Time and Space Matter: how urban transitions create inequality

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Outline

1. Urban forms are key in reducing greenhouse gas emissions

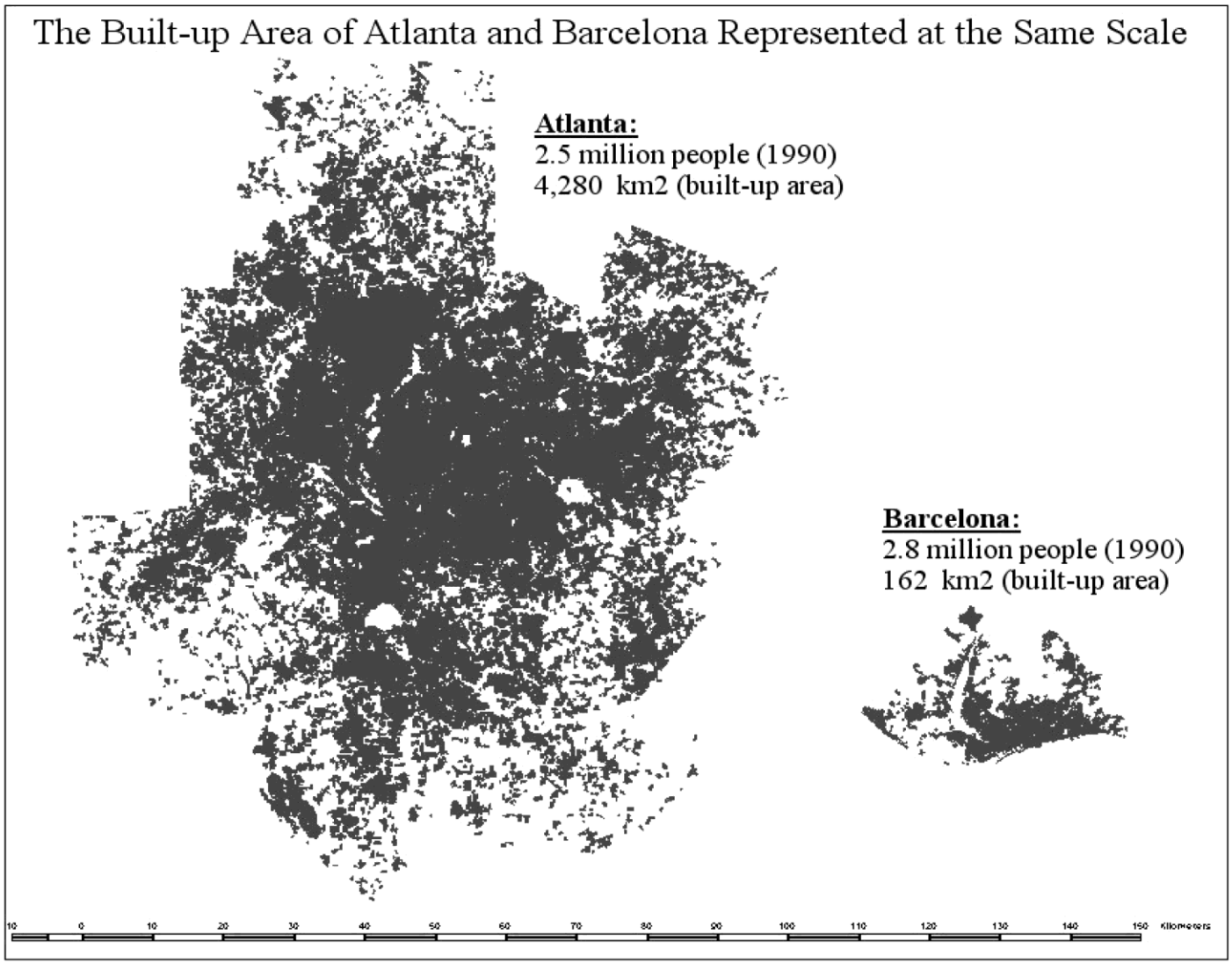
2. NEDUM: A dynamic model of city evolution that can assess spatial inequalities

3. Application of NEDUM to climate policies

4. Conclusions

1. Urban forms are key in reducing greenhouse gas emissions

Urban forms influence GHG emissions



Source: Alain Bertaud

Transport-related emissions per capita can be 50% lower in high-density areas than in low-density areas (Grazi et al., 2008).

GHG emissions can be reduced through city "densification".

