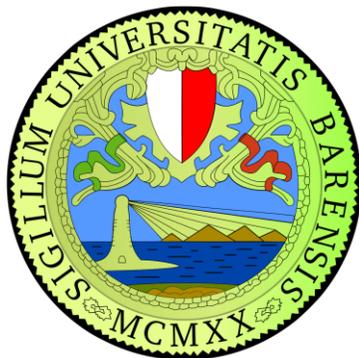


Disentangling the relationship between green spaces and citizens' perceptions in Europe: the mediating effect of quality of life and role of per capita Gross Domestic Product

Giannico Vincenzo, Giovanni Sanesi, Spano G, Elia M, D'este M, Laforteza R



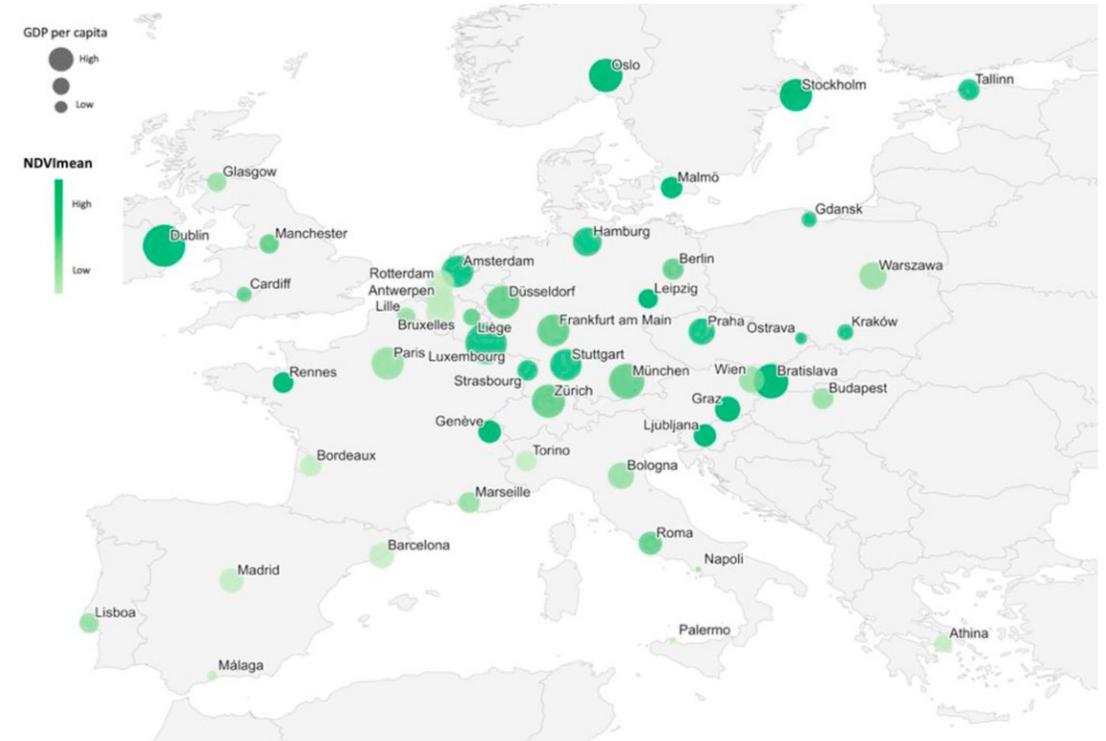
Introduction: Cities are changing

- Urban green spaces contribute to mitigate changes ameliorating human health and well-being **directly** and **indirectly**
- There is strong evidence on how green spaces reduce the effects of the **urban heat island** and, consequentially, **energy consumption** (e.g., by reducing air conditioning usage)
- With the increase in frequency of heavy precipitations, a dense and extensive forest canopy cover can reduce the exposure of cities to **flooding** resulting in **cost reductions** for the population
- Urban forests act as **carbon sinks** and reduce air and noise **pollution** producing **short- and long-term health benefits** to residents
- Not less important is **how citizens perceive those benefits**
- Understand effects of urban green spaces in relation to human perceptions is of **great help for urban planners and policy makers.**



Introduction: From city to continent level

- The majority of factors underlying the perception of these benefits are **explored at city scale**
- In Europe **~75% of the population lives in an urban environment** with different levels of **climate conditions** and **socio-economic development**.
- **Cultural background** can play a role in how environmental features are perceived (e.g. biodiversity value)
- **New knowledge** conducting studies at **continent level**



Goals of the study

- Disentangle the relationship between urban green spaces, citizens' perceived quality of life, quality of the environment, social inclusion and urban management in a great number European cities
- Understanding the role of per capita gross domestic product (GDP) in moderating the effects of greenness on overall perceived quality of life.

