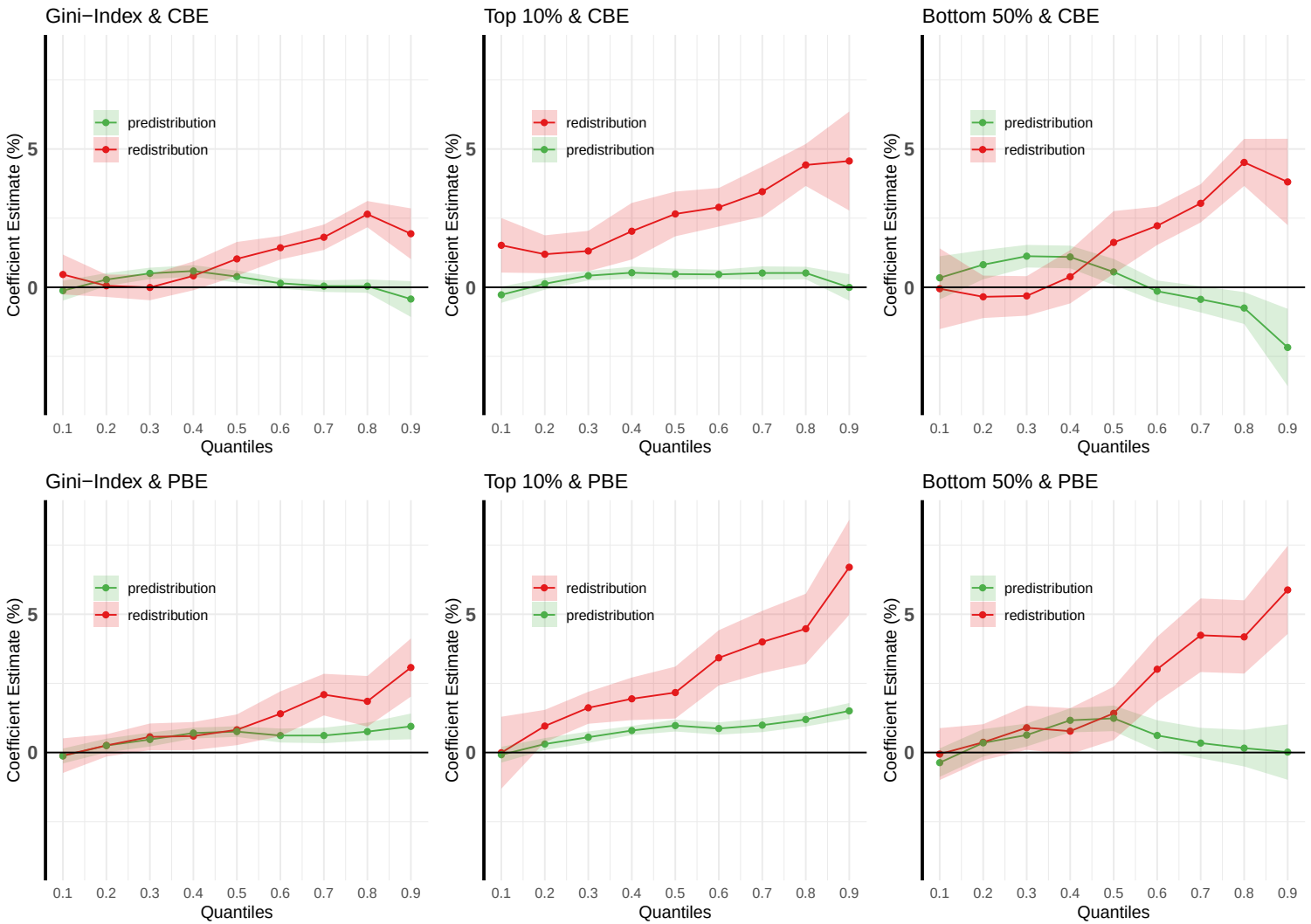


Table: The effect of pre-distribution and redistribution on CBE in low-, low-middle-, upper-middle-, and high-income countries (Benchmark Model)

