

Sustainability in urban vs. rural areas: a comparison of subjective and objective indicators across European countries

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BACKGROUND
AND
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QUESTIONS

DEFINITIONS,
DATA SOURCES
AND METHODS

SUBJECTIVE
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CONCLUDING
REMARKS

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BACKGROUND AND RESEARCH QUESTION



2030 Agenda
for Sustainable
Development
(UN, 2015)

Subjective
indicators of
environmental
impact of cities

Research
questions

2030 Agenda for Sustainable Development

Goal 11: Make cities and human settlements inclusive, safe, resilient and sustainable

Target 11.6

By 2030, reduce the adverse per capita environmental impact of cities, by paying special attention to **air quality** and municipal and other waste management

Indicator 11.6.2

Annual mean **levels of fine particulate matter** (PM_{2.5} and PM₁₀) in cities

Subjective indicators of environmental impact of cities (EIC)

The sensitivity to exposure to environmental risk may differ among individuals

We can expect that subjective indicators give a somewhat different picture of urban sustainability than objective measures. Some studies in the domain of overall quality of life and urban quality of life suggest that objective indicators are weak predictors of satisfaction in related life domains (Cummins, 2000; McCrea et al., 2006).

Certainly, objective and subjective indicators have different implications on health, wellbeing and social exclusion.

We intend to combine and compare both kinds of information with the aim of increasing usefulness for policy making

Research questions

1.

How can we measure the perception of environmental impact of cities?
How can we compare it with an objective measure?

2.

Does the ranking of European countries according to subjective and objective measures of environmental impact of cities differ?

3.

Are both measures associated with the same macroeconomic factors?
Is there a criterion to guide the researcher/policy maker to trust more one or the other measure?

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DEFINITIONS, DATA SOURCES AND METHODS

Subjective
indicator

Objective
indicator

1) Household level perception (data and methods)

Data source: European Union Statistics on Income and Living Conditions (EU-SILC), 2013
Final sample size: 184,876 households living in 26 European countries

The EU-SILC questionnaire investigates whether or not the respondent feels pollution to be a problem for the household (HS180 variable, binary Y variable, 0/1).

By appropriately modelling it as a dependent variable, we are interested in assessing the impact of the degree of urbanisation (DB100, key X variable) on the probability to feel exposed to air pollution, when controlling for some relevant factors.

Degree of urbanisation: categorical regressor (large urban area/small urban area/rural area).

To our purposes, large urban areas are contrasted with rural areas.

2) Country level indicator of EIC

For every country, the subjective indicator comes from the computation of the Average Marginal Effect (AME) of the degree of urbanisation on $\text{Prob}(Y=1)$.

Therefore, for every country, the indicator shows the difference (averaged across all households) in the predicted probability to report environmental discomfort when living in a large urban area and when living in a rural area.

We find that in almost all countries, this difference is significantly different from zero, which means that households living in large urban areas perceive more negative environmental externalities than households living in rural areas.

More methodological details can be found in Chiarini et al. (2017), Housing Environmental Risk in Urban Areas: Cross Country Comparison and Policy Implications, CESifo Working Paper No. 6822

Control variables in the probit model

- Annual equivalised disposable household income
- Income from real and financial activities, as a % of total household income
- Inability to face unexpected expenses
- Tenure status
- Household size
- Presence of children in the household
- Age of the household reference person
- Education level of household reference person
- Work status of household reference person
- Happiness status
- Calmness status

Objective indicator: concentration of particulate matter (PM)

Sources of PM pollution can be both anthropogenic and natural.

Anthropogenic sources are known to produce more fine particles (PM_{2.5}) as a result of traffic emissions or combustion activities (usually more concentrated in urban areas).

Natural sources (that include soil dust and sea salt) are responsible for producing more PM₁₀ particles.

Our aim is to define an objective indicator that can stress the difference in measured air pollution in urban and rural environments.

Based on the population weighted annual means of PM_{2.5} and PM₁₀ (Source: European Environmental Agency, EEA), we have derived the ratio PM_{2.5}/PM₁₀.

Objective indicator: interpretation

High values of PM_{2.5}/PM₁₀ ratio signal that PM₁₀ mainly consists of fine particles whose major sources are combustion processes.