Input Data

51 European Cities

Citizens' perceptions of
quality of life

Economic data

Greenness

Input Data

Citizens' perceptions of quality of life

Economic data

Greenness



- The Flash Eurobarometer 419: “Quality of life in European cities 2015”
- 500 citizens interviewed
- 83 European cities
- covers different aspects of the perceptions of citizens
 - city satisfaction (e.g., on public transport, health care and education),
 - management (e.g., housing and job availability, safety and trust in fellow citizens)
 - environment (e.g., air quality, noise level and availability of green spaces)
 - citizens' personal situation (i.e., quality of life, financial status, satisfaction with their housing and job).

Satisfaction with the quality of the air in EU capital cities

	Total 'Satisfied'
Wien	88%
Helsinki	88%
Dublin	88%
Luxembourg	83%
Stockholm	77%
Ljubljana	76%
Tallinn	75%
Berlin	71%
Amsterdam	70%
Vilnius	69%
Zagreb	69%
Kobenhavn	68%
Riga	67%
Lefkosia	65%
Praha	59%
London	57%
Bratislava	53%
Brussel/Bruxelles	51%
Warszawa	51%
Budapest	48%
Lisboa	47%
Valletta	35%
Roma	32%
Madrid	31%
Sofia	28%
Athina	27%
Paris	25%
Bucuresti	22%

Overall satisfaction to live in the city, in EU capital cities

	Total 'Agree'
Vilnius	98%
Kobenhavn	97%
Stockholm	97%
Luxembourg	96%
Wien	96%
Zagreb	94%
Amsterdam	94%
Dublin	93%
Warszawa	93%
Tallinn	92%
Ljubljana	92%
Valletta	91%
Praha	91%
Helsinki	91%
Berlin	91%
Budapest	90%
Bratislava	90%
London	90%
Riga	89%
Lefkosia	88%
Lisboa	88%
Brussel/Bruxelles	87%
Madrid	87%
Paris	87%
Sofia	86%
Bucuresti	83%
Roma	80%
Athina	67%

Input Data

Citizens'
perceptions of
quality of life

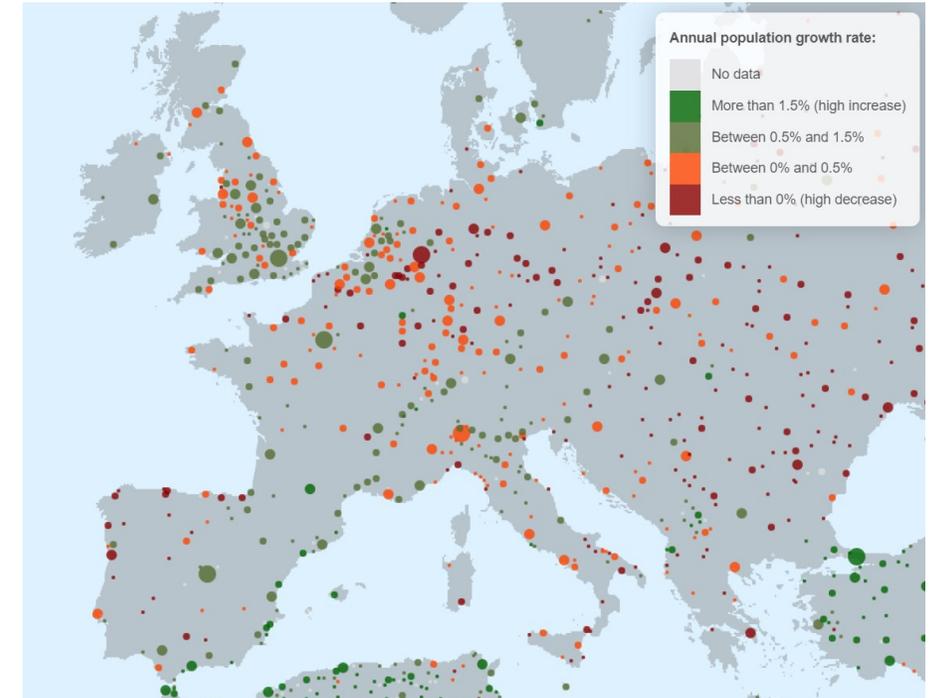
Economic data

Greenness



Regions and Cities Statistical Atlas

- OECD Regional Statistics database
- Over 700 cities around the world
 - Included from 150,000 to 800,000 inhabitants
- Demographic and economic data
- Retrieved directly from cities or spatialized based on Global Human Settlement (GHS) population grids



