Spatial Economics and Statistics

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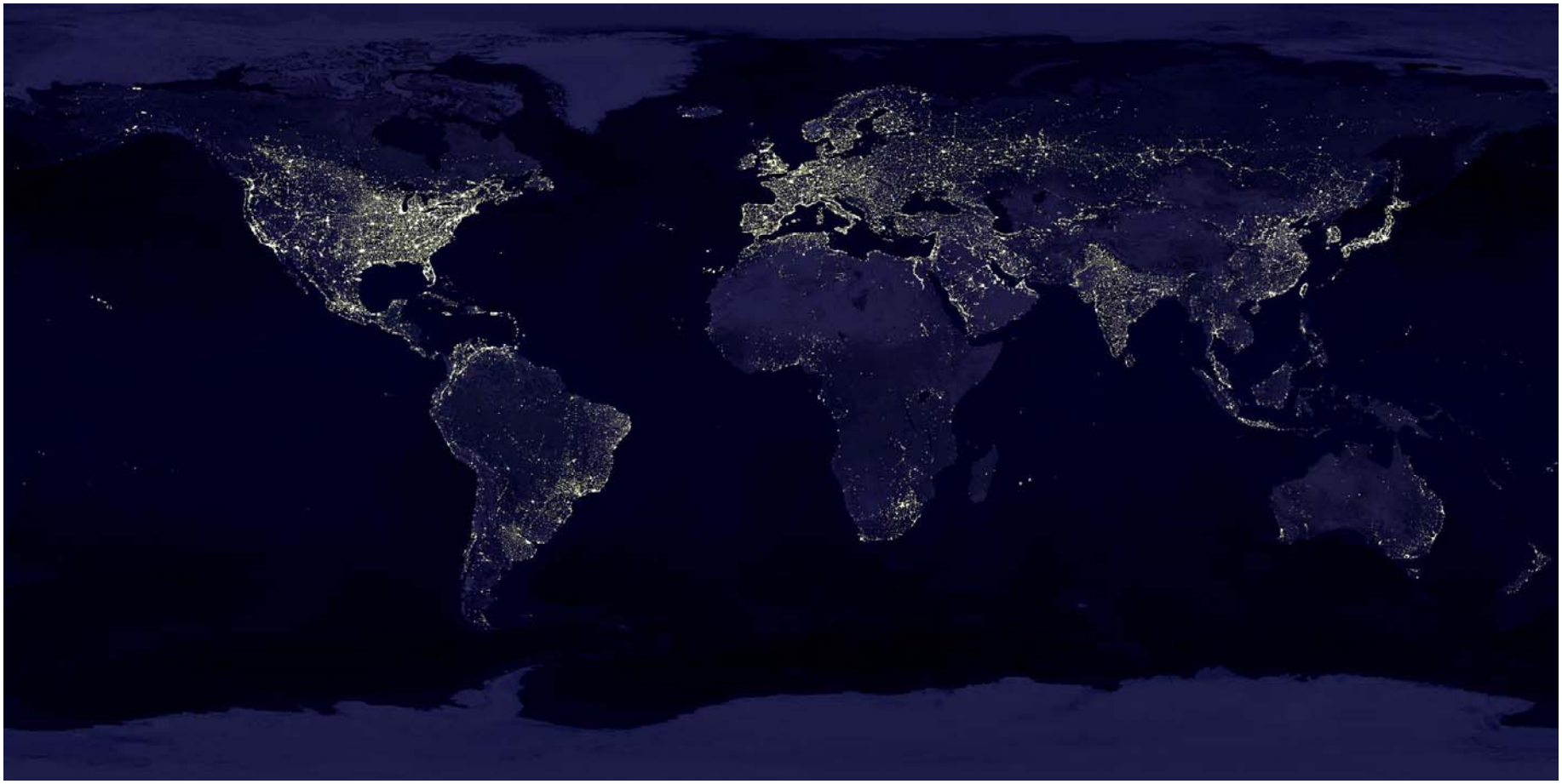
Night time lights: World



Night time lights: Africa (natural resources)

Night time lights: Asia (market potential)

Night time lights: Europe (home market)

Night time lights: USA (market power)

BASIC STATISTICS

Diversity

in biology:

α-diversity: the number of species living in a homogenous habitat (within a habitat)

β-diversity: diversity in a heterogeneous habitat (between habitats)

γ-diversity: the total number of species observed in all habitats within a geographical area (landscape diversity)

α-diversity => richness: absolute abundance of species, regardless of how the population is distributed across those particular species

β,γ-diversity => evenness: relative abundance of species in the population

…in economics:

habitat = industry
species = firms/plants (e.g. by dimensional classes)

Spatial statistics => the spatial distributuon of economic activity

measures => *γ-diversity*. However, note that a *γ-diversity* index, capturing the notion of diversity within a given region, is always a composition of α and β-diversity.

2 Criteria:

- Diversity as Inequality

[α-diversity] …number of firms in a given industry-area

[β-diversity] …diversity between firms within a given industry
… diversity between firms within a given geographical area
=> *HETEROGENEITY*

[γ-diversity] …diversity between industries in a geographical area
=> *LOCALIZATION, SPECIALIZATION, CONCENTRATION*

- Diversity as Polarisation (how diversity is spatially distributed across different geographical areas):
=> spatial contiguity: POLARIZATION

An inequality Index must respect the following properties:

• *The Anonymity Principle*
It does not matter who is earning the income. In other words, permutations of income among people should not matter for inequality judgements.

• *The Population Principle*
Inequality does not depend on the number of individuals but on their proportion, i.e. size does not matter.

• *The Relative Income Principle or Scale Invariance Principle*
If all incomes increase by the same amount, inequality will not be affected.

• The Pigou-Dalton Principle
Any transfer of income from a poor individual to someone richer increases inequality.

• The Lorenz criterion
If one concentration curve is everywhere closer to the diagonal than another, the
associated distribution should be judged less unequal.

An inequality measure is consistent with the Lorenz criterion if and only if it is simultaneously consistent with the anonymity, population, relative income and Dalton principles.

Diversity as INEQUALITY => HETEROGENEITY
(e.g. degree of concentration within a given industry)

- *<u>Herfindal index (HI)</u>*

$$H = \sum_{i=1}^{n} (s_i^2)$$

where s_i is the market share of firm i in the market, and n is the number of firms.

There is also a normalised Herfindahl index. Whereas the Herfindahl index ranges from 1/N to one, the normalized Herfindahl index ranges from 0 to 1. It is computed as:

$$H* = \frac{(H - 1/N)}{1 - 1/N}$$

where again, N is the number of firms in the market, and H is the usual Herfindahl Index, as above.