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The role of transportation costs

- Households trade between:
  - on the one hand, larger dwellings and lower rent in remote areas and,
  - on the other hand, lower transportation costs and shorter commuting time when living close to the city center.
- As a consequence, cities are denser when transportation price is large and transportation speed is low.
- So, higher density can be achieved through higher transportation costs, but:
- Mean lifetime of a building in Paris: between 100 and 200 years.
- Mean lifetime of a building in the U.S.: about 50 years.
- Urban forms cannot be modified rapidly: current urban forms are the results of centuries of history.
- **Considering this inertia, what is the good strategy to increase city density and avoid urban sprawl?**

2. NEDUM: A dynamic model of city evolution

A Non-Equilibrium Dynamic Urban Model

- Our NEDUM model represents cities **out of equilibrium** with:
  - evolution of local rents modeled as a function of housing supply and demand;
  - household behaviors and choices in term of localization modeled as a function of rents and incomes;
  - represents investor behaviors in terms of building density, as a function of rent levels and interest rates;
  - includes a macroeconomic framework to take into account crowding-out effects between buildings and productive capital.

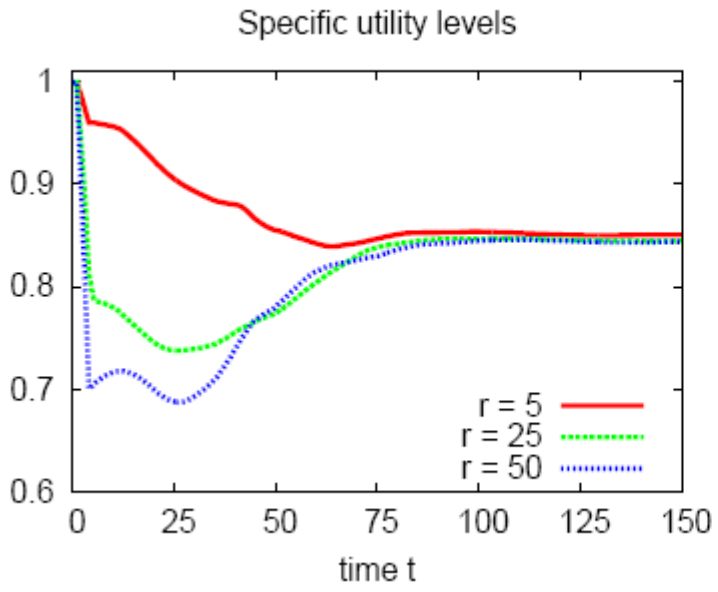
- Provides results in terms of housing density, dwelling surface, rents, transportation expenditures, and consumption of composite goods, as a function of localization in the city.

- Consequences in terms of aggregate welfare (average cost) and inequalities (measured with the Gini index).

Spatialized model and inequality

- **Response to an instantaneous doubling of transportation costs in a city where everybody has the same income.**

- The model provide welfare level at different locations. From this information, inequality measures can be derived.



When transportation costs increase, inhabitants living far from the city center are first hit more strongly than the others.
Then, adaptation processes (e.g., through rents) enter into action and equalize welfare levels.

3. Application to climate policies

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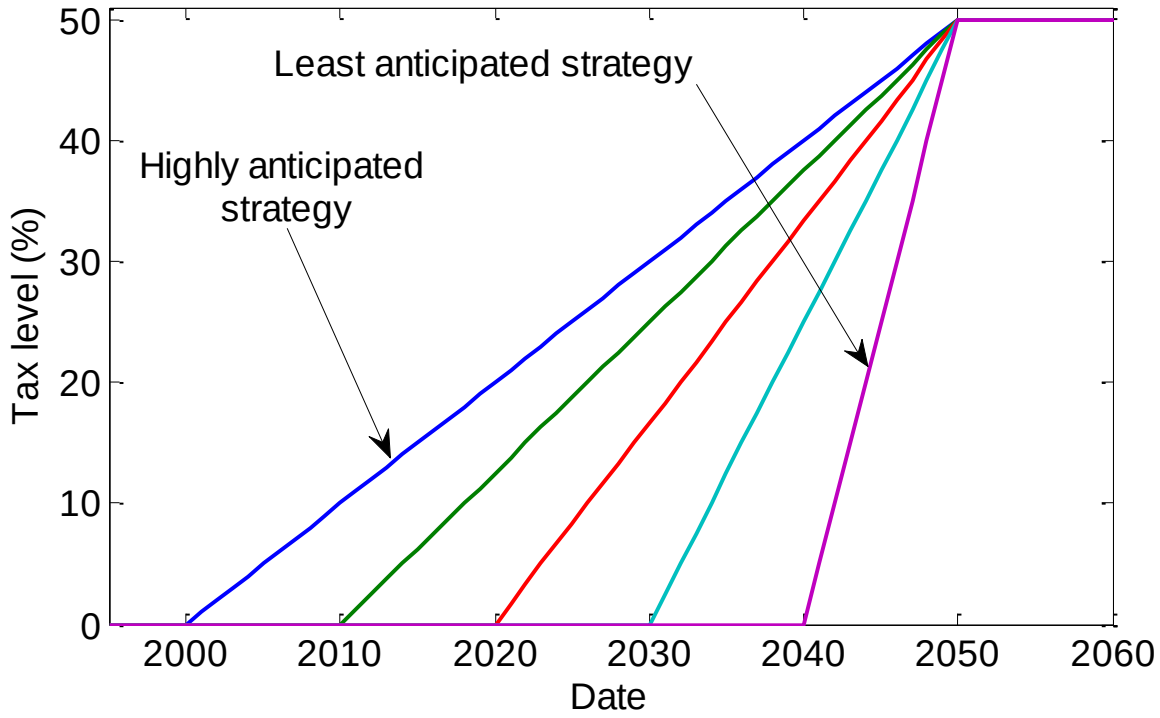
Application on a transportation tax