Input Data

Citizens' perceptions of quality of life

Economic data

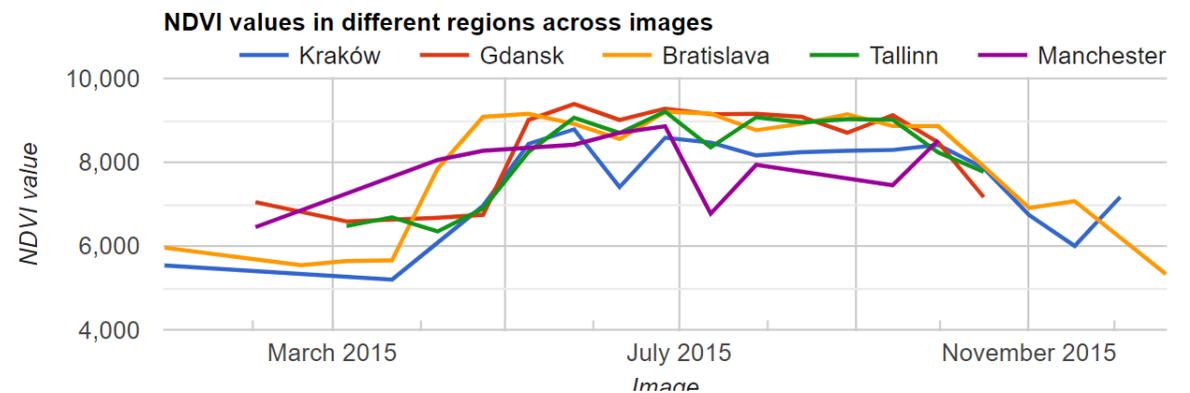
Greenness



- Landsat 8 data through Google earth engine
- Greenness calculated using 2015 images and calculating NDVI in each city

$$NDVI = \frac{b5 - b4}{b5 + b4}$$

- Growing seasons peak was obtained by taking the highest NDVI value for each pixel in the image time series
- Finally, for each city the mean Growing seasons peak NDVI was calculated

