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The Spanish Households' Carbon Footprint Inequality in High Definition & Real Time

Barrutiabengoa, J. (BBVA Research), Carvalho (Cambridge & CEPR), Cubero, J (BBVA Research) ,Hansen, S.(UCL & CEPR), Ortiz, A. (BBVA Research), Rodrigo, T (BBVA Research) and Rodriguez-Mora, J (Edinburg & CEPR)

Creating Opportunities

Key Messages

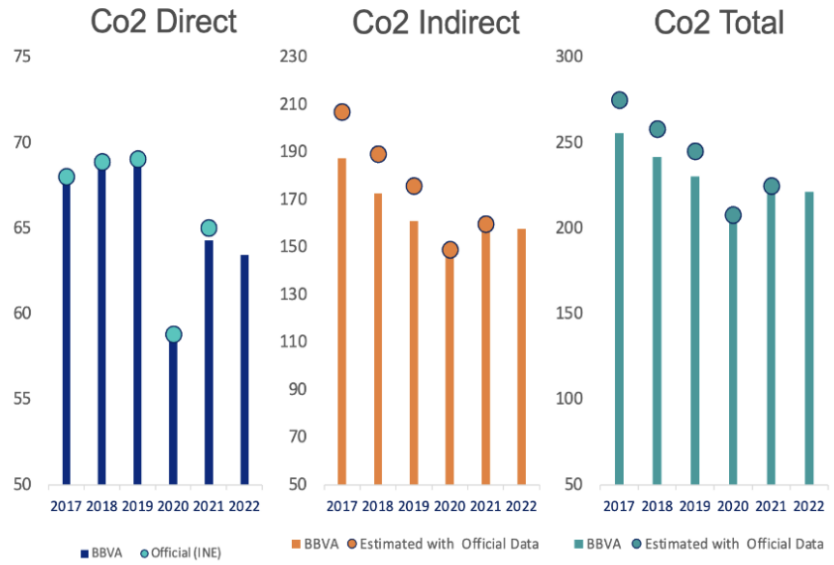
- We present the Environmental Distributional Accounts for GHG Emissions of Spanish Households combining Input-Output methodology with a novel rich Big Data database.
- There is a high inequality in CO2 emissions, in line with consumption but lower than income. Carbon footprint Inequality is highly connected to the use of transport.
- The Co2 emissions from Housing and Energy utilities are more balanced, with relatively higher consumption in the lower percentiles of consumption.
- The Big Data properties enables the design of Smart Policies or those addressed where more needed and/or more effective.
- Our approach also enables the estimation of Household's emissions in real time. The data shows important divergences during Covid-19 by emissions and gases.

Our approach: Input-Output analysis, official data & Big Data

- Macro Consistency: We rely on the standard Macro I-O Approach and on a macro Consistent "Consumption Based" CO_2 emissions.
- Direct & Indirect Emissions:
  - "Direct Emissions": Directly emitted by individuals. Emissions originated from the use of private vehicles or physical combustion at home (i.e.: natural gas for heating).
  - "Indirect Emissions": emissions embedded in the consumption of goods and services, including energy utilities without physical combustion at home (i.e.: electricity).
- Distributional accounts and Real Time GHG Emissions: By Linking CO_2 and CH_4 by category (COICOP) to our Distributional Accounts of Consumption.

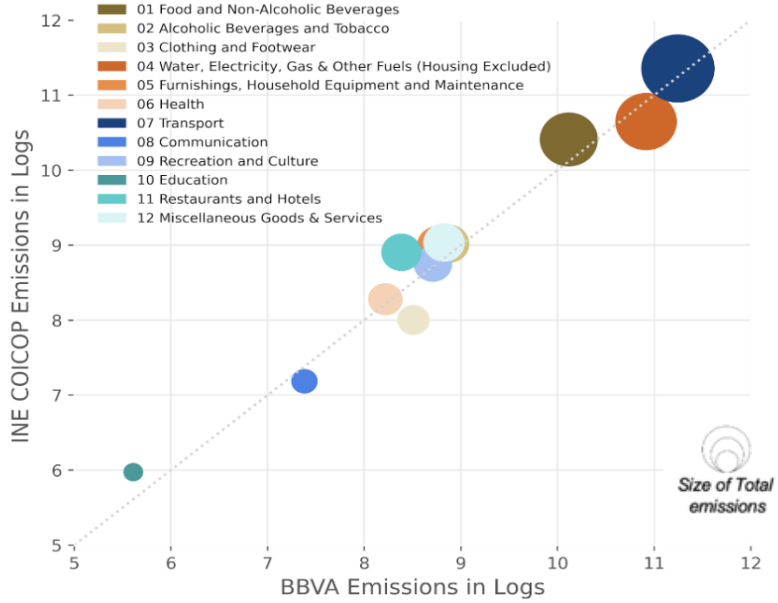
Taking official direct emissions data and adding the estimation of indirect ones (70% of total emissions) by category of consumption

SPAIN: CO2 EMISSIONS 2017-2022
(EMISSION IN MILLION TONS)



Source: BBVA Research, Buda et al. (2022) & INE.

EMISSIONS BY CATEGORY 2020 (BBVA VS INE)
(LOGS OF MILLION TONS). THE BUBBLE SIZE REPRESENTS THE RELATIVE WEIGHT OF BBVA ESTIMATES.

