CENTRE
INTERNATIONAL DE
RECHERCHE
SUR L'ENVIRONNEMENT
ET LE DÉVELOPPEMENT

THE GEOGRAPHY OF SUSTAINABILITY:
AGGLOMERATION, GLOBAL ECONOMY AND ENVIRONMENT

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Motivation of the research

- Lack of knowledge
  - Sustainable development -> spatial dimension ?
  - Regional analyses -> Environmental consequences of location choices by agents and activities ?

Objectives

1. To contribute to the New Economic Geography (NEG) literature: Coupling Pollution and Spatial dynamics

2. To provide the so-far abstract concept of 'Spatial Sustainability' with analytical formalization

3. To pave the way for numerical testing of the sustainability indicator

Focus of the research

- Research questions:
  1. To what extent the economy's spatial structure matters to the sustainability debate?
  2. How the drivers of spatial sustainability can be embedded in a general equilibrium framework to analyze their welfare-offsetting effects?

The Method

Extending the 2-region CP model (Krugman,1991):

- Different spatial configurations
- Spatial Sustainability Drivers:
  - → agglomeration spillovers
  - → environmental externalities
  - → trade advantages
- Dynamics of migration and pollution

The Method (1): The Spatial Economy

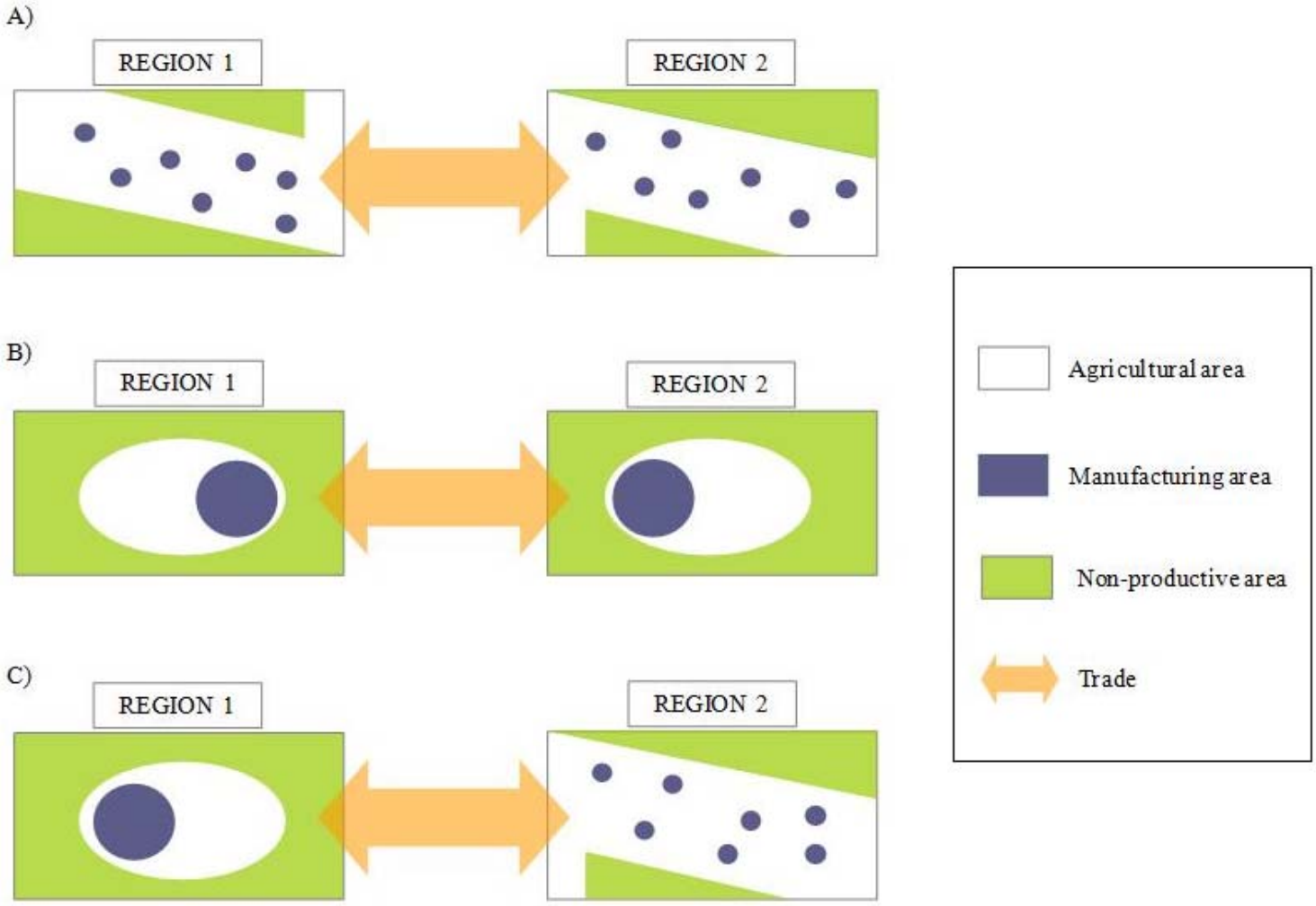
- The economy:
  - Two regions, Two final good sectors (Food, Manufacturing),Two types of workers (Skilled and Unskilled) + One intermediate good (Energy)
- Spatial dimension
  - 3 land-use types