The exposure to these particles is especially critical in urban areas, due to the higher density of human activities

The PM_{2.5}/PM₁₀ ratio is frequently used in spatial and/or temporal analyses (Munir, 2017; Talbi et al., 2018)

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SUBJECTIVE VS. OBJECTIVE INDICATORS

Country
ranking

Relationship
with country-
level factors:
economic
conditions and
business cycle

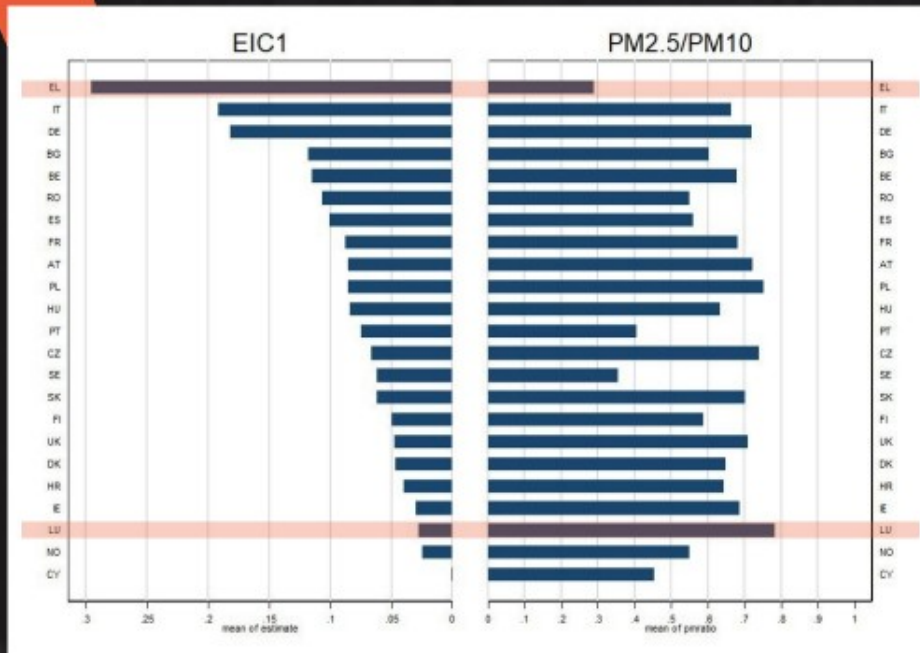
Both EIC indicators refer
to 2013.

Relationship
with country-
level factors:
income
inequality and
public debt

Country-level factors
are expressed as
averages in the period
2009-2012.

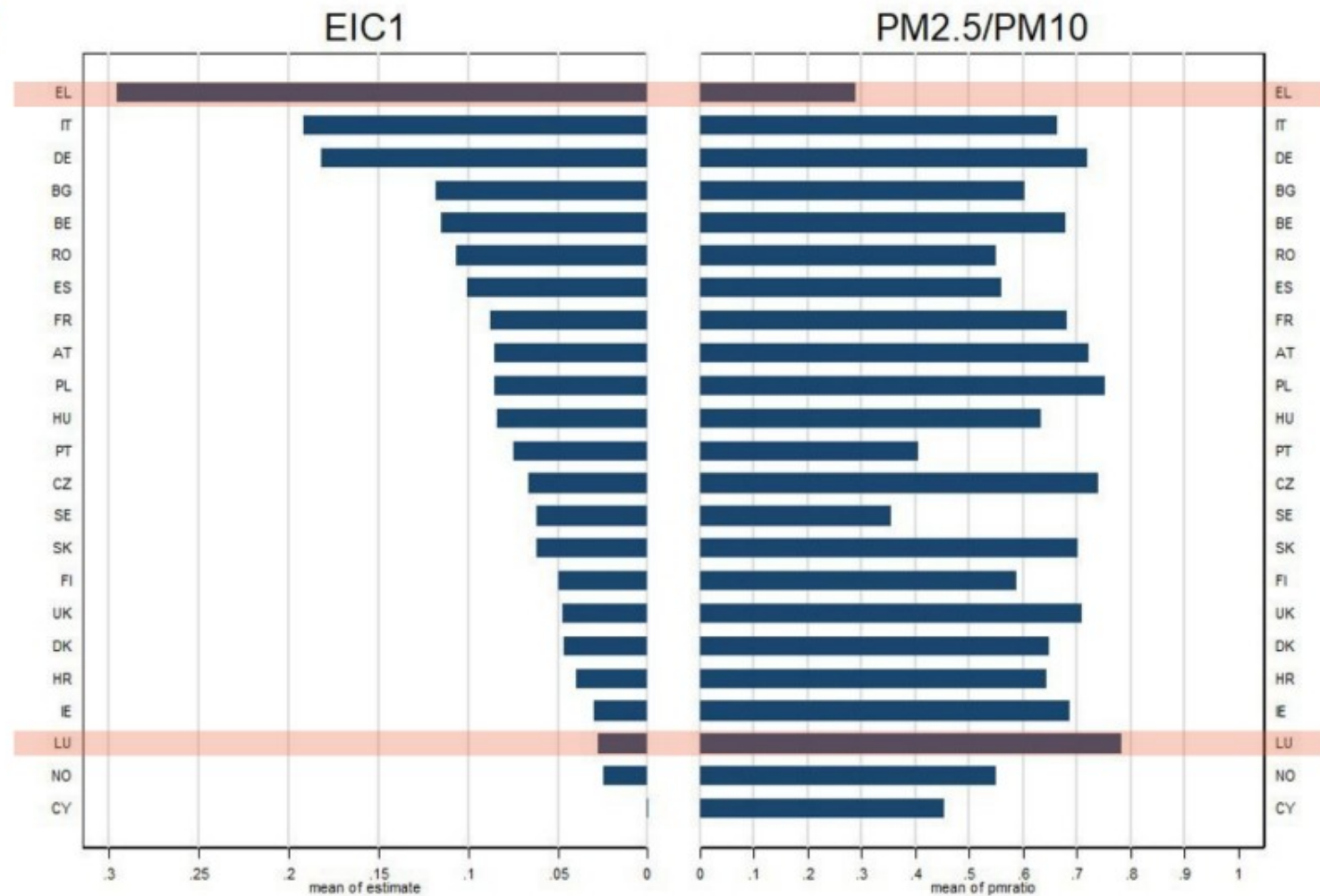
Relationship
with country-
level factors:
environmental
expenditures
and taxes