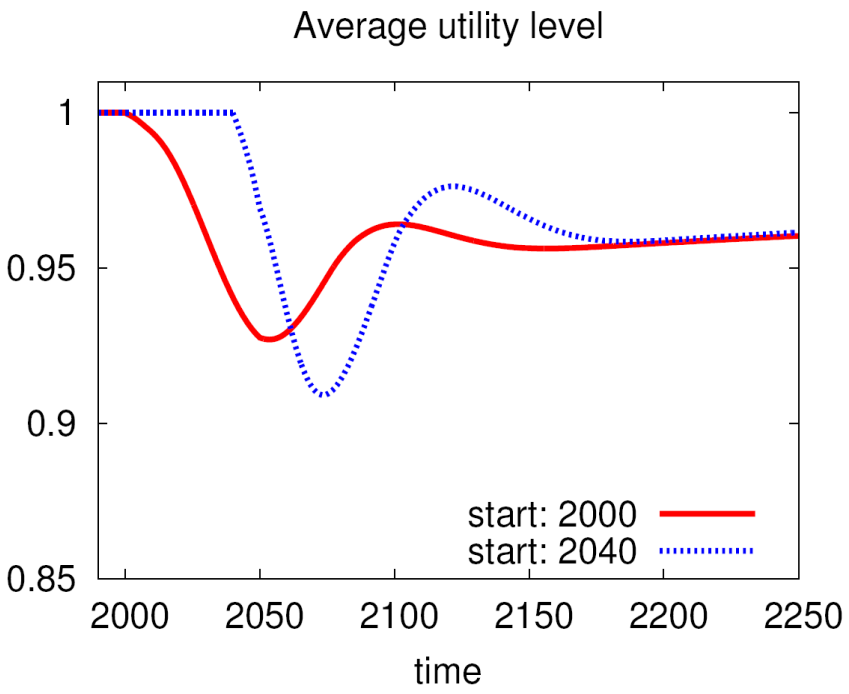
- An application on the progressive introduction of a per-km transportation tax that aims at favoring high-density development.

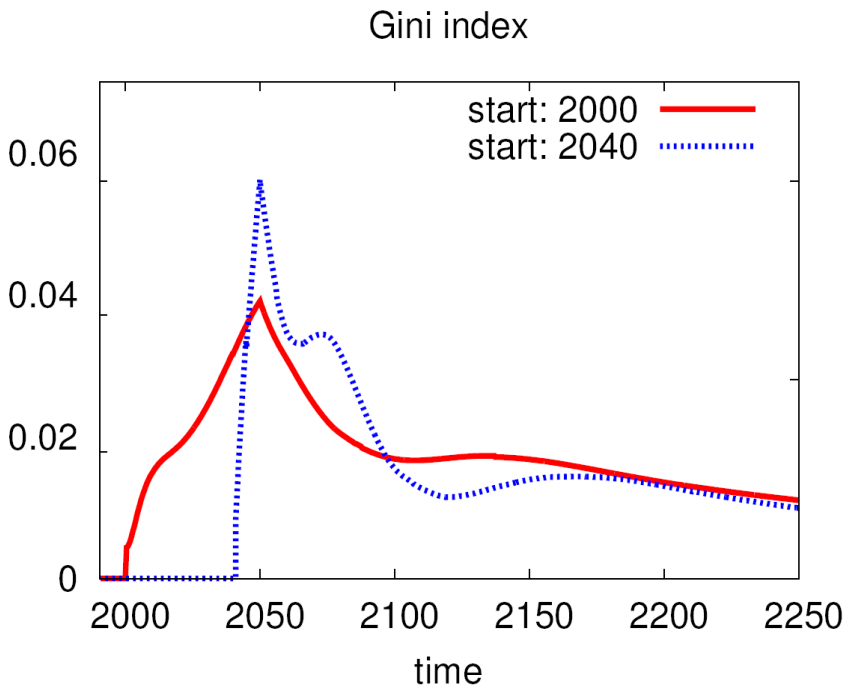


- What are the consequences in terms of aggregate welfare and inequality? Is it useful to anticipate the introduction of the tax?