    →Agriculture, Urban activities, Non-Productive land
  - 2 types of spatial organization

    → Urbanized: high density settlements

    → Undeveloped: low density settlements
  - 3 alternative spatial configurations

Spatial configurations



The Method (2): The spatial sustainability drivers

Trade : trade barrier in the "iceberg" form ($\phi = 1$: free trade; $\phi = 0$: autarky)

Agglomeration spillovers

$$\underbrace{PC}_{\text{Production Costs}} = \underbrace{FC}_{\text{Fixed Costs}} + \underbrace{\beta_j \psi(n_j)}_{\text{Energy Costs per unit of prod}} q_j$$

- *"market density" effect* β_j : degree of infrastructure development, spatial organization
- *"market size effect"* $\psi(n_j)$: intra-industry transaction costs, technological spillovers and knowledge sharing

Pollution (from production and trade):

- *Flow effect* : affects negatively local utility $E_j(h, \phi)$
- *Stock effect* : accumulates over time to build a LT global pollution stock $S(h, \phi)$

The Method (3): The dynamic mechanisms

1. Migration of skilled workers ($h=H_1/H$)
   - Driven by indirect utility gap $\Omega=V_1-V_2$

   (including agglomeration spillovers and pollution)

$$\frac{dh}{dt}=\begin{cases}\Omega(h,\phi) & \text{if } 0<h<1\\ \max\left(0,\Omega(h,\phi)\right) & \text{if } h=0\\ \min\left(0,\Omega(h,\phi)\right) & \text{if } h=1\end{cases}$$

2. Pollution stock accumulation
   - Driven by emission flows $E(h,\phi)$
   - Assimilation capacity A

$$\frac{dS}{dt}=E(h,\phi)-A$$

Formalizing spatial sustainability

1. No incentive for migration:

$$\frac{dh}{dt} = 0$$

2. Non-increasing pollution stock:

$$E\left(h, \phi\right) \leq A$$

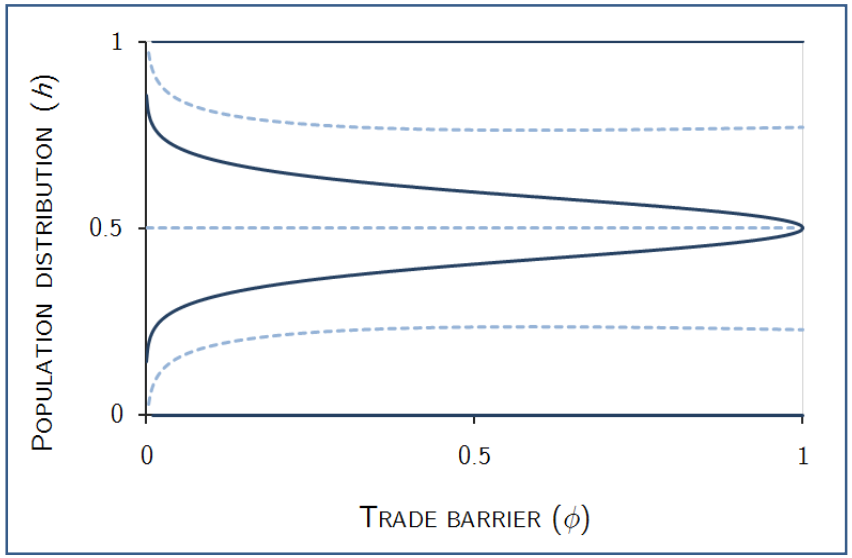
Results:
a 3-step analysis

1. Long-run spatial equilibrium
   - How the spatial economy develops in the LR for the different spatial configurations?

