



CENTRE
INTERNATIONAL DE
RECHERCHE
SUR L'ENVIRONNEMENT
ET LE DÉVELOPPEMENT

THE GEOGRAPHY OF SUSTAINABILITY: AGGLOMERATION, GLOBAL ECONOMY AND ENVIRONMENT

GRAZI, F.,* H. WAISMAN,* J.C.J.M. VAN DEN BERGH#

* *CIRED, Paris France*

ICREA and AUB, Barcelona, Spain

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 empirical 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

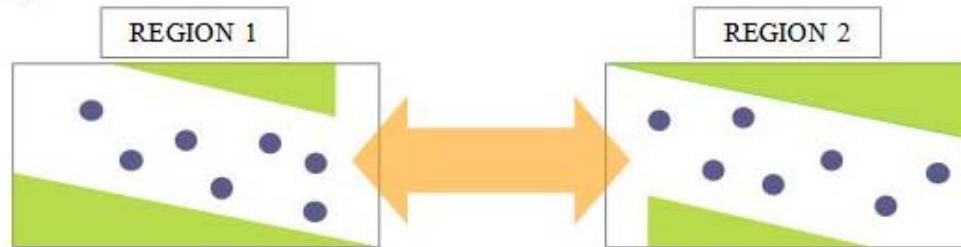
- ▶ Two-region approach
 - Different spatial configurations
- ▶ Extending the CP Krugman model with agglomeration spillovers, pollution dynamics and trade advantages (Spatial Sustainability Drivers)
- ▶ Stylistic application – numerical example to inform on the design of spatially sustainable configurations of an economy

The Spatial Economy

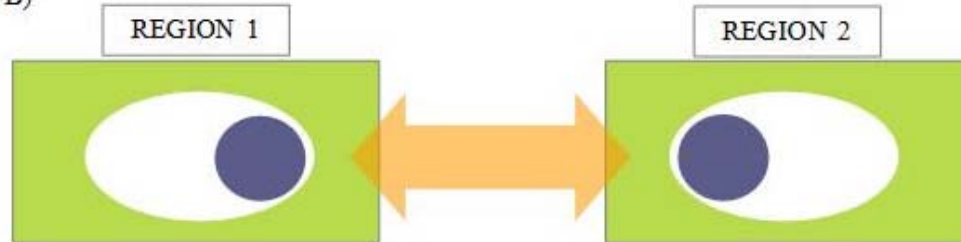
- ▶ Dual Economy: Two-region (j,k), two-sectors (F, M), two input factors (H, L)
- ▶ Shape of a region:
 - ❑ 3 land-use types (Agriculture, Manufacture, non-productive land)
 - ❑ 2 types of spatial organization
 - Concentrated: high agglomeration spillover
 - Dispersed: low agglomeration spillover
- ▶ 3 alternative spatial configurations

Spatial configurations

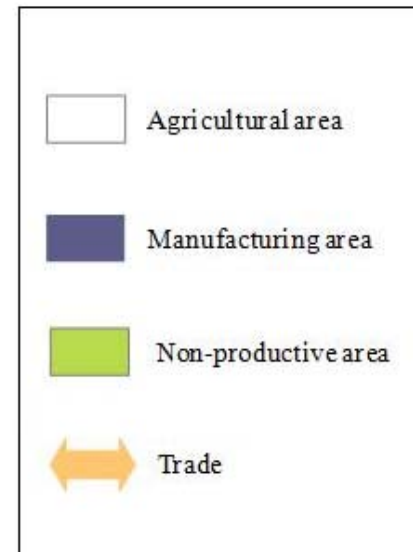
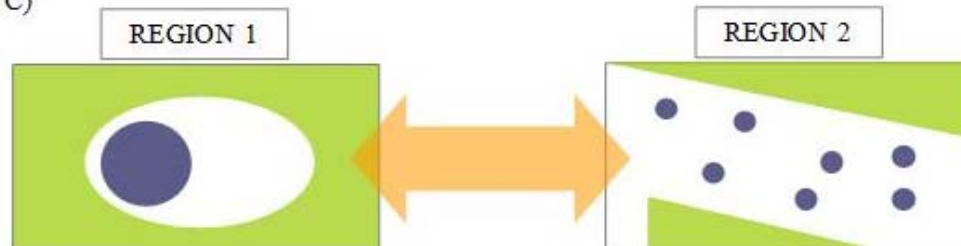
A)