Numerical results

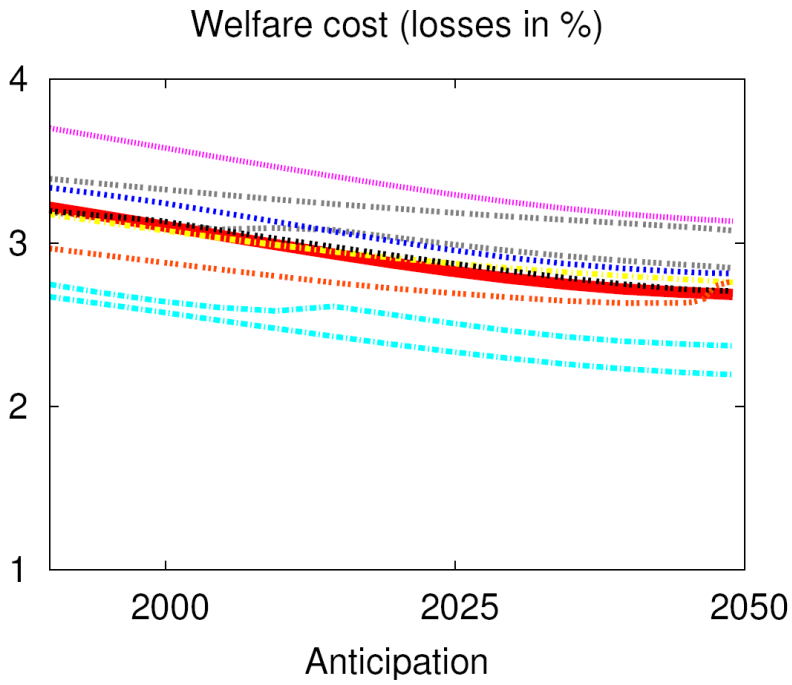
- Anticipated vs. Delayed strategies

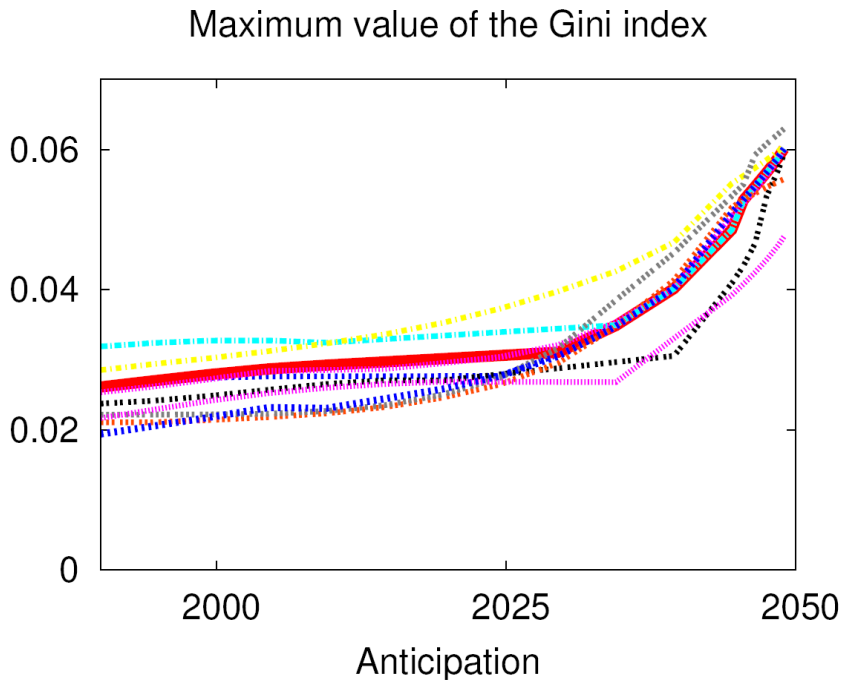




Numerical results

- Welfare cost and inequality as a function of anticipation





1. Welfare losses are larger than what can be inferred from other models
2. To prevent inequalities, the policy must be anticipated.

Conclusions

- City re-densification can be an efficient tool in emission-reduction strategies.
- Re-densification can be achieved through transportation tax (or, equivalently, through differentiated land-use taxes).
- **Cities are vulnerable to rapid changes in transportation costs, welfare losses can be significant**.
- **Potential impacts on spatial inequality are very important if transportation costs change too brutally**
- **This is what is currently observed because of oil prices.**
- **Increasing urban density while avoiding negative side-effects on inequality requires an anticipated and progressive action.**