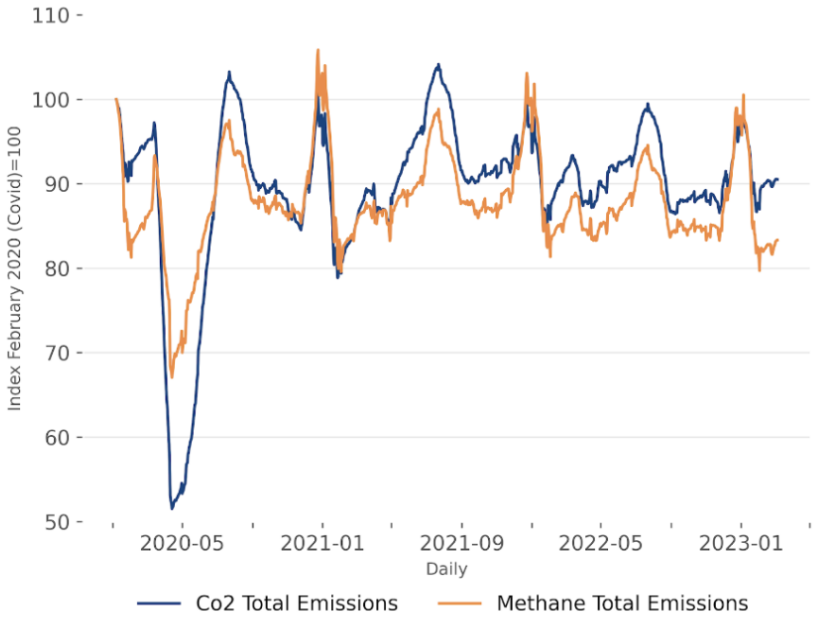


Source: BBVA Research, Buda et al. (2022) & INE.

More Advantages: The Real Time Dimension

SPAIN: TOTAL EMISSIONS CO2 & METHANE

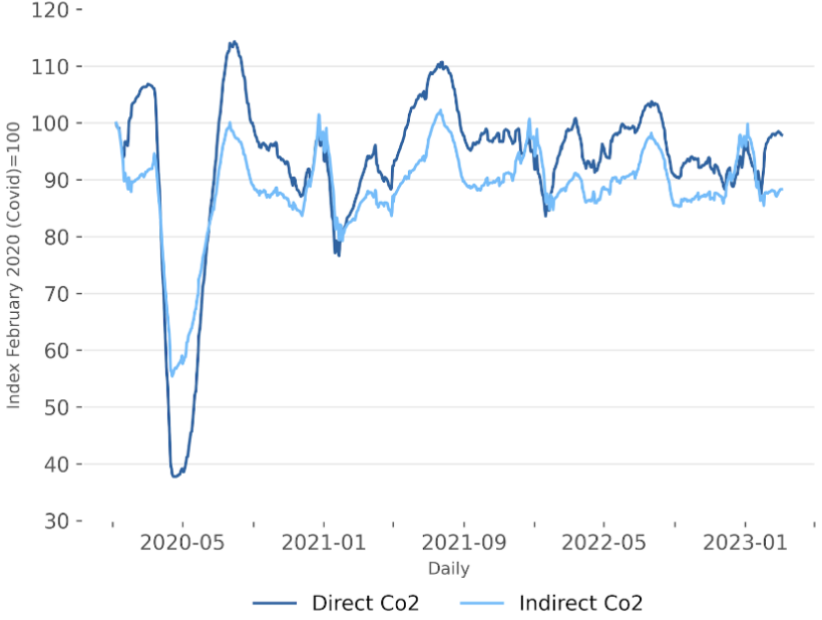
(EMISSIONS IN 000 CO2 EQUIVALENT TONS. INDEX JAN 2020 = 100)



Source: BBVA Research.

SPAIN: TOTAL CO2 DIRECT & INDIRECT EMISSIONS

(EMISSIONS IN 000 CO2 EQUIVALENT TONS. INDEX JAN 2020 = 100)



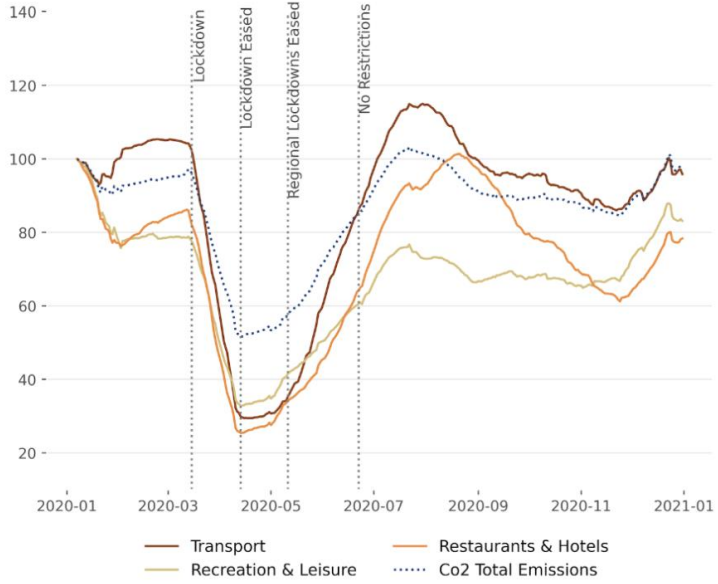
Source: BBVA Research.