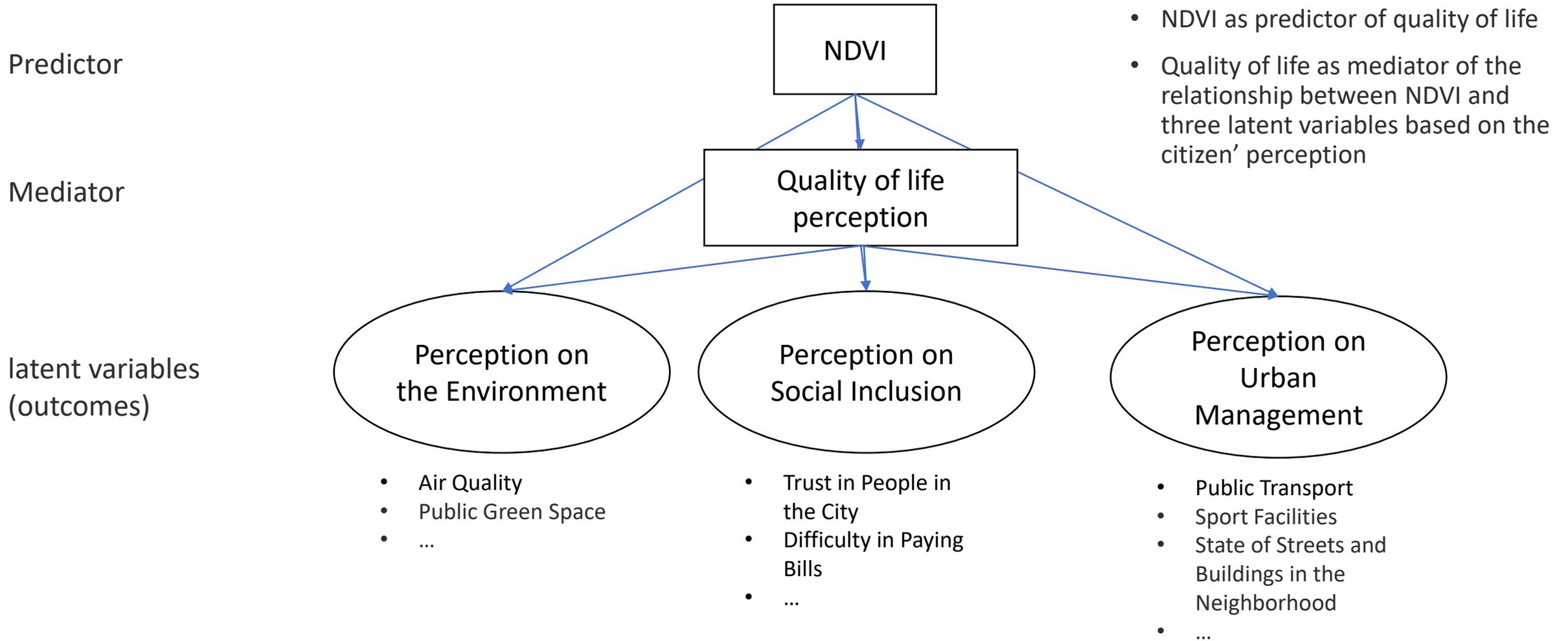


Structural equation modeling

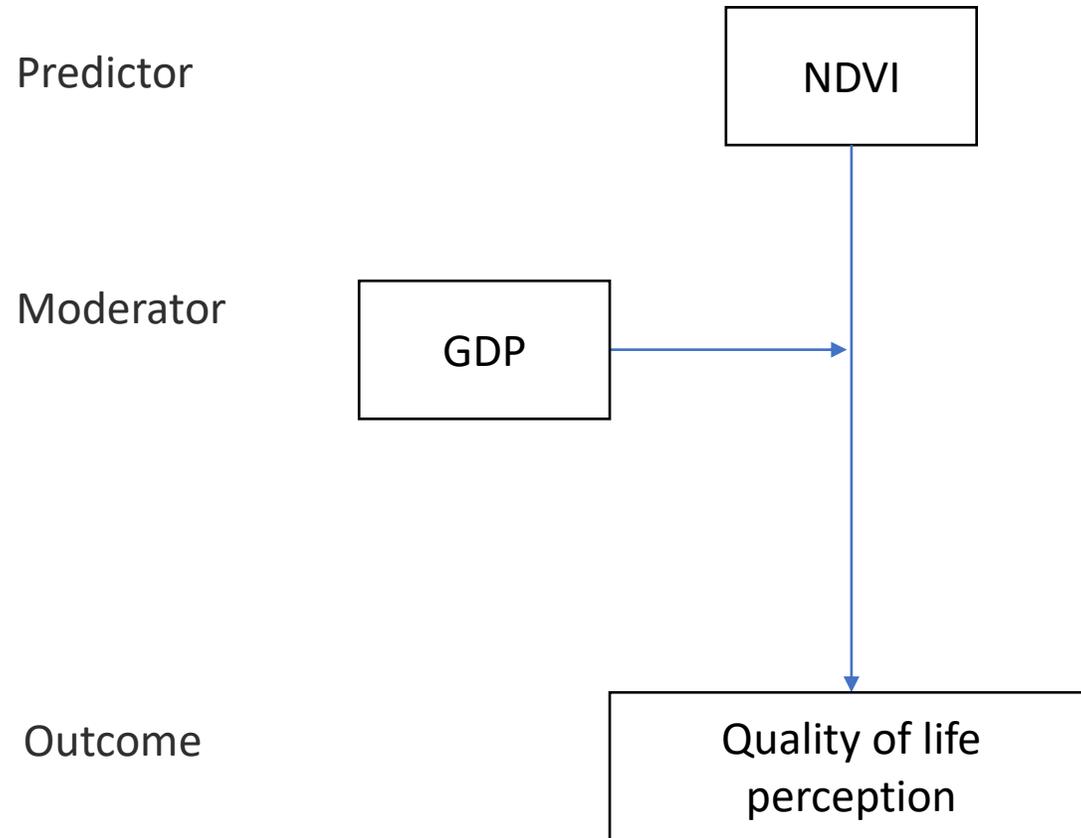
Advantages:

- Possibility to explore multiple relationships through a system of smaller simpler models
- Multipath relationship analysis using variables derived from a wide range of input datasets
- Measure of non directly observable variables (latent variables)

Structural equation modeling: Model 1

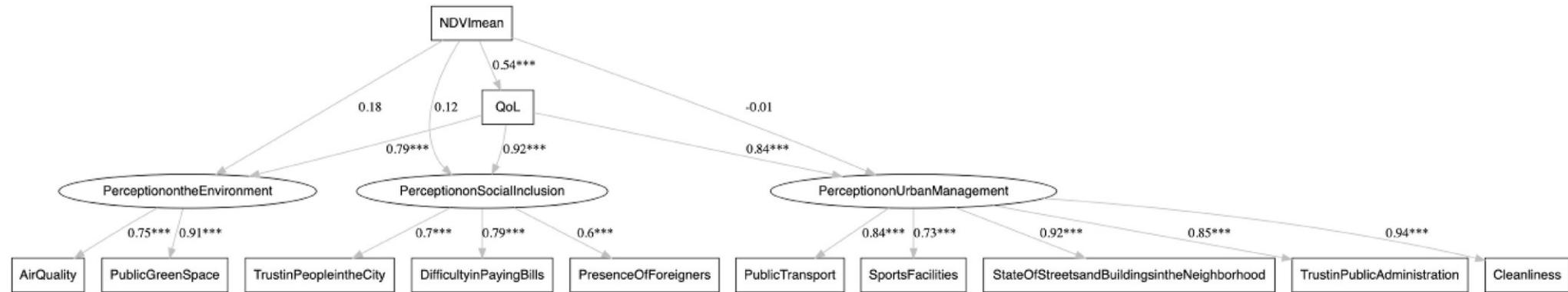


Structural equation modeling: Model 2



- GDP as moderator between NDVI and Quality of life perception was also tested

Results and discussion



- Quality of life act as a mediator of the relationship between greenness, measured through NDVI, and the three constructs of citizens' perceptions
- The direct effect between NDVI and the three constructs were not significant, even for perception of the environment
- Individuals tend to perceive increased quality of life without being necessarily aware and therefore recognize the driving factors

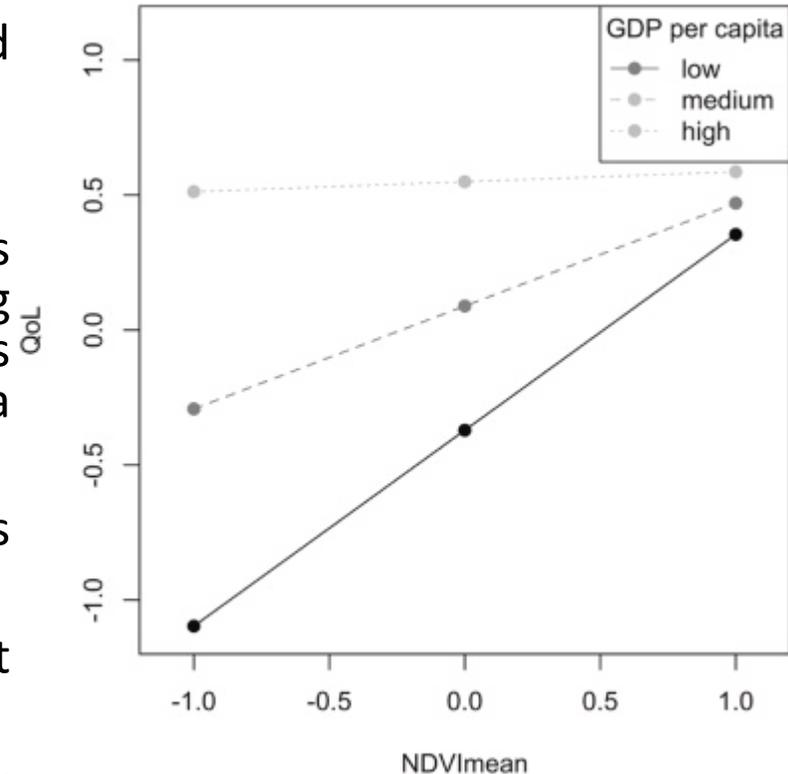
Results and discussion

- The moderator term **GDP was significant** and affected the relationship between greenness and Quality of Life