B)



C)



The dynamic mechanisms

1. Migration of skilled workers

- Indirect utility gap Ω including pollution

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

2. Pollution flow and stock

- Emission flows (from production and trade): $E(h, \phi)$
- Pollution stock accumulation

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

Formalizing spatial sustainability

1. No incentive for migration:

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

2. Non-increasing pollution stock:

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

Three types of analysis

1. Long-run spatial equilibrium

- How the spatial economy develops in the LR

2. Policy analysis of spatial sustainability

- Under what conditions the spatial economy reaches a sustainable LR equilibrium
- Policy instruments: trade barrier, spatial organization

3. Welfare analysis

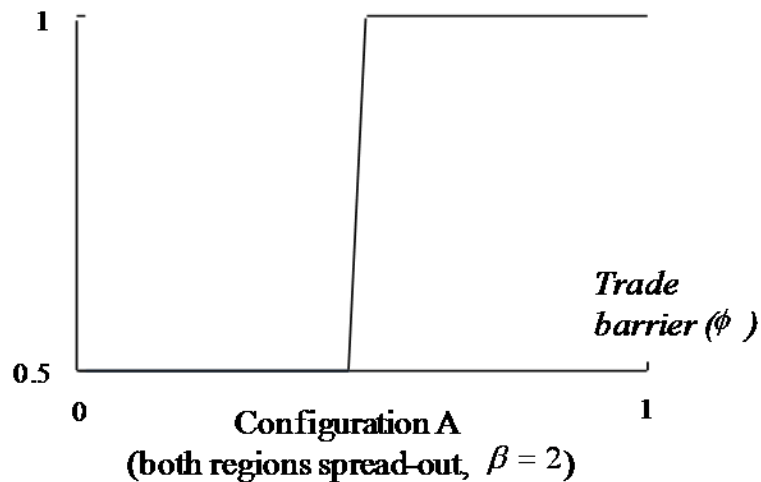
- How sustainable LR equilibrium are rewarded in terms of welfare

Results (1)

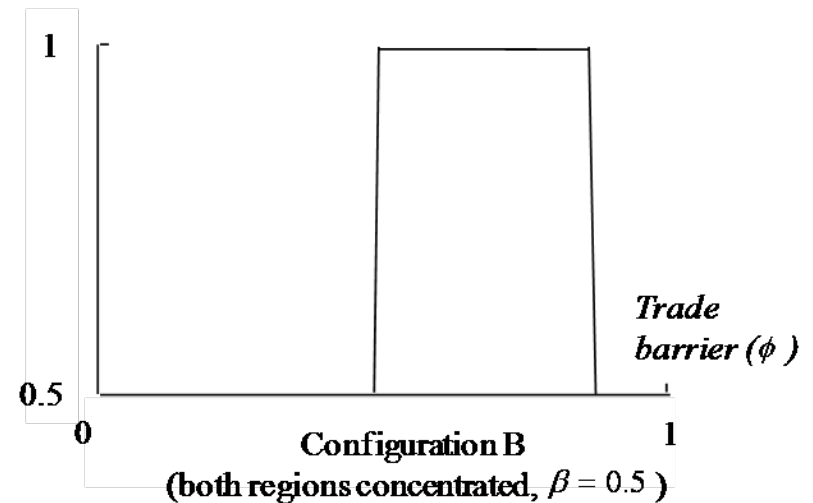
Long-run spatial equilibrium

► Symmetric configurations

Population distribution (h)