CO2 Emissions during Covid-19 Crisis: Lockdown affected (Transport- Recreation- Restaurants) vs Boosted (Food- Housing- Info- Internet)

SPAIN: EMISSIONS CO2 BY CATEGORY DURING THE COVID

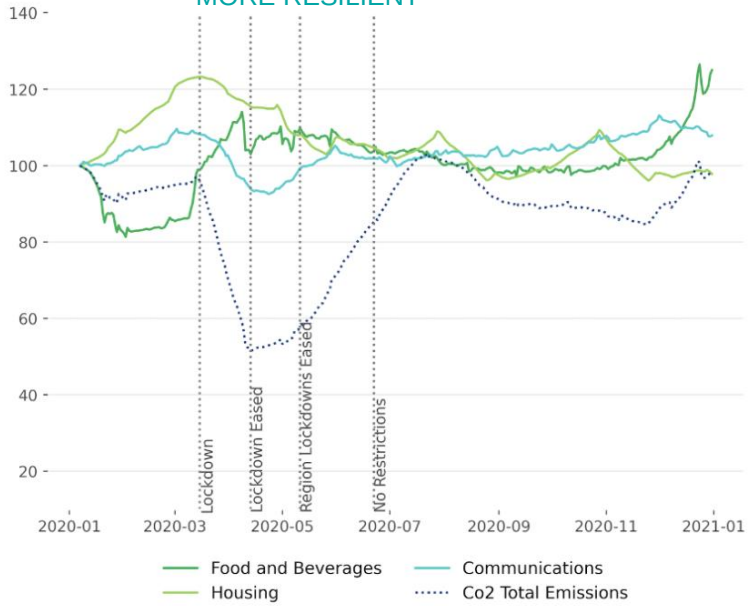
(EMISSIONS IN 000 CO2. INDEX JAN 2020 = 100)

MOST AFFECTED BY LOCKDOWNS



Source: BBVA Research.

MORE RESILIENT



Source: BBVA Research.

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CO2 Emissions In High Definition:

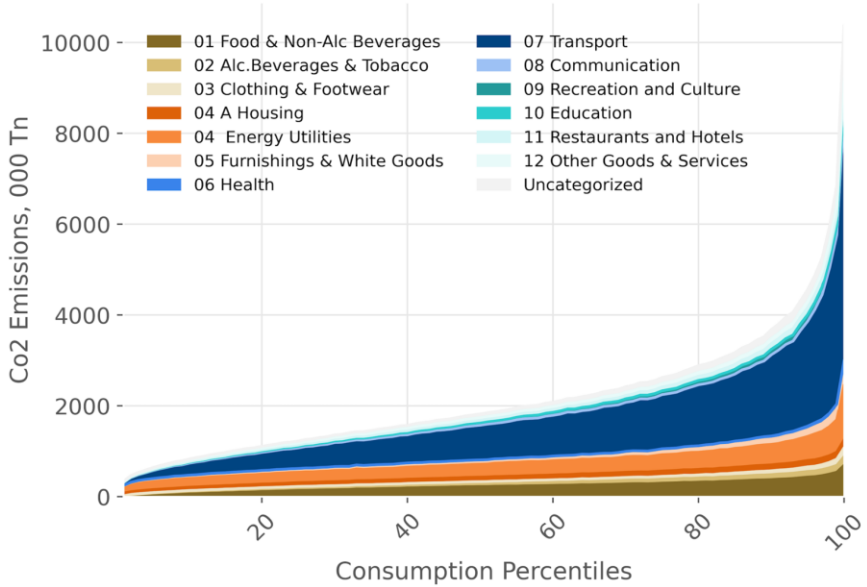
The potential for Smart Policies

Distribution of CO2 Emissions: Important role of Transport and Energy Utilities but in the opposite tails of the consumer distribution

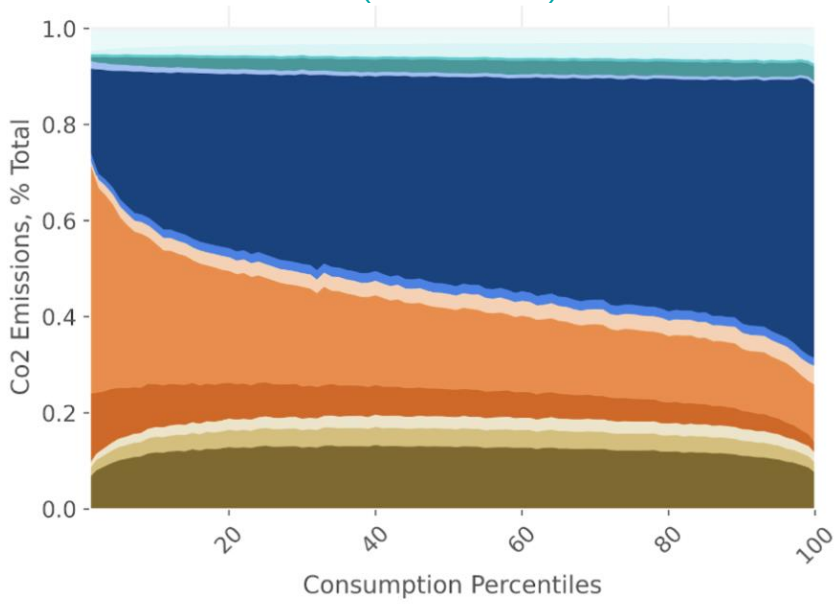
SPAIN: CO2 EMISSIONS 2021: LEVELS AND SHARE (%)

(CO2 EMISSIONS BY CONSUMPTION CATEGORIES AND PERCENTILES OF CONSUMPTION)

LEVELS (THOUSANDS TONS)



SHARE (% OF TOTAL)



Source: BBVA Research, Buda et al. (2022) & INE.