Diversity as INEQUALITY => HETEROGENEITY

(e.g. degree of differentiation of manufacturing industry, according to size-classes)

- *Herfindal index (HI)*

$$HI = \sum_{h=1}^{H} N_h \left(\frac{S_h}{W} \frac{1}{N_h} \right)^2$$

where:
H = number of size-classes
N_h = number of firms in size-class (h)
S_h = number of employees in size-class (h)
W = total number of employees

Maximum homogeneity [H=(1/N)=(W/S)] => HI = 1

Maximum heterogeneity => [N_h=N for h = i and N_h=0 $\forall$ h $\neq$ i] => HI = 1/N

Diversity as INEQUALITY => HETEROGENEITY

- *<u>Theil Index (TI)</u> ...entropy (advantage: decomposability)*

$$TI = (TI)_0 + \sum_{r=1}^{R} \frac{S_{.r}}{W}(TI)_r$$

$$(TI)_0 = \sum_{r=1}^{R} \frac{S_{.r}}{W} ln \frac{W}{S_{.r}} \quad \text{(between regions)}$$

$$(TI)_r = \sum_{i=1}^{N_r} \frac{S_{ir}}{S_{.r}} ln \frac{S_{.r}}{S_{ir}} \quad \text{(within regions)}$$

where:
S_{ir} = *number of firms in industry (i), in region (r)*
$S_{.r}$ = *total number of firms in region (r)*
N = *number of industries in region (r)*
R = *number of regions*
W = *total number of firms*

Maximum homogeneity $[\, R=(W/S.);\ N_i=(S_{.r}/S_r)\,]$ => $(TI)_0 = ln\ R$; $(TI)_r = ln\ N_r$

Maximum heterogeneity => $T = 0$

Entropy: observations are weighted using their correspondent relative scores.

Diversity as INEQUALITY => HETEROGENEITY

- *Gini Index*

$$G_r = 1 - \sum_{r=1}^{R} (n_{r+1} - n_r)(s_r + s_{r+1})$$

where:

- *classes (you can think at regions...) are ranked by size-class*

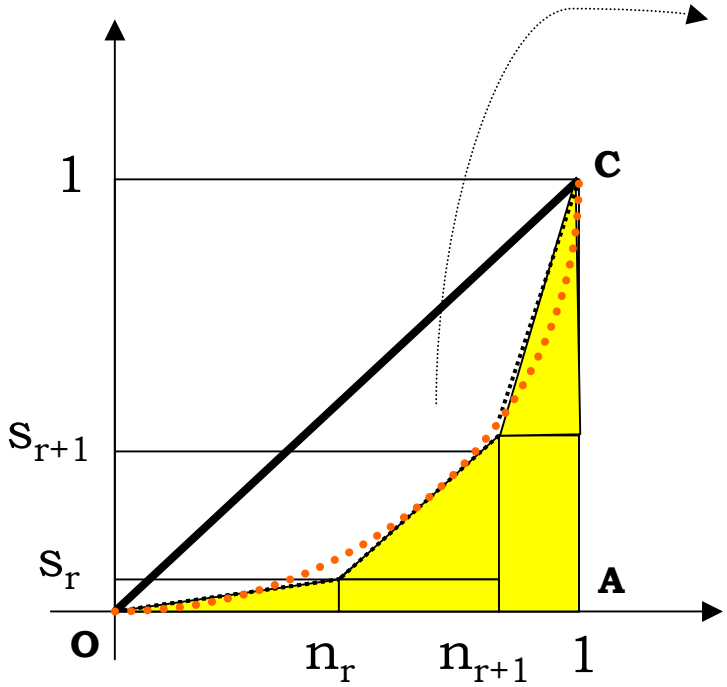
n_r = *share of firms whose number of employees is ≤ the upper bound of region (r)*

s_r = *share of employees owned by firms with a number of employees ≤ the upper bound of region (r)*

R = number of classes

Absolute concentration $G_r = 1$
Absolute equality $G_r = 0$

Diversity as INEQUALITY => HETEROGENEITY - Gini index

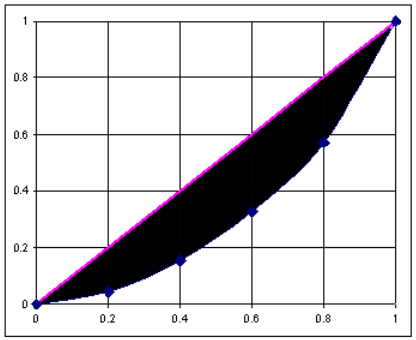


Concentration area (black area below)

Lorenz curve

Lorenz curve (approximation)

Line of equality (45-degree line)



$$G_r = \frac{\widehat{black}}{\widehat{OAC}} = \frac{\widehat{OAC} - \widehat{yellow}}{\widehat{OAC}} =$$

$$= \frac{\frac{1}{2} - \frac{1}{2}\sum_r (n_{r+1} - n_r)(s_r + s_{r+1})}{\frac{1}{2}}$$

EXAMPLE. An analysis of German and English cities, addressing the question of concentration (monocentric vs polycentric city regions).

Gini index for cities is calculated as:

$G = 1 - \frac{1}{N} \sum_{i=1}^{N} (s_i + s_{i+1})$,

where cities are previously ranked by size (S_i) (i.e. population) and $s_i = \sum_{j=1}^{i} \frac{1}{W} S_j$ is the cumulative percentage of population in all the cities in which this latter is $\leq S_j$.

Gini index for regions is instead calculated as

$G_r = 1 - \sum_{r=1}^{R} (n_{r+1} - n_r)(s_r + s_{r+1})$,

where: regions are ranked by size (S_r); $n_r = \frac{1}{N} \sum_{h=1}^{r} N_r$ indicates the cumulative percentage of the number of cities (N_r) in all those regions whose population is $\leq S_r$; s_r is the cumulative percentage of population in all regions (that is: in all cities in the region) in which population itself is $\leq S_r$.

Theil index is calculated as follows:

$T = T_0 + \sum_{r=1}^{R} \frac{S_{.r}}{W} T_r,$

where: population in city i in region r has been indicated by S_{ir}; $S_{.r}$ is the population in region r; R is the number of regions (with $r = 1, \ldots, R$). Hence,

$T_0 = \sum_{r=1}^{R} \frac{S_{.r}}{W} ln \frac{W}{S_{.r}}$

measures the entropy between regions, and

$T_r = \sum_{i=1}^{N_r} \frac{S_{ir}}{S_{.r}} ln \frac{S_{.r}}{S_{ir}}$

is the measure of the within regions entropy, where N_r is the number of cities in region r.

Finally, the *Herfindal* index has been calculated as:

$H = \sum_{h=1}^{H} N_h \left(\frac{S_h}{W} \frac{1}{N_h} \right)^2$

where N_h and S_h are, respectively, number and size of cities in class h (size-classes are defined on the basis of city population).