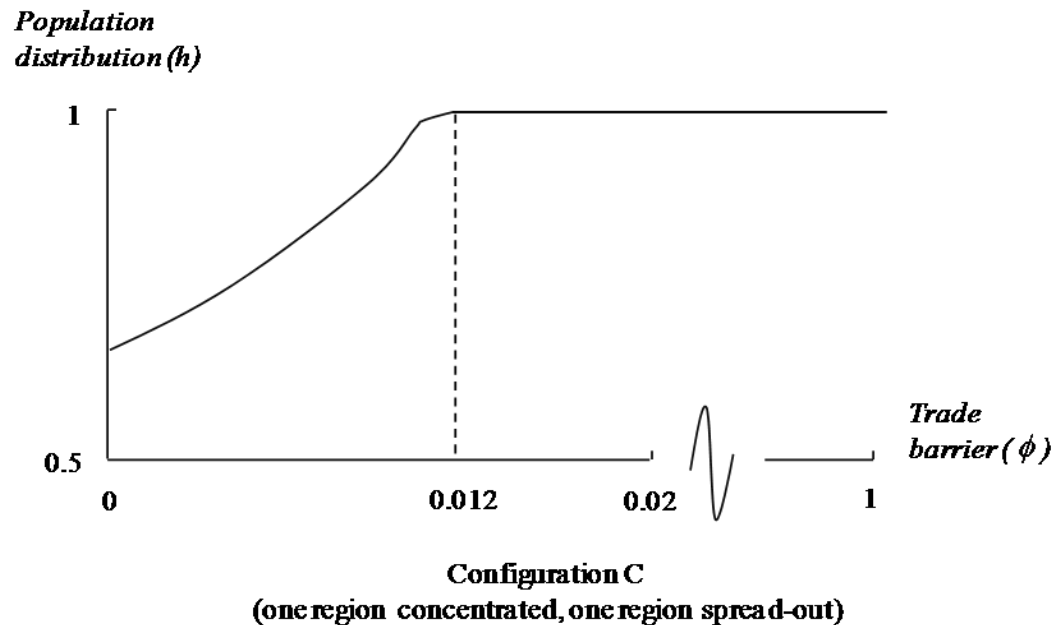
Population distribution (h)



Results (1)

Long-run spatial equilibrium

► Non-symmetric configuration



High trade cost leads to partial concentration

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 (Three spatial configurations)

Condition on sustainability

- ❑ Assimilation capacity of the environment (A)

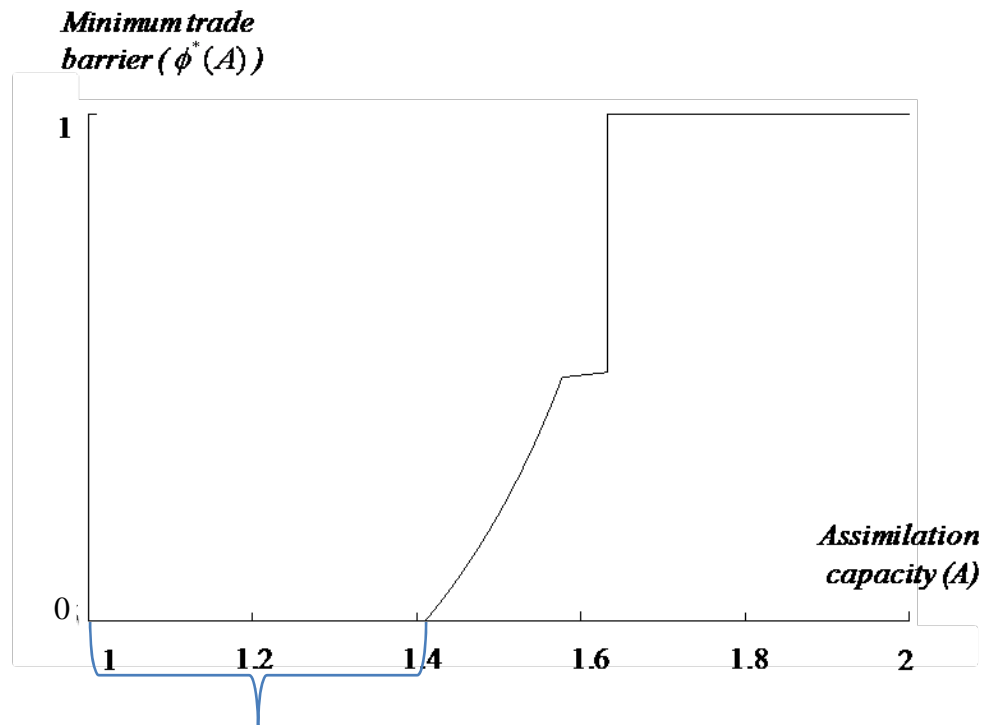
What is the combination of policy measures that lowers long-run emissions wrt given assimilation capacity A ?