Country rankings according to subjective indicator (left panel) and objective indicator (right panel)

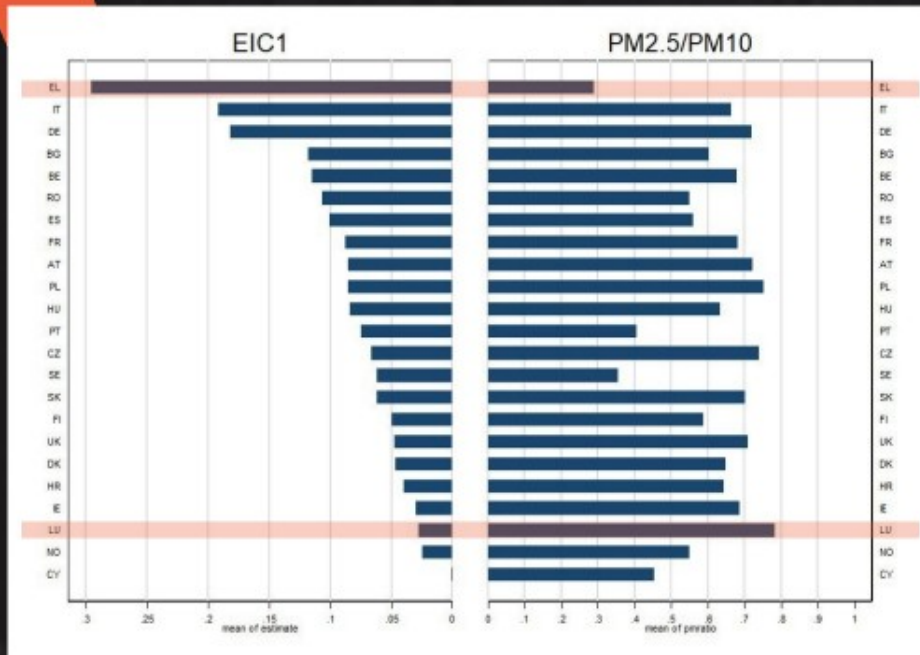


Objective indicator: relative contribution of cities to PM pollution

Country rankings



Country rankings according to subjective indicator (left panel) and objective indicator (right panel)