Results (1)

Long-run spatial equilibrium

Symmetric configurations

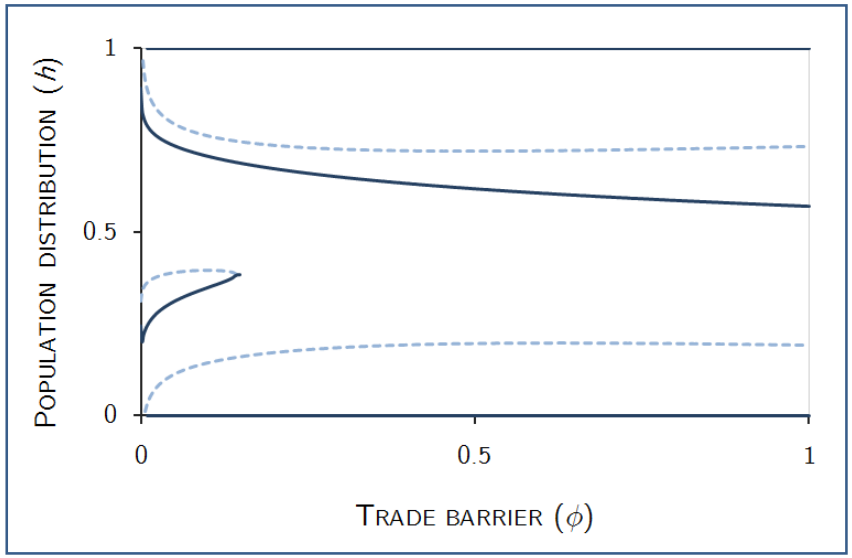


- A stable partial equilibrium exists for any trade barrier

stable

unstable

Non-symmetric configuration



- For high trade barrier, two stable partial equilibria exist.
- For low trade barrier, stable partial agglomeration in urbanized region.

Results: a 3-step analysis

1. Long-run spatial equilibrium

2. Policy analysis of spatial sustainability
   - Under what conditions the LR equilibrium reached by the spatial economy is sustainable?

Policy analysis: Trade, Space and Sustainability

Two types of policy measures

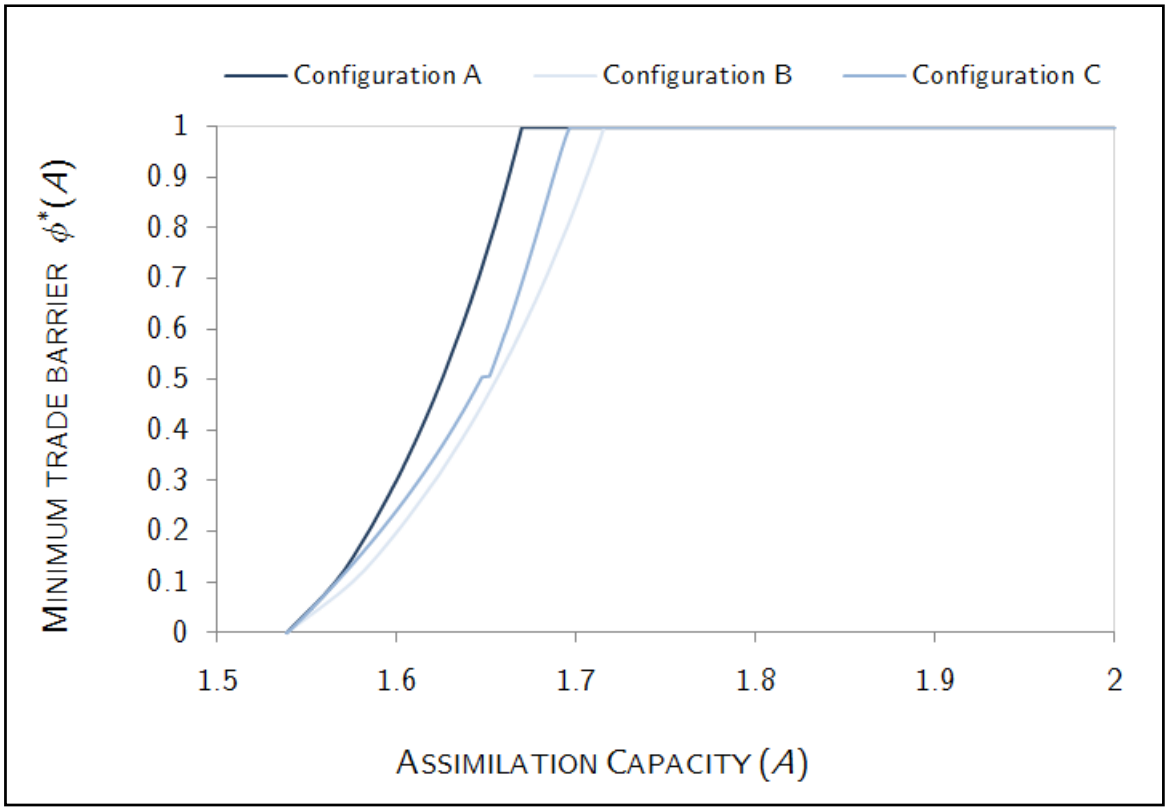
- (Physical) Trade regulation
  - → Trade barrier : $0 \leq \phi \leq 1$ ($\phi = 1$: free trade ; $\phi = 0$: autarky)
- Spatial planning
  - → Spatial concentration (3 spatial configurations)

Condition on sustainability : $E(h, \phi) \leq A$

- Assimilation capacity of the environment (A)

What is the combination of policy measures that lowers long-run emissions wrt given assimilation capacity A ?