- ❑ trade barrier and sustainability

- ❑ trade barrier, spatial organization and sustainability

Results (2)

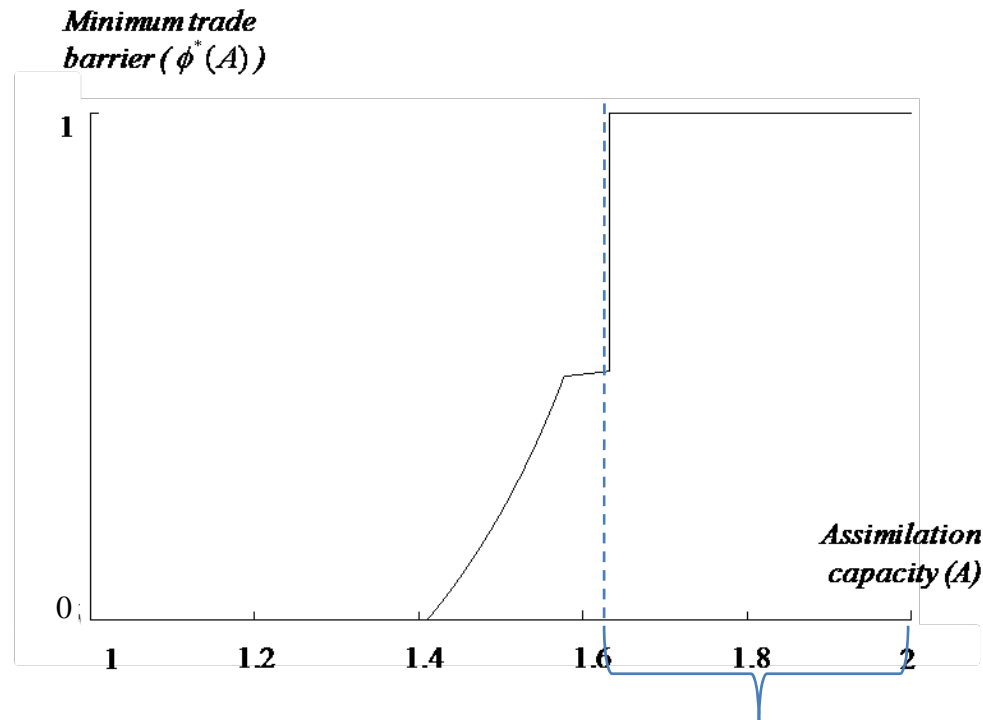
Trade and sustainability



For low assimilation values, the sustainability condition cannot be matched $\phi^*(A) = 0$

Results (2)