Table 1. English and German cities. 2001

	England	***Germany***
Total population (W)	49 138 831	82 440 309
Cities:		
Number (N)	354	439
Size (S):		
range (max - min)	974 938	3 352 635
max	977 091	3 388 434
min	2 153	35 799
mean	138 810	187 791
standard deviation	93 289	217 868
median	111 629	134 105

Source: Own elaboration on National Statistics (England) and Federal Statistical Office Germany (Germany) data. Census 2001.

Table 2. Analisys of diversity.

	England	***Germany***	***Germany / England***
GINI (for cities)	30.7%	38.3%	1.25
GINI (for regions)	3.2%	28.6%	8.98
THEIL:			
THEIL (total)	97.1%	85.1%	0.88
THEIL between regions	98.0%	84.9%	0.87
THEIL within regions	(see tables 3 and 4)		
HERFINDAL (by size-classes of cities)	2.7%	6.7%	2.48

Source: Own elaboration on National Statistics (England) and
Federal Statistical Office Germany (Germany) data. Census 2001.

Table 3. Within regions Theil Index *(English regions)*. 2001.

West Midlands	90.9%
Yorkshire and The Humber	92.3%
North East	94.0%
North West	96.1%
South West	96.2%
East Midlands	97.2%
London	98.6%
South East	98.9%
East of England	99.0%

Source: Own elaboration on National Statistics data. Census 2001.

Table 4. Within regions Theil Index (German regions). 2001.

Hamburg	0.0%
Berlin	0.0%
Mecklenburg-Vorpommern	57.9%
Sachsen-Anhalt	58.0%
Thüringen	64.1%
Bremen	68.0%
Bayern	72.3%
Rheinland-Pfalz	74.0%
Reg.-Bez. Weser-Ems	81.5%
Baden-Württemberg	82.0%
Sachsen	83.1%
Hessen	85.5%
Nordrhein-Westfalen	88.3%
Brandenburg	91.6%
Niedersachsen	92.3%
Schleswig-Holstein	94.1%
Saarland	94.1%

Source: Own elaboration on Federal Statistical Office Germany data. Census 2001.

Diversity as INEQUALITY => LOCALIZATION

...industries in a geographical area

=> LOCALIZATION INDEXES (SPECIALISATION/ CONCENTRATION)

- Balassa Index for specialization

$$B_{ij} = \frac{\frac{S_{ir}}{S_r}}{\frac{S_i}{W}}$$

- Balassa Index for concentration

$$B_{ij} = \frac{\frac{S_{ir}}{S_i}}{\frac{S_j}{W}}$$

- where:

S_{ir}/S_r *= share of industry (i) in region (r)*

S_{ir}/S_i *= share of region (r) in industry (i)*

W = total amount of the observed characteristic (firms, employment, value added, etc.)

Diversity as INEQUALITY => LOCALIZATION

- *Industry Gini Coefficient*

1) calculate the Balassa index for specialisation (for every industry in the region);

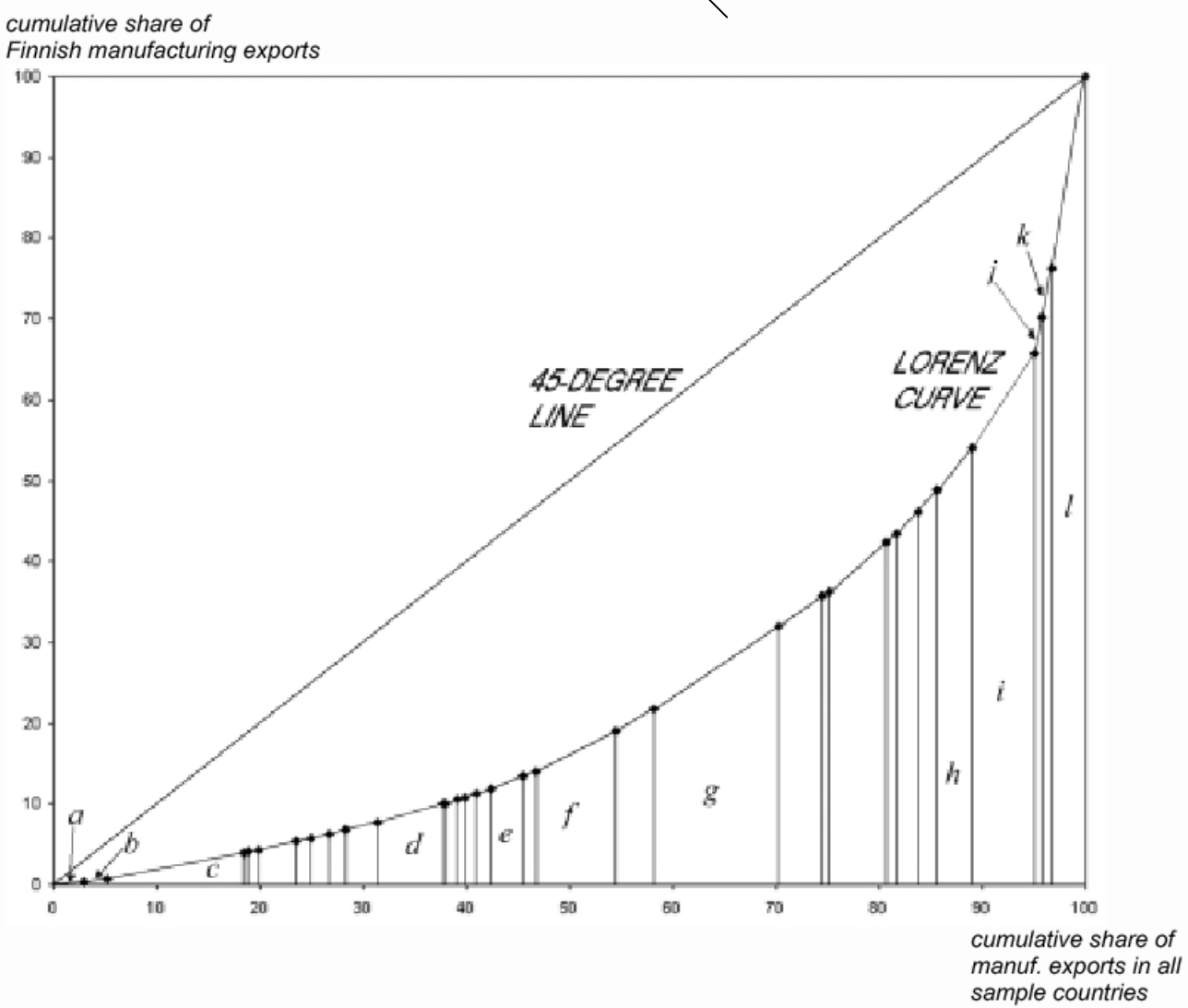
2) rank the scores in descending order and plot the cumulative of the numerator on the vertical axis against the cumulative of the denominator(on the horizontal axis (as in figure 1), and get the Lorenz curve;

3) calculate the Gini index

=> the higher the score, the higher is the degree of specialisation!