Results (2)
Trade and sustainability



- Trade barrier and assimilation capacity A
- Trade barrier and spatial configuration

Results: a 3-step analysis

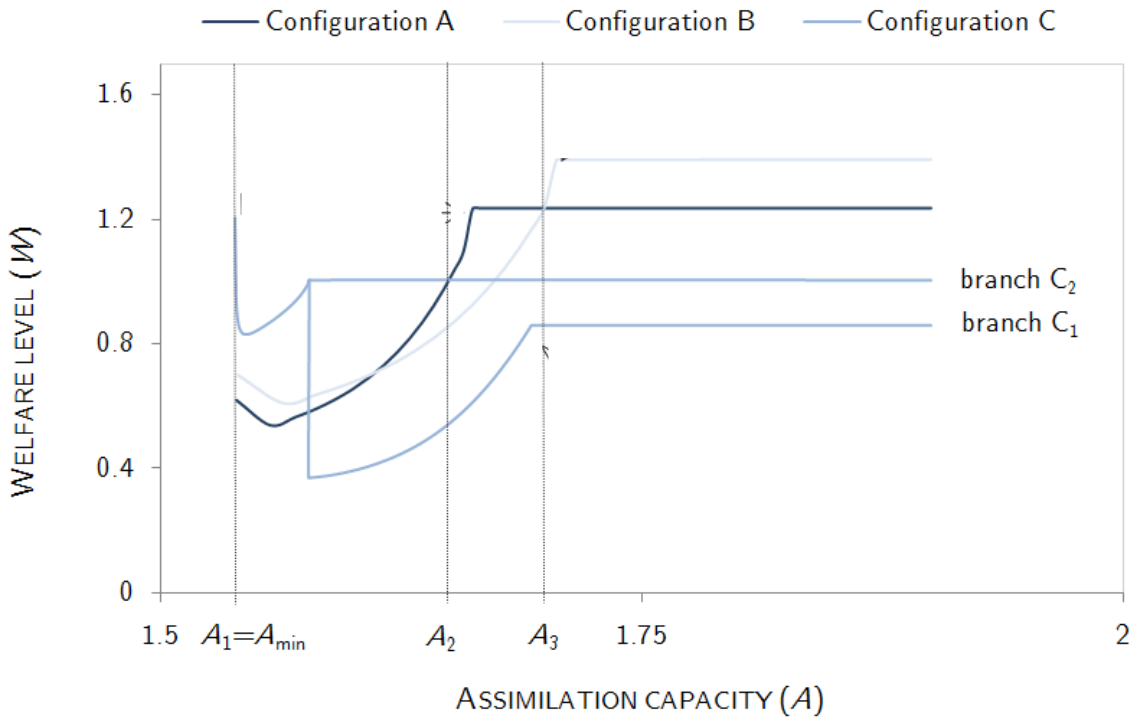
1. Long-run spatial equilibrium

2. Policy analysis of spatial sustainability

3. Welfare analysis
   - How sustainable LR equilibrium are rewarded in terms of welfare?

Results (3)
Welfare analysis

What is the socially optimum configuration according to the assimilation capacity?



Results (3)
Welfare analysis

- *For high assimilation capacity,* configuration B is the most desirable
  - intense agglomeration spillovers

- *For intermediate assimilation capacity,* configuration A is the most desirable
  - lower trade barrier imposed by sustainability.

- *For low assimilation capacity*, configuration C is the most desirable
  - high trade barrier: pollution essentially from production
  - balanced configuration btw. agglomeration spillovers and emissions

Conclusions

- Importance of coupling spatial and environmental dimensions in a welfare analysis to formalize spatial sustainability
- More thorough comprehension of the sustainability mechanisms : interaction between three drivers (trade, environment and space)
- Respective role of policy instruments on trade vs. local spatial organization

Conclusions

- For high assimilation capacity, the more urbanized spatial organization (config. B) is the most desirable

- For low assimilation capacity, a more balanced configuration (config. C) is more rewarded in terms of welfare

Questions or Comments?

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