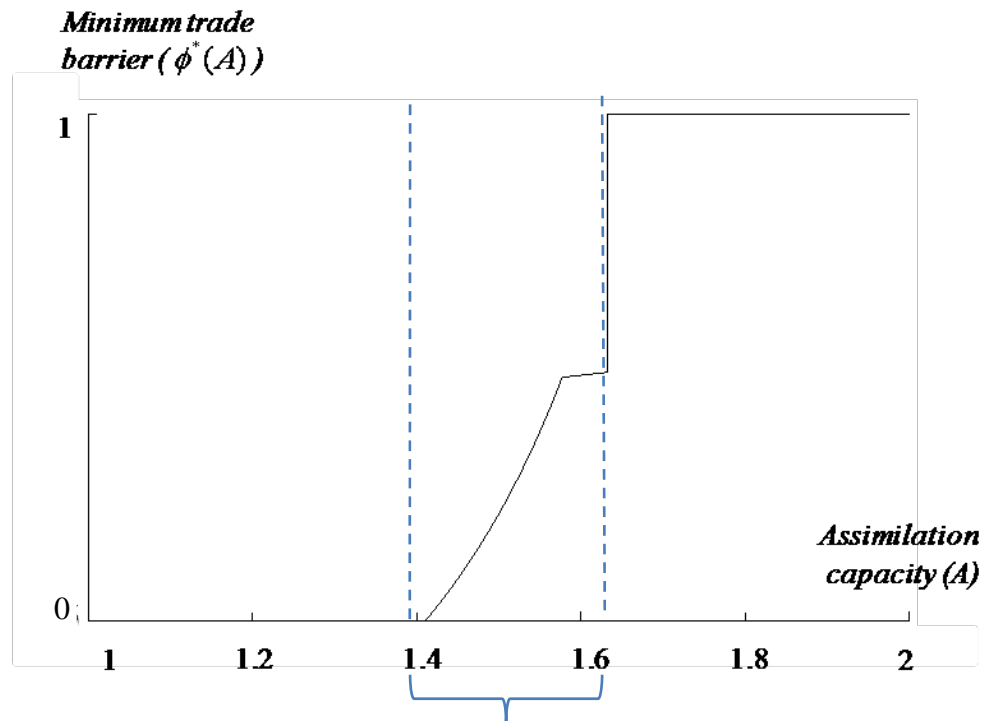
Trade and sustainability



For high assimilation values, the sustainability condition is satisfied even with free trade $\phi^*(A) = 1$

Results (2)

Trade and sustainability



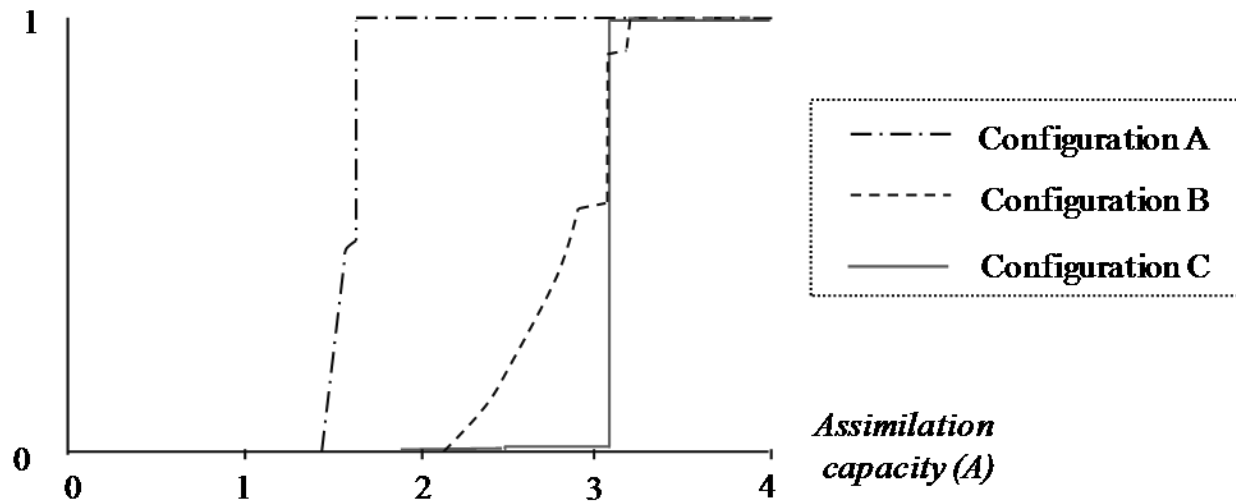
For intermediate assimilation values, the sustainability condition is satisfied only if trade cost is high enough

$$0 < \phi^*(A) < 1$$

Results (2)