Figure 1: A Locational Lorenz Curve

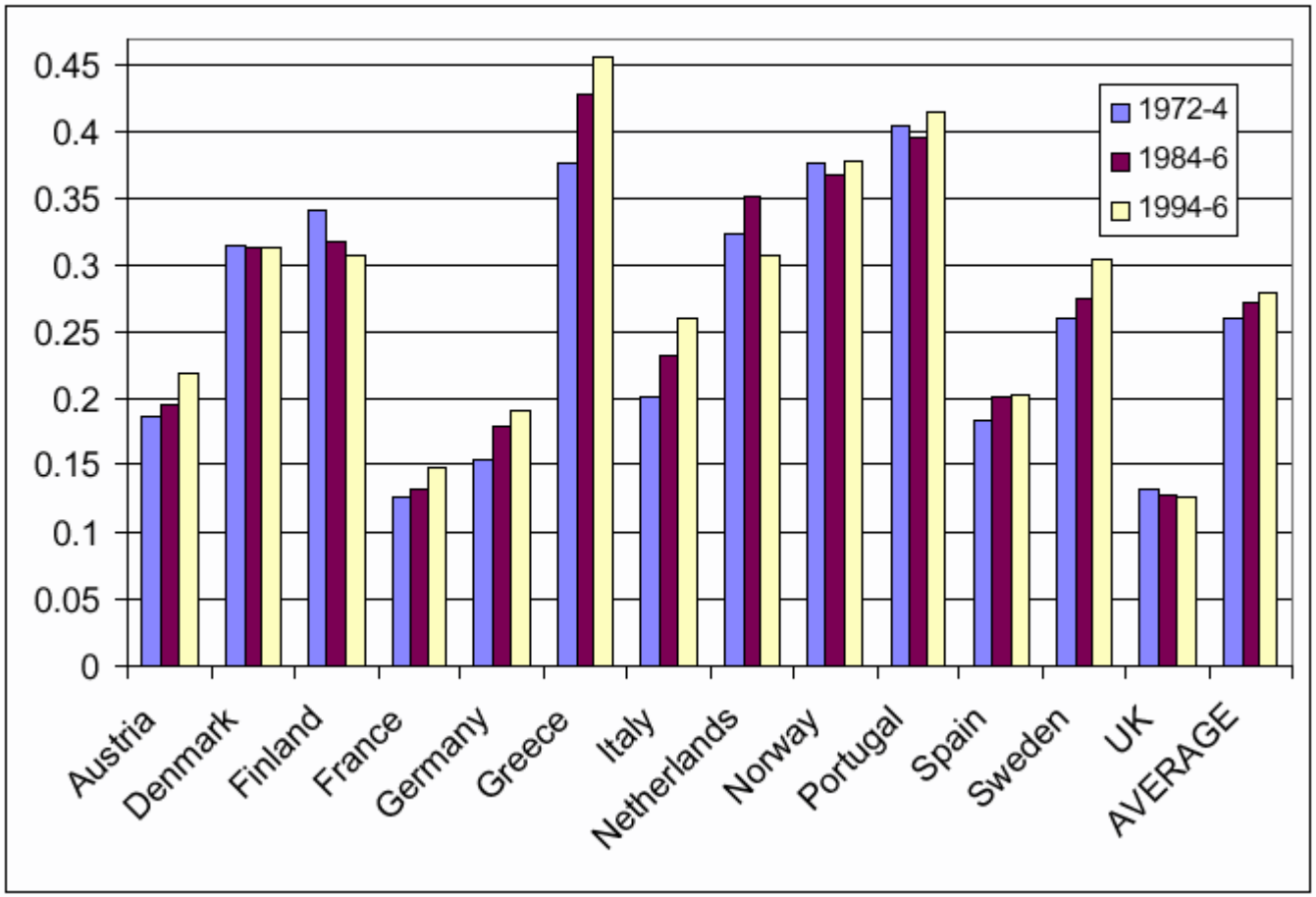
(Manufacturing specialisation of Finland, 1996)



a… Transport equipment n.e.c.
b… Pharmaceuticals
c… Motor vehicles
d… Food products
e… Professional and scientific equipment
f… Industrial chemicals
g… Machinery n.e.c.
h… Iron and steel
i… Radio, TV and telecom equipment
j… Shipbuilding
k… Wood products
l… Paper products

Source: Brülhart (2001b)

Figure 2: Country Specialisation in Manufacturing Employment, 1972-1996
(Gini indices, unweighted averages)



Source: Brülhart (2001b)

- *<u>Country (or locational) Gini Coefficient</u>*

1) calculate the Balassa index for concentration (for every region);

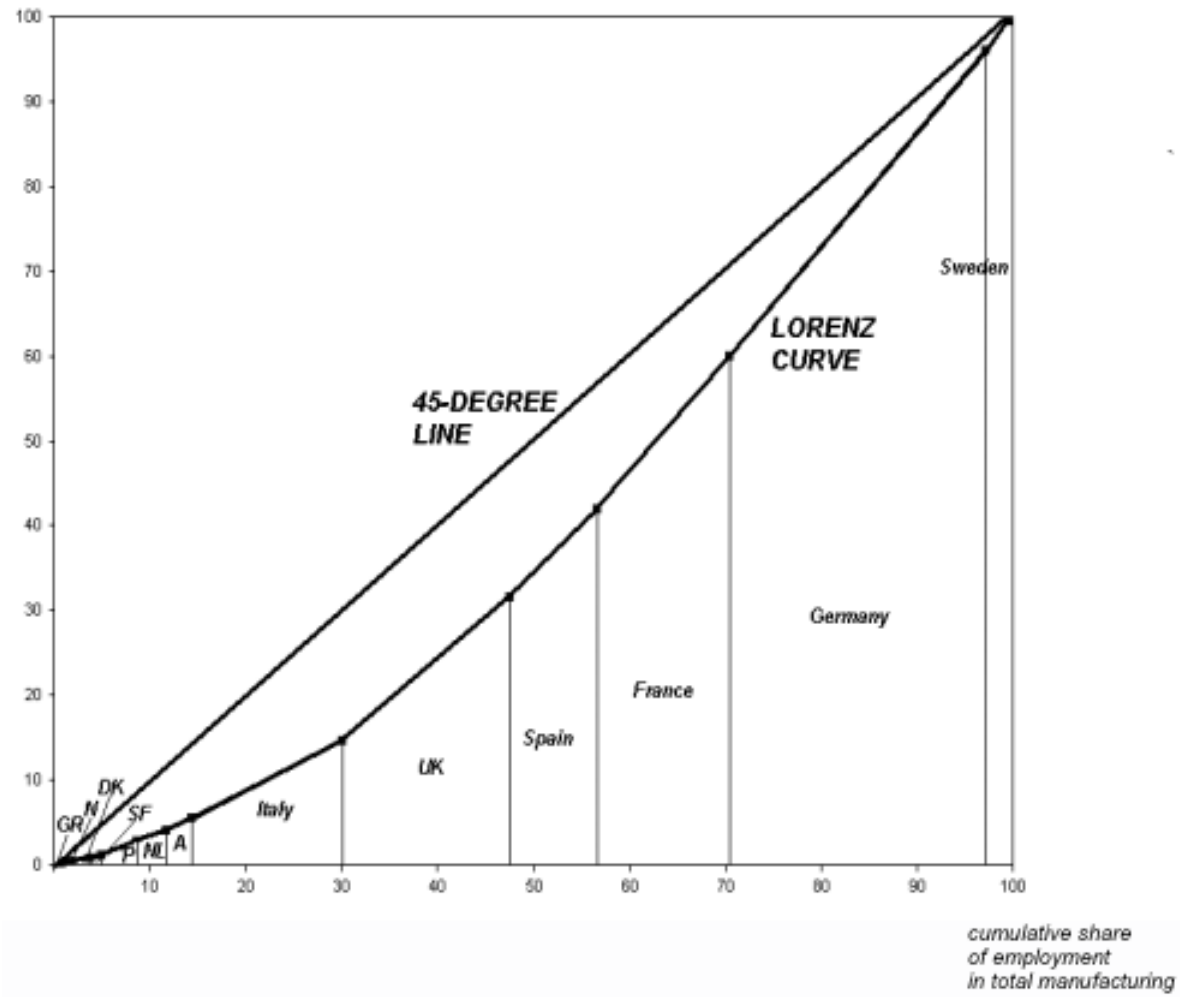
2) rank the scores in descending order and plot the cumulative of the numerator on the vertical axis against the cumulative of the denominator(on the horizontal axis (as in figure 1), and get the Lorenz curve;