CO2 Emissions Inequality is high in line with consumption but lower than income

The top 10% percentile of consumers account for 25% of Co2 Emissions…

…and emit 8.5X times more Co2 than the bottom 10%...

…The top 10% generates 16.5X more emissions in transport than the bottom 10%...

…The top 1% consumers emit 30.X times more than the bottom 10%

SPAIN: CO2 EMISSIONS 2021 INEQUALITY RATIOS

	CO2	Methane	CO_Direct	CO_Indirect	Coicop 1	Coicop 2	Coicop 3	Coicop 4	Coicop 5	Coicop 6	Coicop 7	Coicop 8	Coicop 9	Coicop 10	Coicop 11	Coicop 12	Coicop 13
Emissions (000Tn)	215401	32430	66311	149089	23243	6761	4955	10104	33043	6577	3896	94744	1547	6471	323	6199	7176
Average per Household (kg)	114.9	17.29	35	79	12.4	3.6	2.6	5.4	17.6	3.5	2.1	50.5	0.8	3.5	0.2	3.3	3.8
Average Per person (kg)	45.5	6.9	14	31	4.9	1.4	1.0	2.1	7.0	1.4	0.8	20.0	0.3	1.4	0.1	1.3	1.5
% Total Emissions of Gas	100.0%	100.0%	30.8%	69.2%	10.8%	3.1%	2.3%	4.7%	15.3%	3.1%	1.8%	44.0%	0.7%	3.0%	0.1%	2.9%	3.3%
Gini Coefficient	0.32	0.29	0.34	0.31	0.27	0.27	0.32	0.13	0.17	0.36	0.31	0.39	0.21	0.35	0.47	0.41	0.30
Top 1%	4.8%	3.8%	5.3%	4.6%	3.0%	2.8%	4.0%	1.7%	3.6%	5.8%	4.1%	5.8%	3.5%	5.1%	7.6%	5.2%	5.9%
Top 5%	15.4%	12.9%	16.9%	14.8%	11.3%	10.9%	13.6%	7.5%	11.2%	17.6%	13.8%	18.5%	11.6%	15.5%	22.4%	17.0%	16.4%
Top 10%	25.0%	22.0%	26.9%	24.2%	20.0%	19.5%	23.0%	14.2%	18.7%	27.8%	23.3%	29.2%	19.6%	25.3%	34.2%	28.2%	25.5%
Mid 40%	46.9%	48.3%	46.4%	47.1%	49.3%	49.8%	49.4%	45.1%	42.6%	46.9%	48.5%	47.5%	44.8%	48.9%	47.2%	50.4%	44.4%
Bottom 50%	28.0%	29.7%	26.6%	28.7%	30.8%	30.7%	27.6%	40.6%	38.7%	25.3%	28.2%	23.3%	35.7%	25.7%	18.6%	21.5%	30.1%
p90/p10	8.53	7.78	9.68	8.06	7.62	7.73	10.56	2.24	2.87	13.12	9.92	16.56	3.80	12.68	30.73	21.60	6.74
p90/p50	0.89	0.74	1.01	0.84	0.65	0.64	0.83	0.35	0.48	1.10	0.83	1.25	0.55	0.99	1.84	1.31	0.85
p10/50	0.10	0.09	0.10	0.10	0.09	0.08	0.08	0.16	0.17	0.08	0.08	0.08	0.14	0.08	0.06	0.06	0.13
p75/25	5.22	5.35	5.32	5.18	5.50	5.64	6.00	3.75	3.55	5.85	5.69	6.47	4.05	6.22	7.80	7.67	4.54

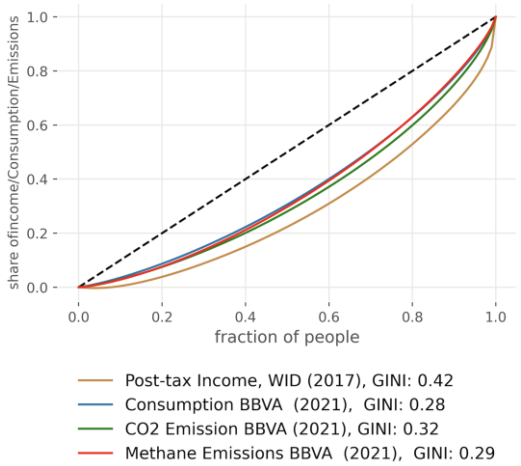
Coicop1: Food & Beverages. Coicop2: Alcohol and Tobacco. Coicop3: Textile & FootWear.Coicop4: Housing. Coicop5: Housing Energy Utilities. Coicop6: Furnishing & Maintenance. Coicop7: Health. Coicop8: Transport. Coicop9: Communications. Coicop 10:Recreation and Culture. Coicop11:Education. Coicop 12: Restaurant & Hotels Coicop13: Other good and services

Source: BBVA Research, Buda et al. (2022) & INE.