Objective indicator: relative contribution of cities to PM pollution

Country rankings

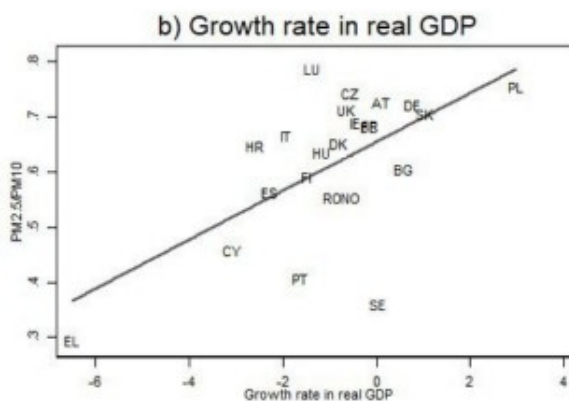
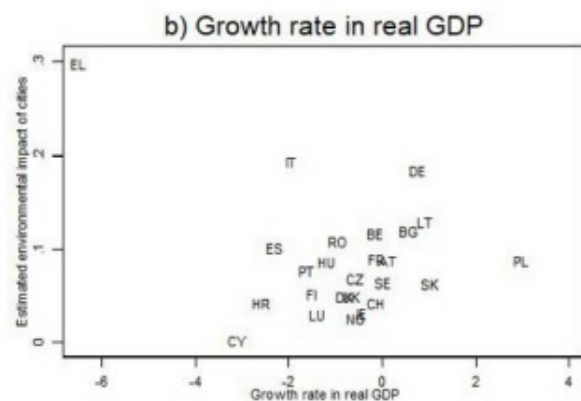
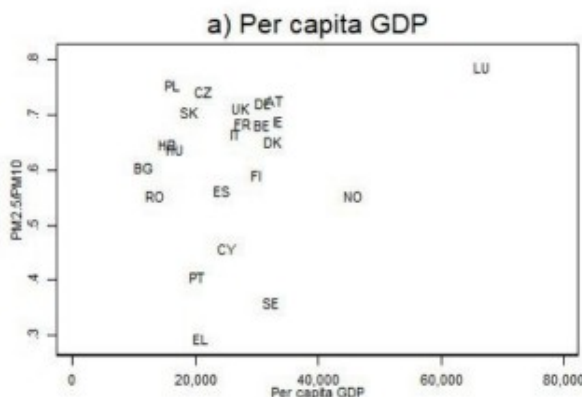
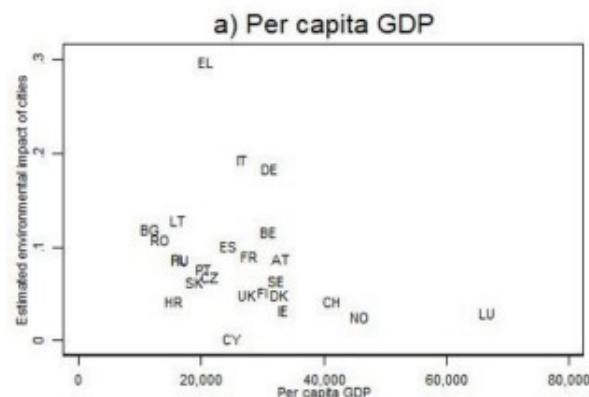
Country rankings

The two rankings do not show any association (Spearman coefficient = -0.06)

Possible explanations of the mismatch:

- population density and/or concentration of polluting activities in urban areas
- threshold of subjective acceptance of environmental pollution, that can be affected by:
 - institutional features; environment-related legislation; cultural and psychological aspects