3) calculate the Gini index

=> the higher the score, the higher is the degree of concentration!

Figure 1: A Locational Lorenz Curve

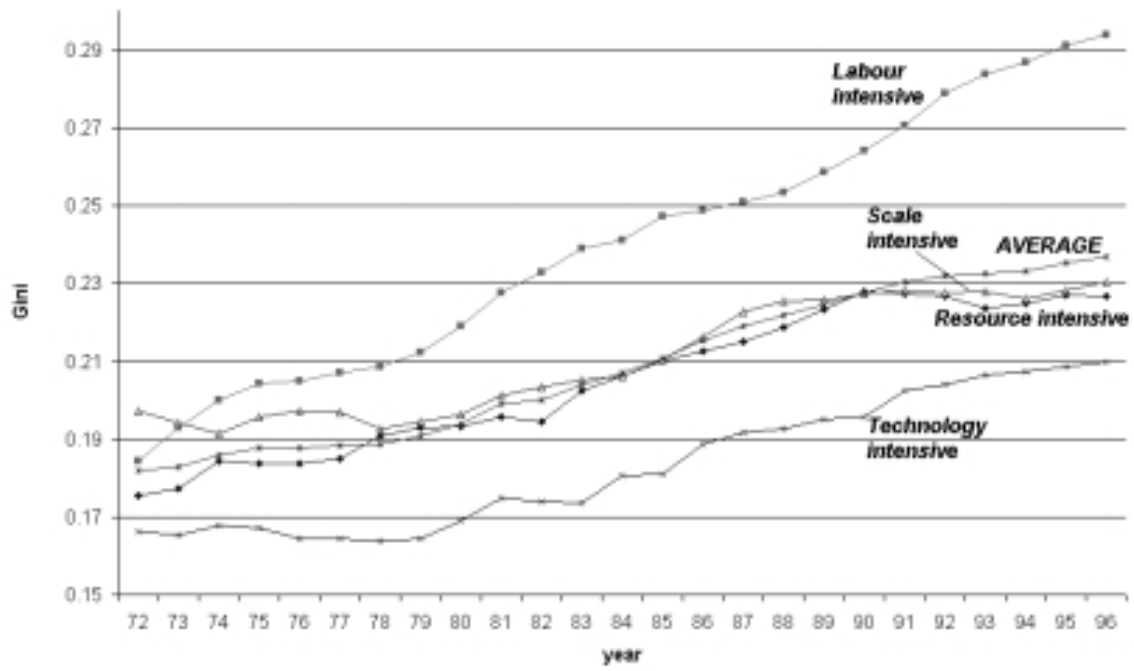
(Concentration in Motor Vehicles [ISIC 3843], 1996)



Source: Brülhart (2001a)

Figure 2: Employment Concentration Patterns in Five Industry Categories

(categorisation based on OECD, 1987)



Source: Brülhart (2001a)

Diversity as POLARISATION => SPATIAL CONCENTRATION

Measures of Polarisation:

...how diversity (in the organisation of economic activities) is localized

R = number of locations

N_i *= variable value at location (i)*

d_{ij} *= weight applied to the comparison between location (i) and location (j)*

In particular, $\mathbf{d_{ij}}$ is a contiguity matrix which compares the sum of the cross-products of values at different locations, two at a time, weighted in the following way**:**

1. dichotomic: if location (*j)* is adjacent to location (*i)*, the interaction receives a weight of 1; otherwise, it receives 0;
2. another option is to make d_{ij} a distance-based weight which is the inverse distance between locations (i) and (j) ($1/\tau_{ij}$);

A 'dissimilaruty' index is given by

<u>*Geary Index*</u> *(Geary, 1954):*

$$G = \frac{(R-1)\sum_{i=1}^{R}\sum_{j=1}^{R} d_{ij}(N_i - N_j)^2}{2dv}$$

where:

$$d = \sum_{i=1}^{R}\sum_{j=1}^{R} d_{ij}$$ *is the sum of all (positive) weights*

$$v = \sum_{i=1}^{R}(N_i - \mu)^2$$ *is simple variance*

Notes:

- the numerator is a 'distance' term, the squaring of which makes the index slightly more sensitive to extreme values than Moran's I;

- G normally takes on values on [0,2].

- [0,1] => positive correlation; 0 => perfect positive correlation; 1 => uncorrelation; > 1 => negative correlation.

Moran Index is still a defacto standard for determining spatial autocorrelation (see the next slide…):

Moran Index (Moran, 1950):

$$M = \frac{R}{d} \frac{\sum_{i=1}^{R} \sum_{j=1}^{R} d_{ij}(N_i - \mu)(N_j - \mu)}{\sum_{i=1}^{R} (N_i - \mu)^2}$$

where:

$d = \sum_{i=1}^{R} \sum_{j=1}^{R} d_{ij}$ *is the sum of all (positive) weights*

$\sum_{i=1}^{R} (N_i - \mu)^2$ *is variance (that is the expected perfect autocorrelation at no spatial lag); (μ is simple mean)*

Notes:

- as a correlation index, M should vary on [–1,1]; in practice, it varies on (+/- [VAR(LN)/VAR(N)]$^{1/2}$, with L=Lag operator) (Cliff and Ord, 1981); ii) the value in case of absolute uncorrelation is: M = - (R-1)$^{-1}$ (…and not zero!);
- therefore: M "tends" to +1 in case of positive correlation, and -1 in case of negative correlation;
- inverse (and linear) relation with G

The idea of Spatial autocorrelation is meant to capture the extent to which the occurrence of an event in a certain location (areal unit) influences (makes more or less probable) the occurrence of an event in a neighboring areal unit.