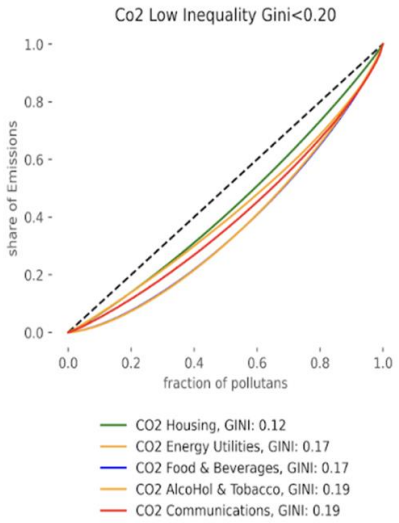
Inside the Carbon Footprint: Different Inequality Degrees by Emission Categories

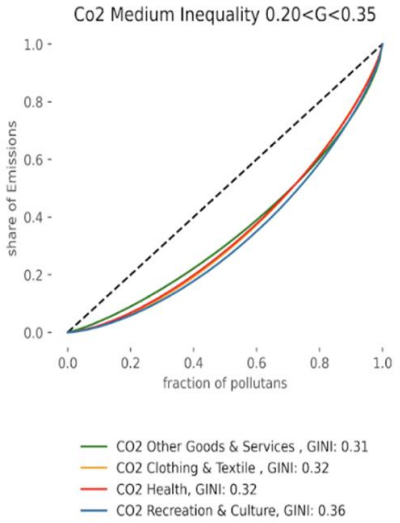
SPAIN: CO2 EMISSIONS 2021 INEQUALITY: GINI COEFFICIENTS & LORENZ CURVES

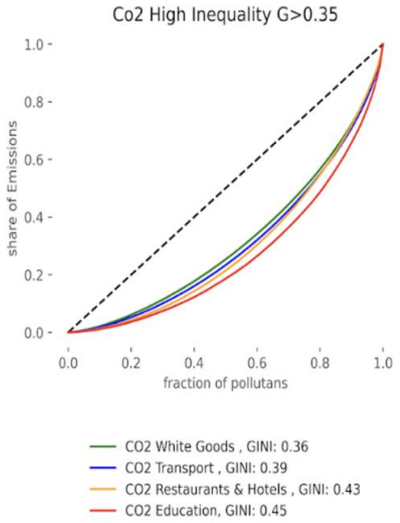
AGGREGATES



INDIVIDUAL CATEGORIES





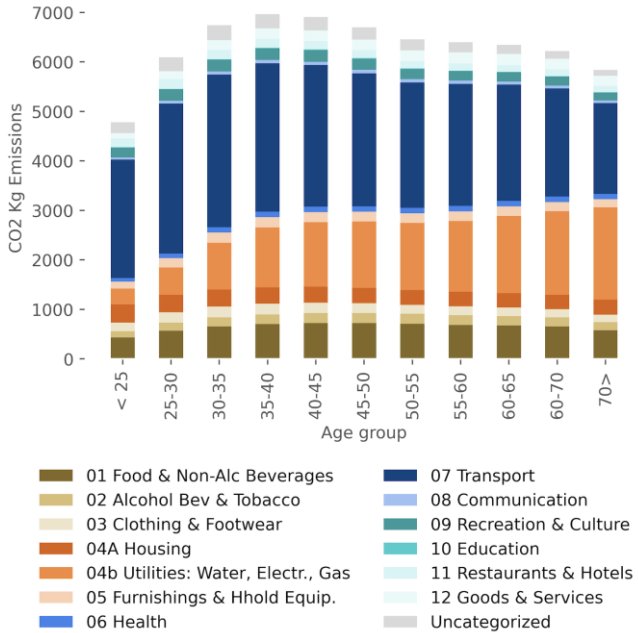


Source: BBVA Research, Buda et al. (2022) & INE.

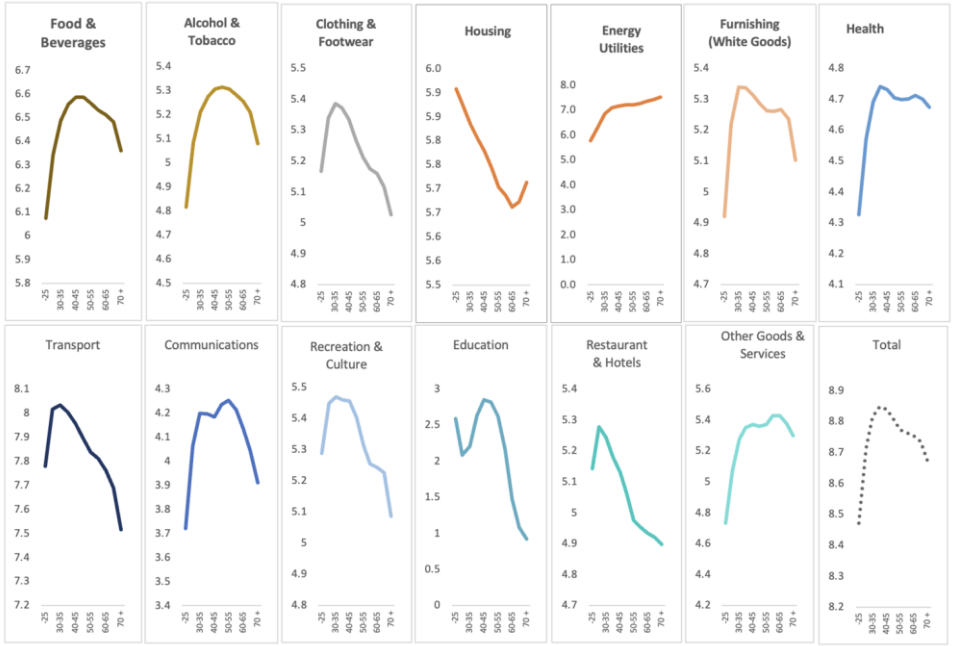
CO2 Emissions by Age & Category: Inverted "U" shape with differences