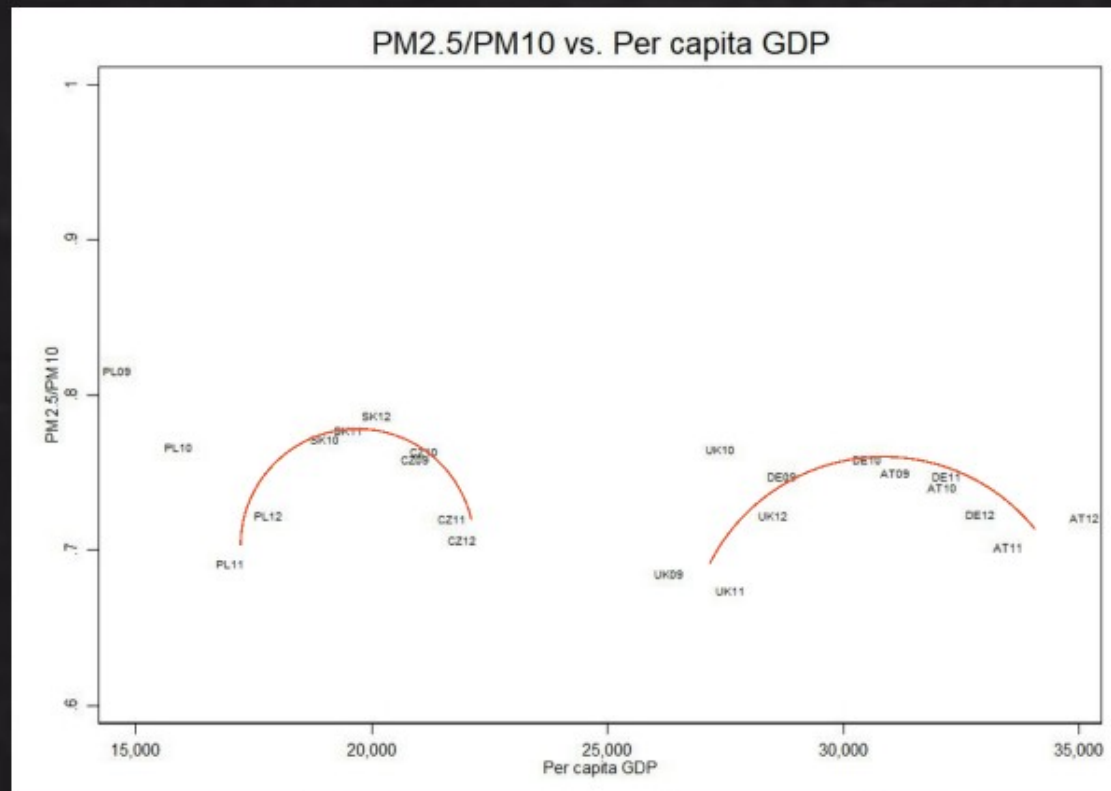
Per capita GDP and growth rate in real GDP



No significant association between economic conditions (either per capita GDP or growth rate) and **subjective** indicator (left panel). Some evidence of a positive correlation between growth rate and **objective** indicator (bottom right panel)

Objective indicator vs. per capita GDP over time.

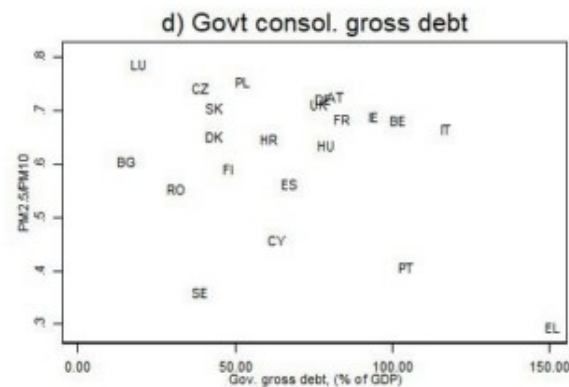
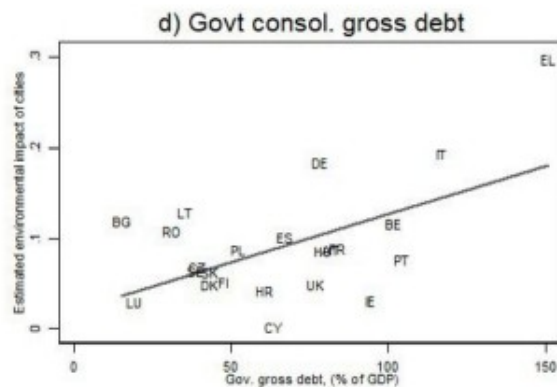
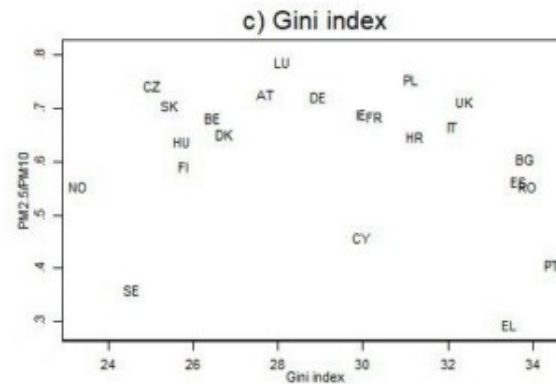
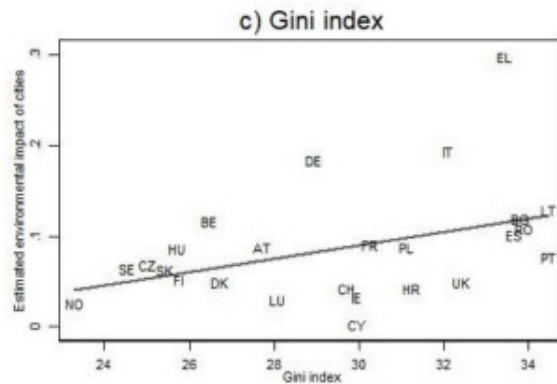
Selected countries with the highest PM2.5/PM10 values