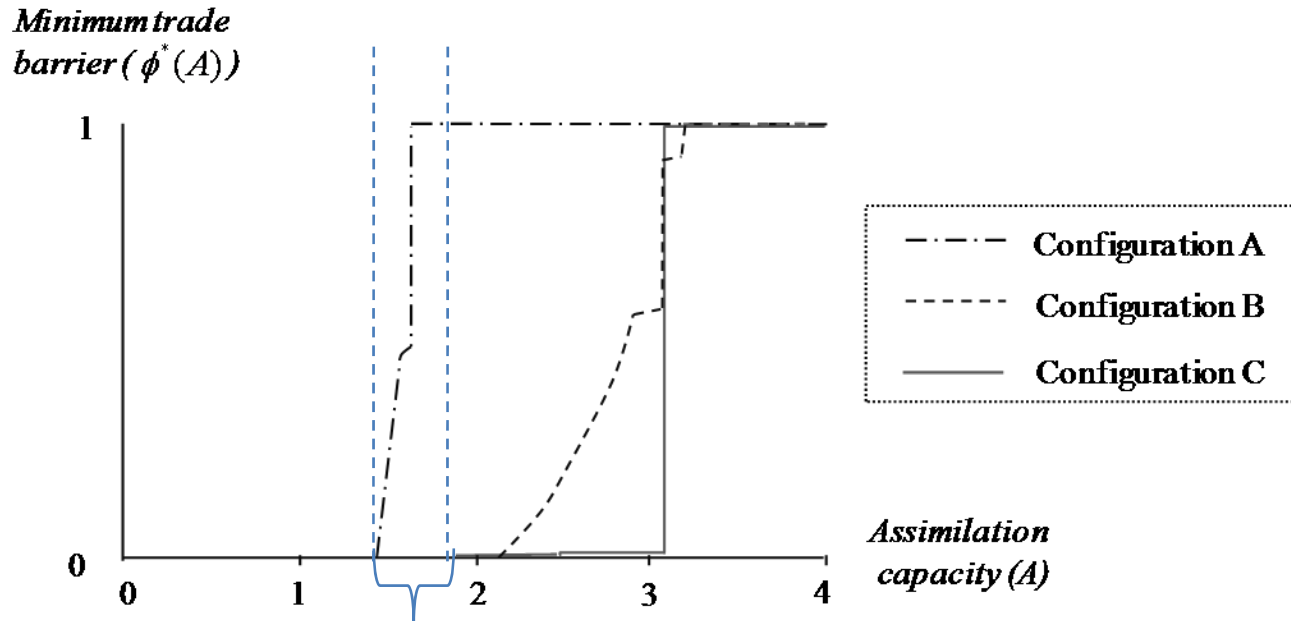
Trade, Space and Sustainability

*Minimum trade
barrier ($\phi^*(A)$)*



Results (2)