SPAIN: AVERAGE CO2 EMISSIONS BY CATEGORIES & AGE 2017*

(CO2 EMISSIONS IN 2017 IN KG IN THE FIRST GRAPH. INDIVIDUAL CO2 EMISSIONS BY INDIVIDUAL CONSUMPTION CATEGORIES IN LOGS IN THE SECOND)



Source: BBVA Research, Buda et al. (2022).

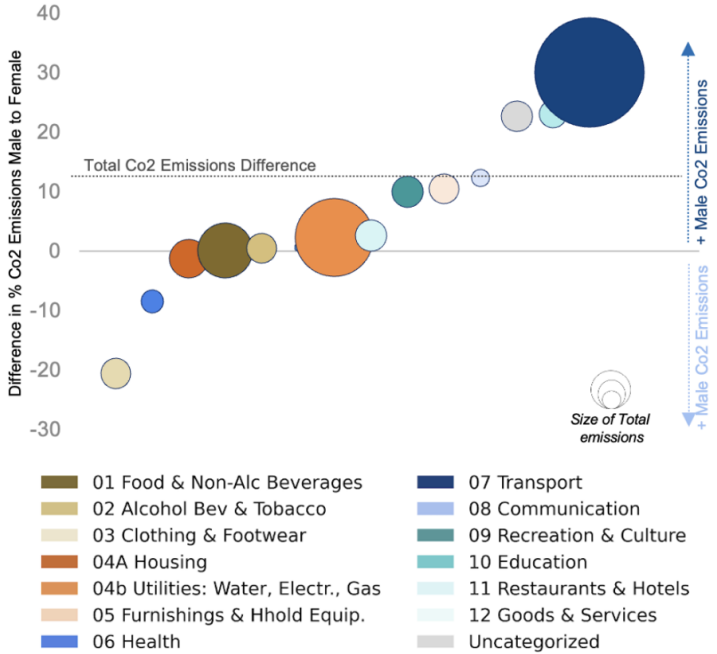


Source: BBVA Research, Buda et al. (2022).

CO2 Emissions Gender Inequality: Males are more pollutants mainly through a more intensive use of transport

GENDER INEQUALITY: DIFFERENCE IN CO2 EMISSIONS

(CO2 EMISSIONS DIFFERENCES MALE – FEMALE IN %)



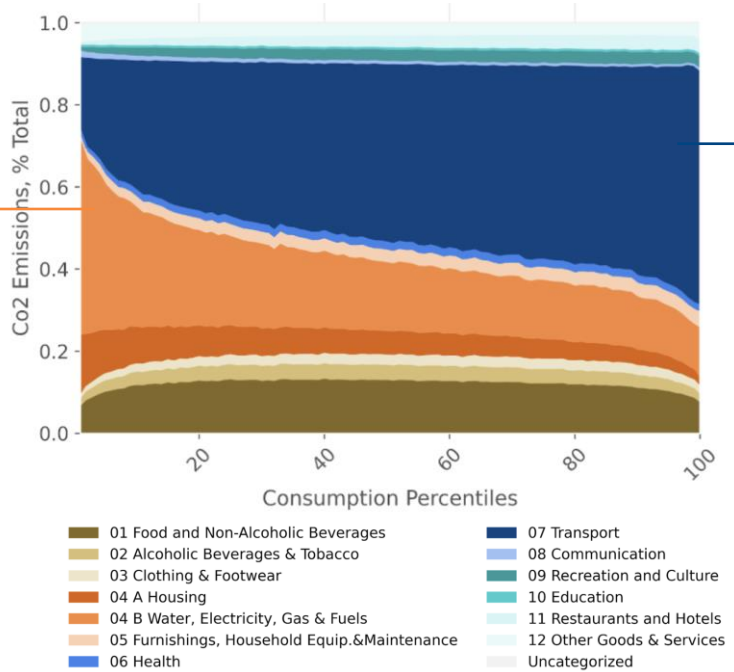
Source: BBVA Research, Buda et al. (2022).