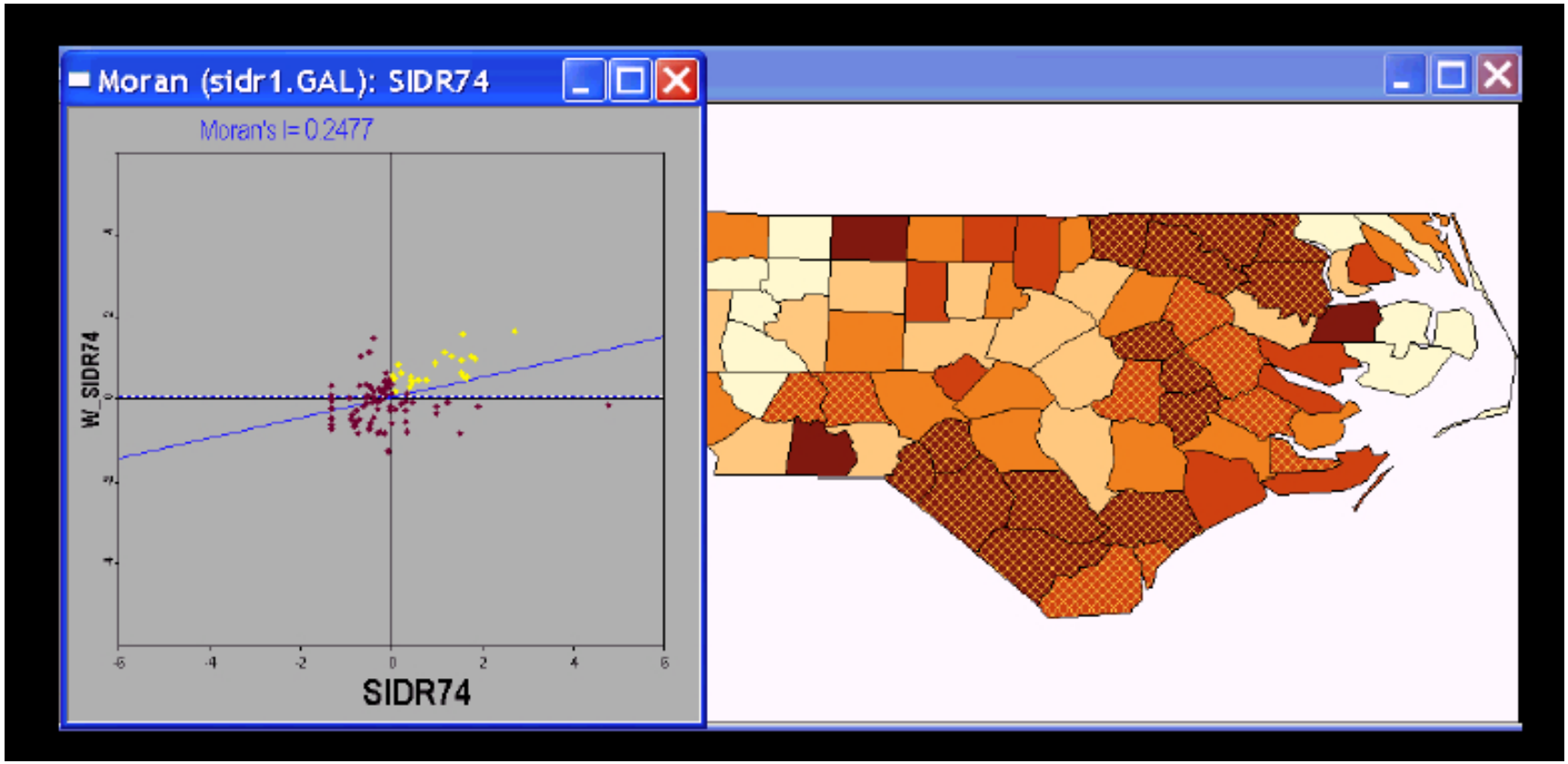
First Law of Geography: everything is related to everything else, but closer things are more closely related... (Tobler, 1970)

Diversity as POLARISATION => *SPATIAL* CONCENTRATION - Moran Index

Consider the linear association between value at (i) and weighted average of neighbours => four quadrants:

- high-high,low-low =spatial clusters
- high-low,low-high =spatial outliers

=> M: slope of linear scatterplot smoother



Source: Anselin L. (web site)

One coin: the spatial organization of economic activity;
Two sides: 'concentration' + 'spatial concentration'
A 'two sides of the same coin' problem => not able to see both sides…

1

0	0	0	0
0	3	0	3
0	0	0	0
0	3	0	3

a)
Moran I = - 0.18
Gini Concentration Ratio = 0.75

3	3	0	0
3	3	0	0
0	0	0	0
0	0	0	0

b)
Moran I = 0.27
Gini Concentration Ratio = 0.75

Moran

G = 0.5
M ≈ 0

1	1	1	1
1	0	1	0
0	1	0	1
1	1	1	1

c)
Moran I = - 0.22
Gini Concentration Ratio = 0.25

0	1	1	1
0	1	1	1
0	1	1	1
0	1	1	1

d)
Moran I = 0.22
Gini Concentration Ratio = 0.25

Gini

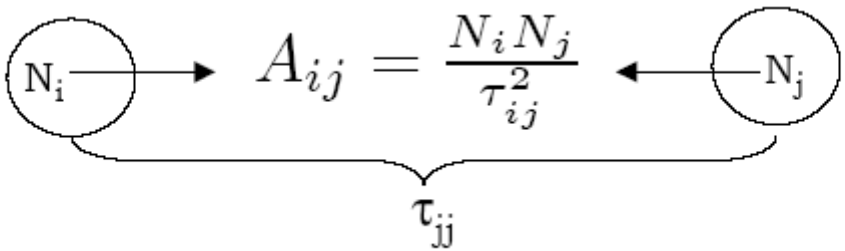
Source: Arbia (1998)

Market Potential (MP),

...IDEA: Newton's Universal Law of Gravitation

⇒any two objects exert a gravitational force of attraction on each other

The direction of the force is along the line joining the objects. The *magnitude* of the force is proportional to the product of the gravitational masses of the objects, and inversely proportional to the square of the distance between them.