With slope analysis:

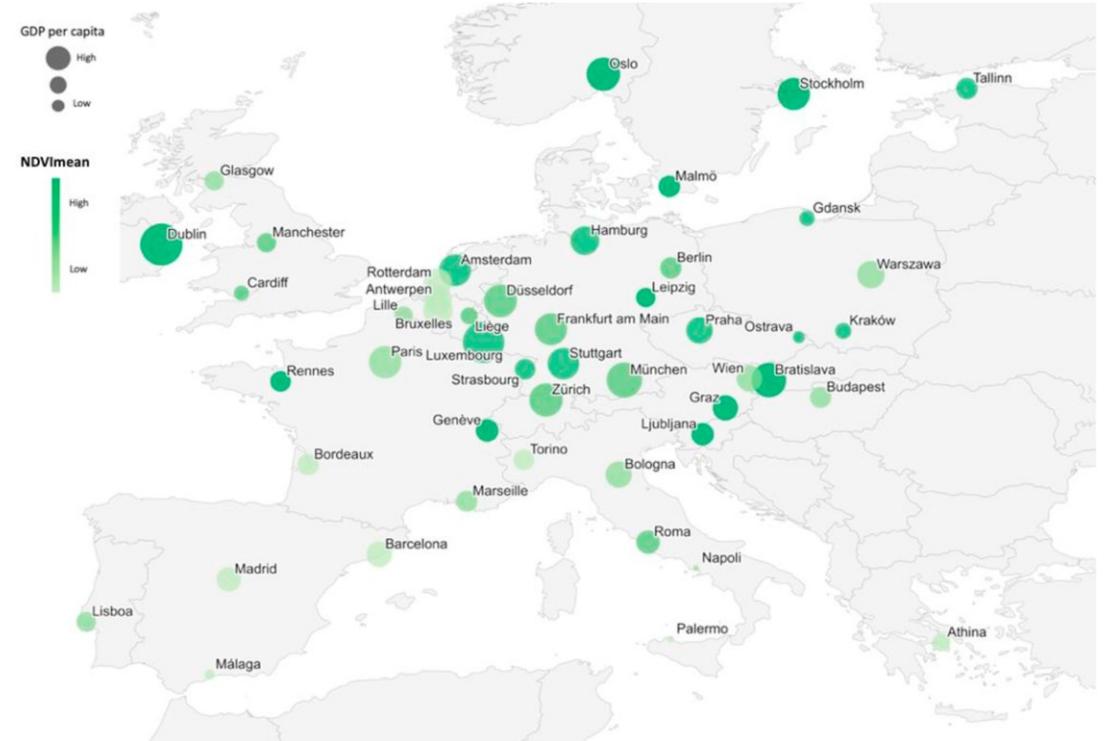
- For lower GDP per capita, the moderator term was significant and exhibited a steeper coefficient, meaning that an increase in green spaces in low-income cities allows the QoL perceived by citizens to rise at a substantially higher rate.
- For medium GDP per capita, the moderator term was significant although with a smaller coefficient
- For high GDP per capita, the moderator term was not significant

There is a tendency for low-income citizens to consider increments in environmental performance more valuable for overall well-being



Results and discussion

- In Europe, where GDP per capita is mainly distributed along a **latitudinal gradient** another reason for greenness (i.e., NDVI_{mean}) being more influential in lower-income cities can be found in **environmental and climatic factors**.
- Warmer and dryer biomes, such as those found in southern Europe, tend to have a greater benefit from green spaces, especially in terms of **heat mitigation**



Conclusion

- The overall **quality of life perceived by citizens is positively correlated with urban greenness**
- **Small increases in greenness** can substantially improve the life of individuals in cities with **lower per capita income**, which is extremely important from the environmental justice perspective.
- **Advances in computing power** and greater data availability gives us opportunities to **observe trends at continent level**
- At the institutional level, **European planners and policy makers** should be aware of these effects in order to define **large-scale plans** which, in turn, could be **fine-tuned at country and city level** based on needs