Sm@rt Policies: Targeting Policies where more needed & efficient

SPAIN: AVERAGE CO2 EMISSIONS DISTRIBUTION

(CO2 EMISSIONS BY CATEGORIES & PERCENTILES OF CONSUMPTION)

Low Consumption Percentiles concentrate a larger share of their emissions in Energy utilities



High Consumption Percentiles concentrate 60% of their emissions in transport

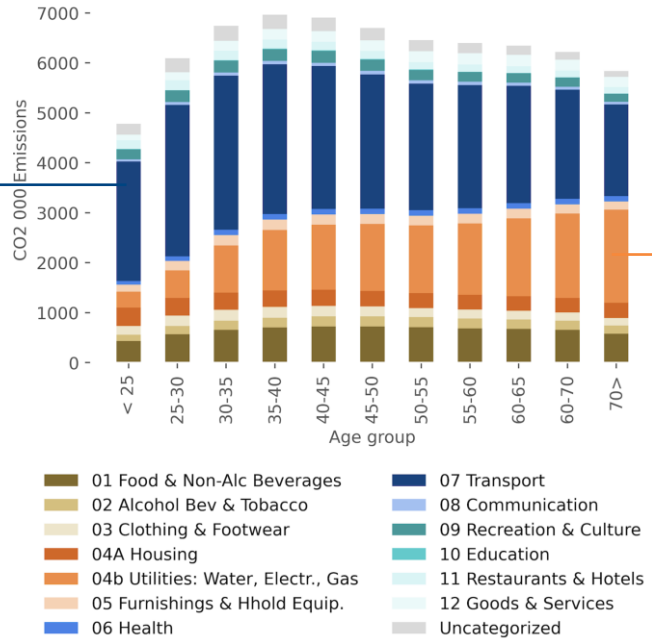
Source: BBVA Research, Buda et al. (2022) & INE.

Sm@rt Policies (II): Addressing Policies where more needed & efficient

CO2 AVERAGE EMISSIONS DISTRIBUTION BY AGE & CATEGORY

(CO2 EMISSIONS BY CATEGORIES & PERCENTILES OF CONSUMPTION)

Emissions from Transport Consumption concentrated in Younger Cohorts



Older People Concentrating Emissions from Energy Utilities

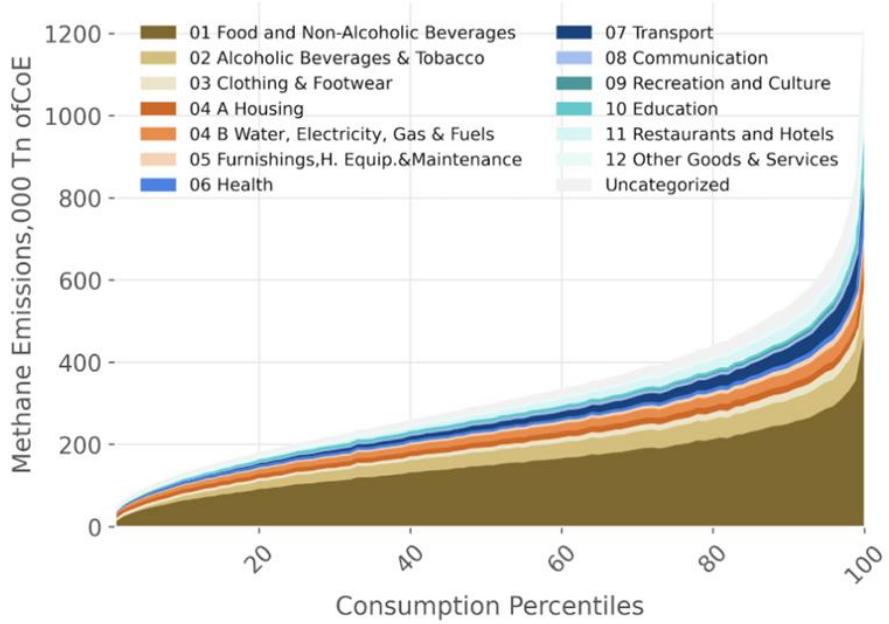
Source: BBVA Research, Buda et al. (2022) & INE.

Are all Gases Alike?: Not Really

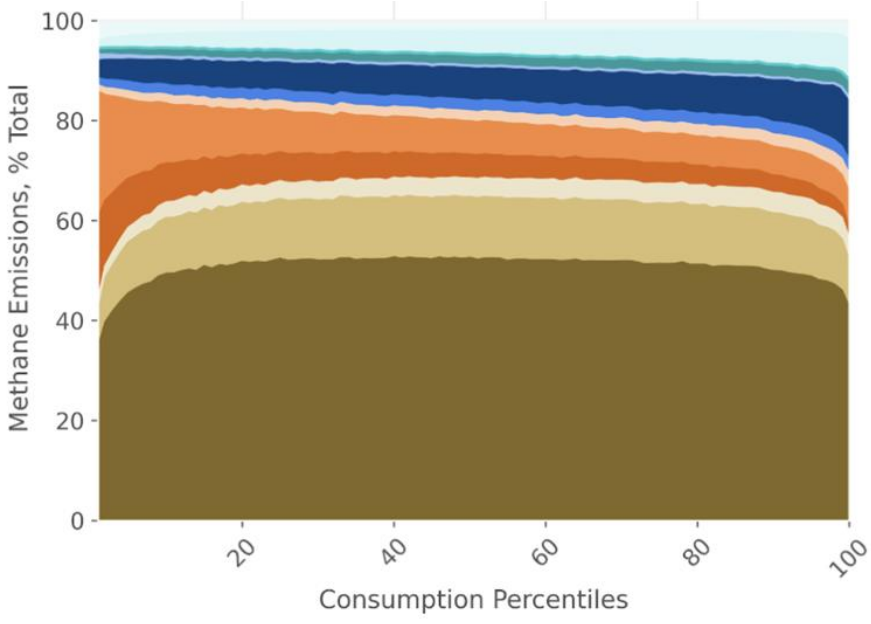
SPAIN: METHANE EMISSIONS 2021: LEVELS AND SHARE (%)

(CH4 MISSIONS BY CONSUMPTION CATEGORIES AND PERCENTILES OF CONSUMPTION)

LEVELS (MILLION OF CO2 EQUIVALENT TONS)



SHARE (% OF TOTAL)



Source: BBVA Research, Buda et al. (2022) & INE.