Directly from Newton's law:

- a classical measure of <u>*Market Potential*</u> *(Harris, 1957) is:*

$$MP_i = \sum_{j=1}^{R} \frac{N_j}{\tau_{ij}}$$

where: N_i can be intended as population or income in location (i)

- a measure for the share of sales attracted by two sell-centres from a common intermediate location is due to (Reilly, 1931) (s.c. <u>*Law of Retail Gravitation*</u>*):*

$$\frac{F_{ia}}{F_{ib}} = \frac{N_{ia}}{N_{ib}} \left(\frac{\tau_{ia}}{\tau_{ib}} \right)^2$$

- an estimation of the flow between two locations (i) and (j) is provided by the s.c. <u>*Gravity Model*</u> *(based on Stewart, 1947):*

$$F_{ij} = G \frac{N_i^{\alpha} N_j^{\beta}}{\tau_{ij}^{\theta}}$$

where F_{ij} is the flow between locations (i) and (j); G is a gravitational constant, and α, β, θ are parameters to estimate.

- The following is a <u>market area</u> estimation for location (i):

$$MA_{i.} = \sum_{j=1}^{R} F_{ij}$$

- Another interesting notion is that of accessibility of a given location (Hansen, 1959):

$$Acc_{i.} = \sum_{j=1}^{R} N_j e^{-\lambda \tau_{ij}}$$

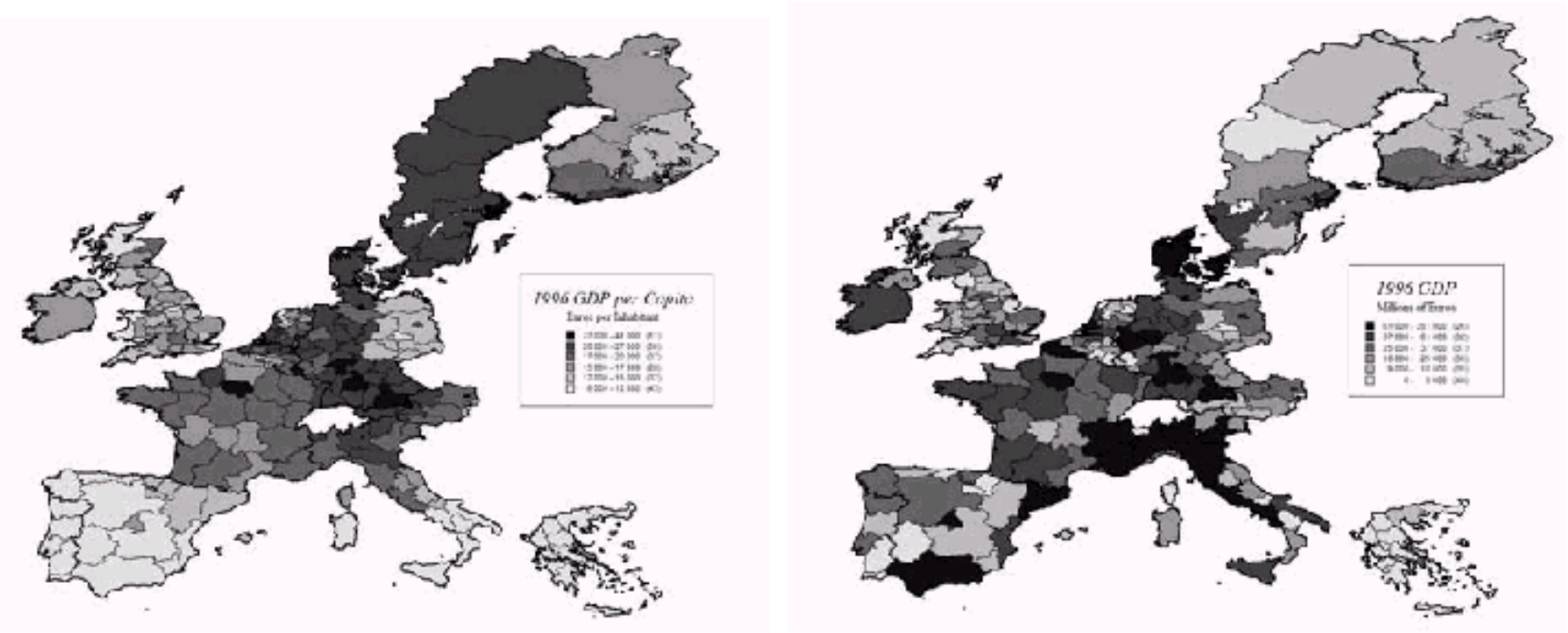
where: λ is a parameter indicating the friction of distance; and N_j is taken as a measure of business (or whatever else) opportunities in location (j)

- Note also that the following (very similar to the polarisation indexes above described...) can be thought of as a relative measure of MP dispersion across space:

$$D = \frac{\sum_{i=1}^{R} \sum_{j=1}^{R} d_{ij} N_i N_j}{N^2}$$

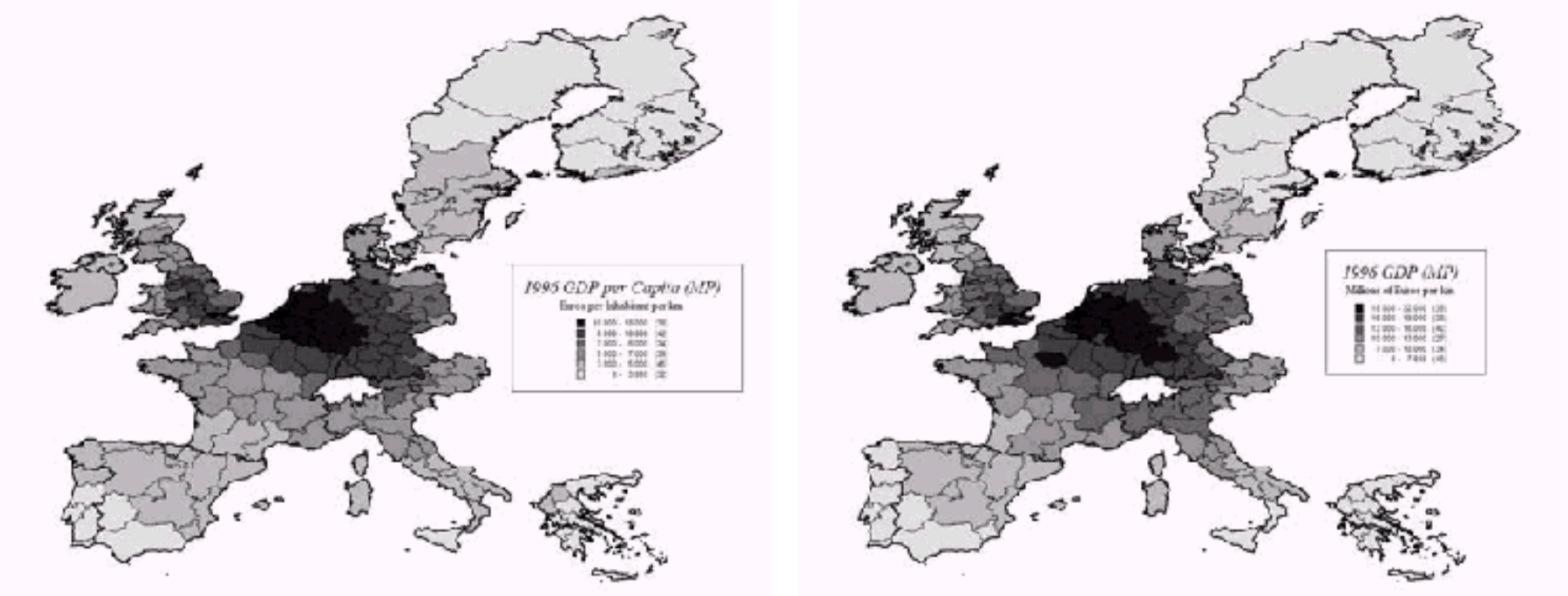
-> N^2 is the maximum of the numerator when: N_j=0 and d_{ij}=0 $\forall$ j≠i;
-> D could be seen as a unified dispersion-heterogeneity index in which: D=1 => maximum dispersion (heterogeneity); D=0 => minimum dispersion (heterogeneity)