Panel data of **objective** indicator vs. per capita GDP suggest the possible existence of Environmental Kuznets Curve(s)

Different clusters of countries have different EKC. Lower income countries are located on the left curve. Higher income countries are on the right curve

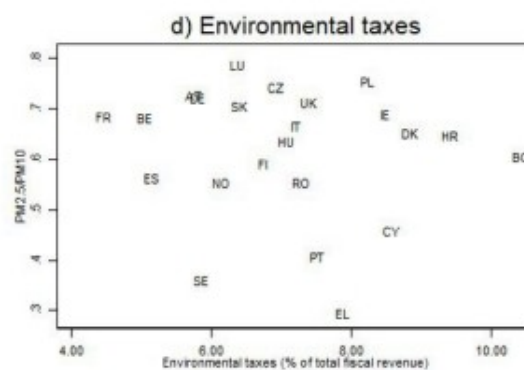
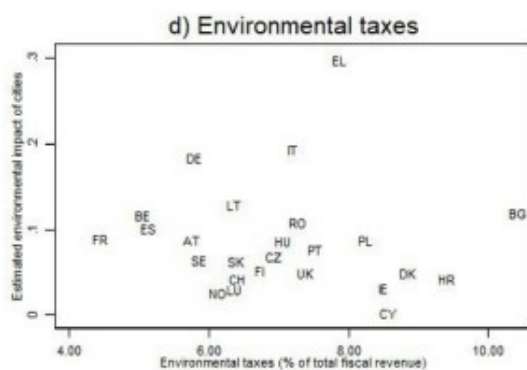
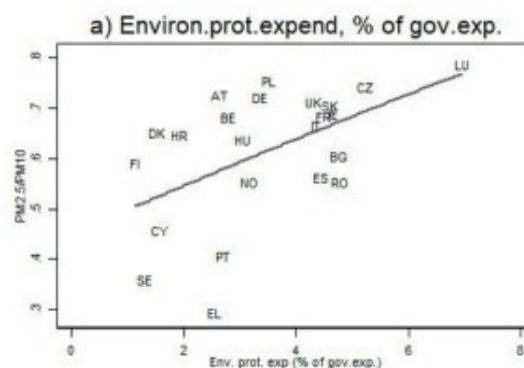
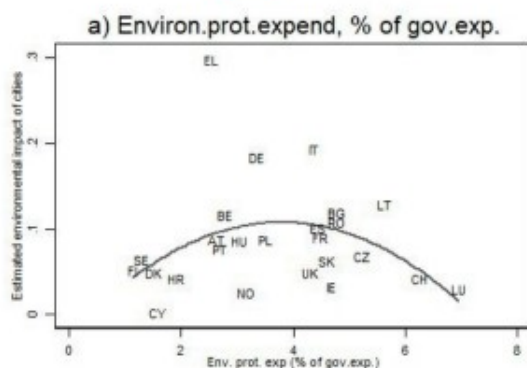
Income inequality and public debt



Only the subjective indicator (left panel) appears to be linearly associated with Gini index and with public debt.

No apparent relationship is found with the objective indicator (right panel)

Environmental expenditures and environmental taxes



Public spending for environment does matter for improving the perception of urban sustainability (subjective indicator, top left panel) only when it reaches a threshold. A linear relationship is observed between public expenditure and objective indicator (top right panel). No apparent association with environmental taxes

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An aerial photograph of a city street at night. A white car is visible on the left side of the road. A large orange circle is superimposed over the center of the image, containing text. The background shows the grid-like pattern of city streets and buildings.