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02

Conclusions

Conclusions

- The combination of Input-Output Models and Big Data allows us to analyze the Sustainability of Households in high detail.
- We estimate Indirect emissions (70% of total) in real time time and high definition, while we take the direct ones consistent with official data.
- High inequality exists in CO2 emissions resulting from our income, preferences, lifestyles … affecting our consumption.
- The inequality is mainly the result of the CO2 emissions by transport which are concentrated in the highest consumption percentiles and younger people.
- The role of Energy Utilities is different: an important (but less than transport) source of emissions that is more relevant for low consumers and older people.
- The Distributional accounts and Real time components of this approach open the door for the design of Smart Policies to better fight climate change.

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Creating Opportunities

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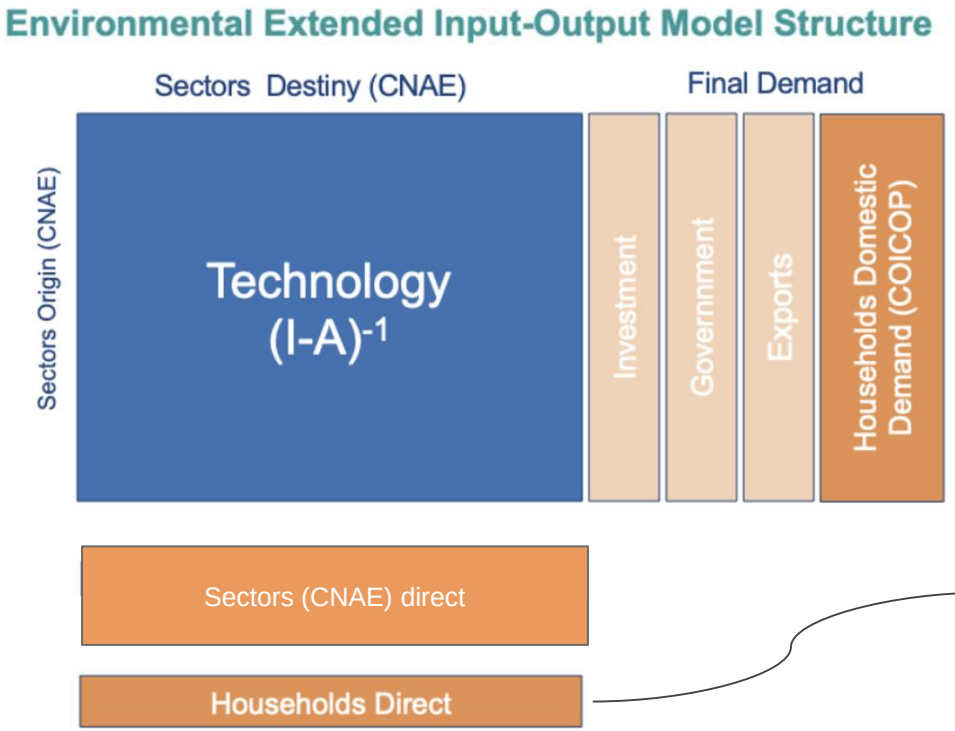
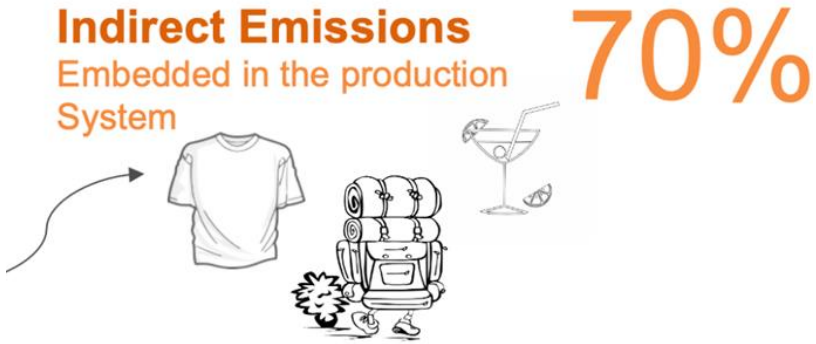
03

Appendix

Input-Output Models are used to construct the carbon footprint





What are we doing?

Estimating the CO2 emission footprint of the Spanish households by consumption level and in "real time"… Combining official data, Input-Output analysis, and Big Data granularity

HOUSEHOLD CARBON FOOTPRINT

Direct emissions + indirect emissions

OFFICIAL DATA | **OFFICIAL DATA + INPUT-OUTPUT ANALYSIS**

Distributional & Real Time Emissions (Real Time & High-Definition Enissions)

BBVA RICH DATABASE DERIVED FROM FINANCIAL TRANSACTIONS