	Low	Low-Middle	Upper-Middle	High
	(log of consumption-based emissions per capita)			
Pre-tax Gini	0.564	0.456	−1.707*	−0.136
	(0.898)	(0.787)	(0.910)	(0.480)
Red. Gini	0.107	3.151**	2.365	1.470*
	(1.883)	(1.518)	(1.587)	(0.780)
GDP pc	0.650***	0.503***	0.549***	0.465***
	(0.206)	(0.192)	(0.187)	(0.150)
Pop. Urban	0.023**	0.015*	−0.009	−0.002
	(0.012)	(0.008)	(0.012)	(0.008)
Rnew. Energy	−0.018**	−0.012**	0.006	−0.010**
	(0.008)	(0.005)	(0.015)	(0.005)
Civil Liberties	0.018	−0.021	−0.059	0.006
	(0.028)	(0.019)	(0.044)	(0.020)
Industry VA	−0.003	−0.001	−0.010	−0.012
	(0.011)	(0.007)	(0.010)	(0.013)
Agri. VA	0.00001	−0.018**	−0.026	−0.038
	(0.009)	(0.007)	(0.023)	(0.026)
Services VA	0.002	0.001	0.004	−0.005
	(0.007)	(0.005)	(0.008)	(0.012)
Observations	482	1,121	1,025	1,220
Adjusted R^2	0.213	0.360	0.175	0.190
F Statistic	20.357***	78.558***	32.544***	40.921***
	(df = 9; 428)	(df = 9; 1042)	(df = 9; 949)	(df = 9; 1137)
Note:				*p<0.1; **p<0.05; ***p<0.01

Table: The effect of pre-distribution and redistribution on PBE in low-, low-middle- upper-middle-, and high-income countries (Benchmark Model)

	Low	Low-Middle	Upper-Middle	High
	(log of production-based emissions per capita)			
Pre-tax Gini	0.186	0.116	−0.037	−0.852*
	(0.706)	(0.594)	(0.480)	(0.438)
Red. Gini	−0.747	2.228*	0.703	1.445**
	(1.449)	(1.225)	(0.560)	(0.709)
GDP pc	0.614***	0.323**	0.418***	0.464***
	(0.135)	(0.143)	(0.129)	(0.118)
Pop. Urban	0.031***	0.008	0.006*	0.009
	(0.011)	(0.008)	(0.004)	(0.007)
Rnew. Energy	−0.042***	−0.024***	−0.020***	−0.025***
	(0.006)	(0.005)	(0.003)	(0.004)
Civil Liberties	0.013	−0.016	−0.069***	0.008
	(0.023)	(0.017)	(0.021)	(0.019)
Industry VA	−0.003	0.003	0.001	−0.013*
	(0.008)	(0.004)	(0.003)	(0.008)
Agri. VA	−0.006	−0.018***	0.003	−0.024*
	(0.007)	(0.006)	(0.005)	(0.014)
Services VA	0.004	−0.006*	0.001	−0.018**
	(0.006)	(0.004)	(0.004)	(0.007)
Observations	482	1,121	1,025	1,220
Adjusted R^2	0.551	0.518	0.509	0.419
F Statistic	71.587***	142.264***	126.343***	106.893***
	(df = 9; 428)	(df = 9; 1042)	(df = 9; 949)	(df = 9; 1137)
Note:				*p<0.1; **p<0.05; ***p<0.01

Conclusion and policy implications

- Pre-distribution (structural changes accompanied by social protection programs) yields better environmental outcomes than redistribution (transfers)
- Developing countries and producers of carbon intensive products face bigger challenges regarding joint inequality and emission reduction
- Future research should further explore the differences in the effect of social protection and structural changes, the impact of inequality itself on the nexus as well as the transmission channels of inequality policies to other countries.

Thank You for Your Attention!

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