Concluding remark 1

Policies targeted to limit the emissions should account for:

- the "business cycle" dimension of air pollution [during upturns (downturns) pollution rises (shrinks)]
- the "wealth level" dimension of air pollution [different clusters of countries have different EKC]



Concluding remark 2

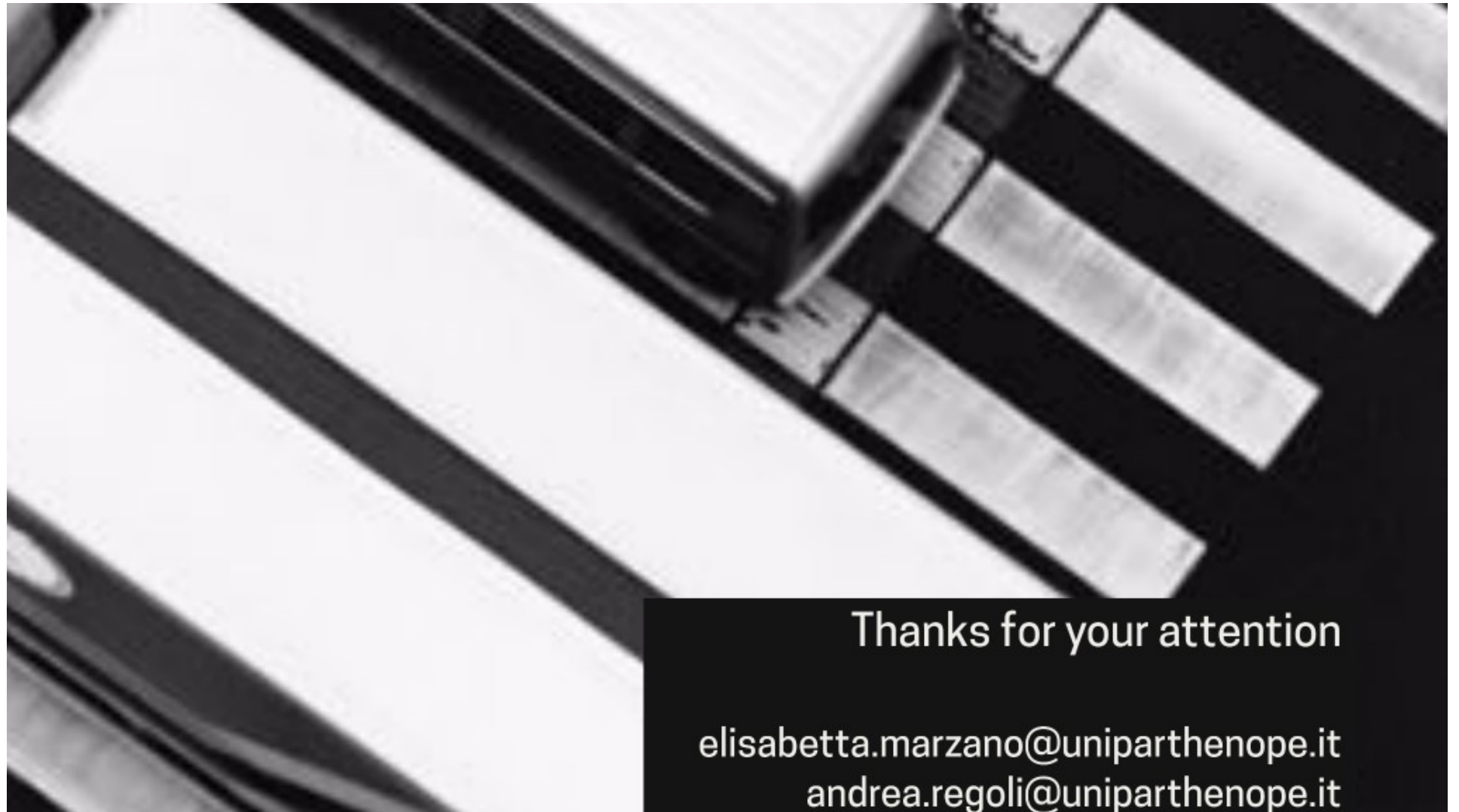
Urban planners and urban mobility managers can do a lot for a livable urban environment. The reduction in the concentration of pollutants is indeed the actual trend in many countries.

Nevertheless, due to the absence of association between the two kinds of indicators, an improvement in the concentration of emissions does not automatically entail an improvement in the perception of urban sustainability



Further developments

A longitudinal approach for both kinds of measures would allow to study the dynamics of the relationships by stressing the patterns of the countries towards urban sustainability



Thanks for your attention

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