Trade, Space and Sustainability

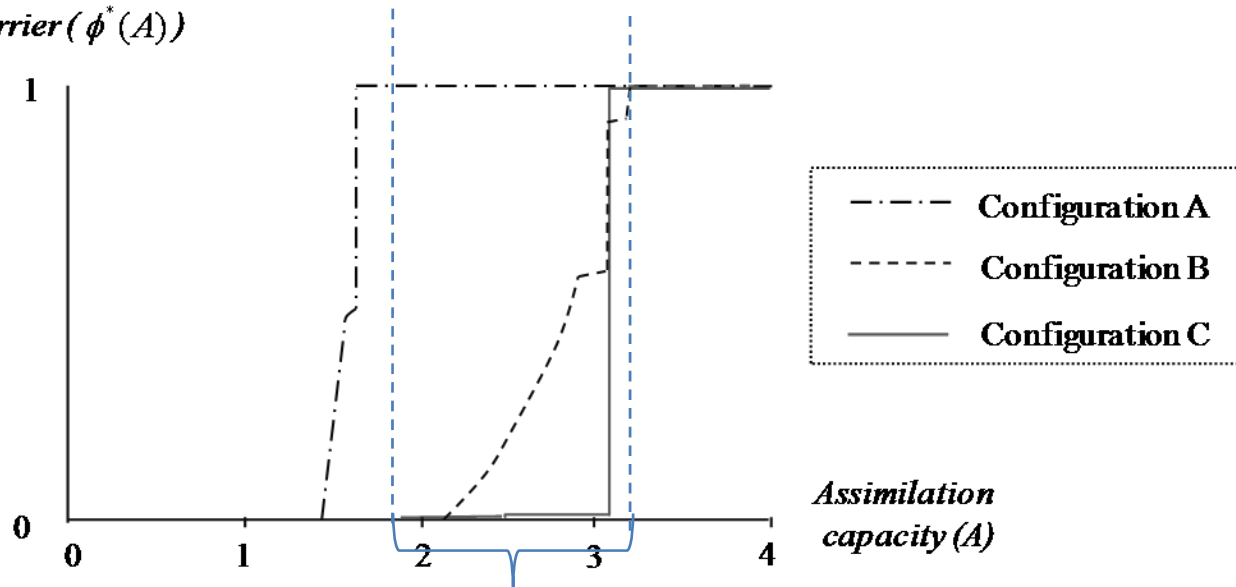


For low assimilation values, only spread vs spread configuration (config. A) is sustainable.

Results (2)

Trade, Space and Sustainability

*Minimum trade
barrier ($\phi^*(A)$)*

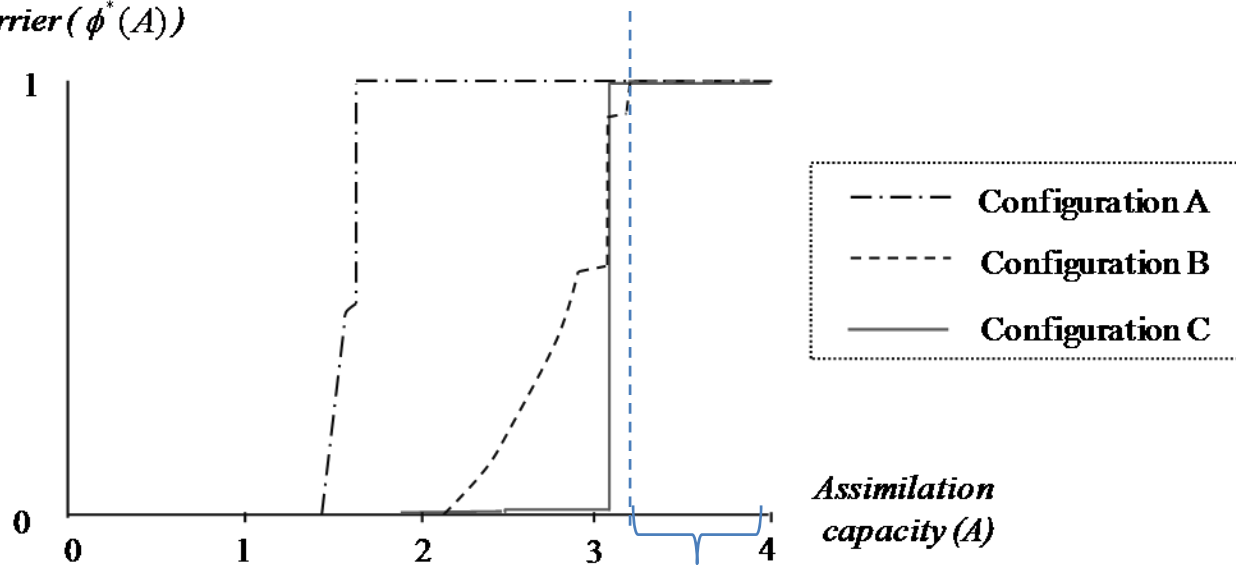


For intermediate assimilation values, several configurations can be sustainable, but with different restrictions (costs) on trade.

Results (2)

Trade, Space and Sustainability

*Minimum trade
barrier ($\phi^*(A)$)*

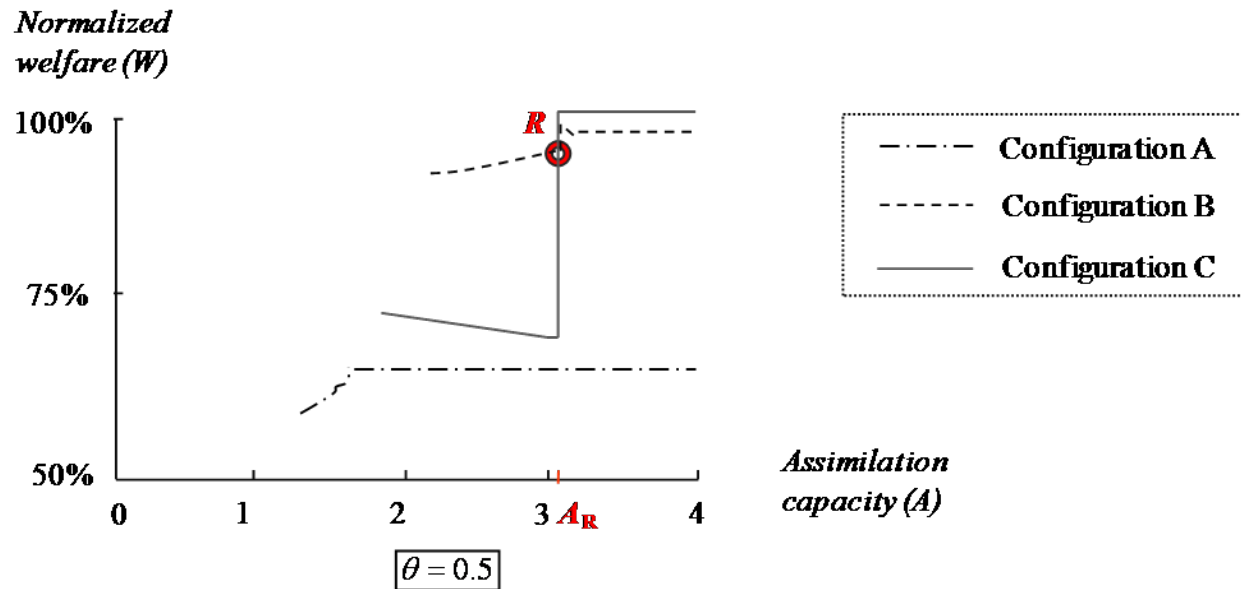


- For high assimilation values, all configurations are sustainable, whatever the restriction on trade (i.e., cost).

Results (3)

Welfare analysis

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



Results (3)

Welfare analysis

| Ranking position | $E_{\min}^A \leq A \leq E_{\min}^C$ | $E_{\min}^C \leq A \leq E_{\min}^B$ | $E_{\min}^B \leq A \leq A^R$ | $A^R \leq A$ |
|------------------|-------------------------------------|-------------------------------------|------------------------------|--------------|
| 1 | Config. A | Config. C | Config. B | Config. C |
| 2 | – | Config. A | Config. C | Config. B |
| 3 | – | – | Config. A | Config. A |

Around point 'R', configuration C assumes a full concentration structure, which is rewarded by welfare

Conclusions (1)

- 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 (2)

- For low assimilation capacity, only symmetric spread-out spatial organization (config. A) leads to sustainability (through production)
- For high assimilation capacity, a more balanced configuration (config. C) may be more rewarded in terms of welfare (through trade)

Questions or Comments?

Contact :

Fabio GRAZI - grazi@centre-cired.fr

Henri WAISMAN - waisman@centre-cired.fr

Web: www.centre-cired.fr