Figure 1: Per capita (left) and total (right) GDP in European NUTS 2 regions



Source: Combes and Overman (2003)

Figure 3: Market potential of per capita (left) and total (right) GDP in European NUTS2 regions



Source: Combes and Overman (2003)

ELEMENTS OF GEOGRAPHICAL ECONOMICS

A - geographical economics: the origins

B - models of agglomeration

C - the relationship between integration and concentration in modern location theory

D - Integration in Europe and the spatial distribution of economic activities. Where do we stand, and what can we expect?

URBAN ECONOMICS

Von Thünen (1826) started:

- Isolated Town [Beckman(1957), Wingo (1961), Alonso (1964,1967), Mills (1967), Muth (1969),...]

Problem: it does not explain city formation!

- Central Place Theory [Christaller (1933), Lösch (1940),...]

Problem: (micro) fundamentals!

TRADE AND LOCALISATION THEORIES

- Transport costs [...Loria (1898), Hall (1902), Weber (1909),...]
- Economies of scale [Marshall (1890)]
  - M.1 - Technological externalities
  - M.2 - Thick markets
  - M.3 - Market size effects

Regional economics [Hoover (1933), Perroux (1950), Isard (1956), Pred (1966), Harris (1954),...]
(demand linkages)

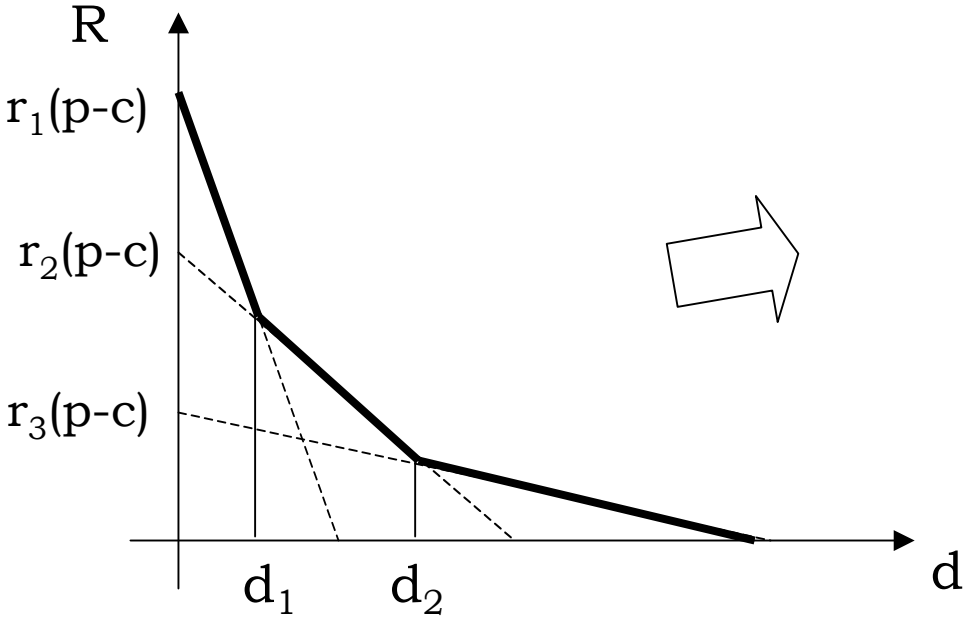
Problem: => Spatial Impossibility Theorem!

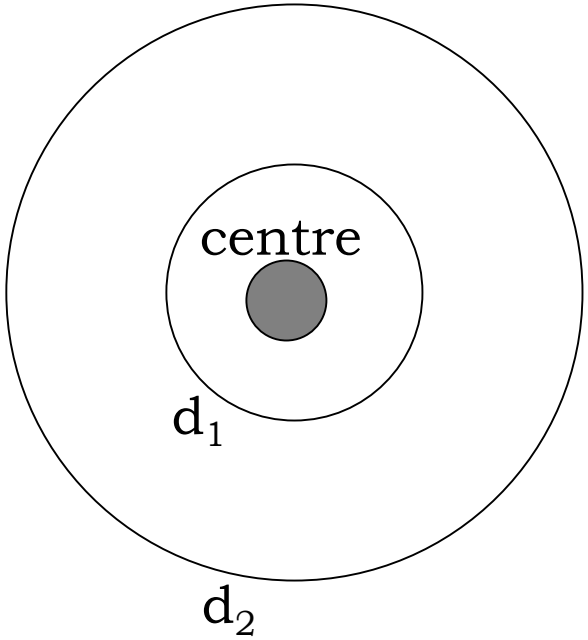
The town according to *Von Thünen (1826)*:

distance (from the centre) => TC => land rent => land use

↓

market



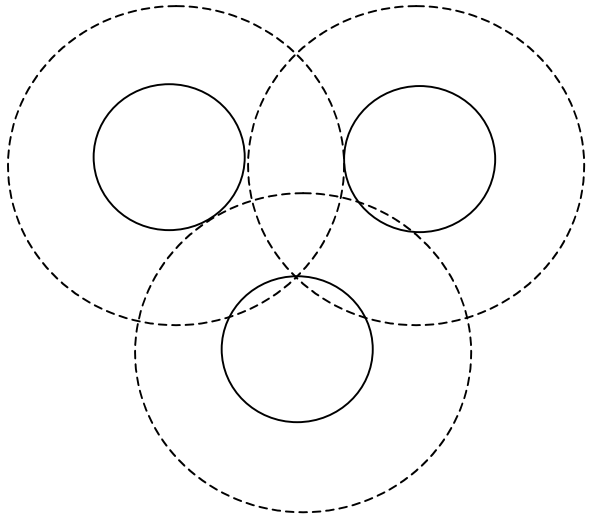


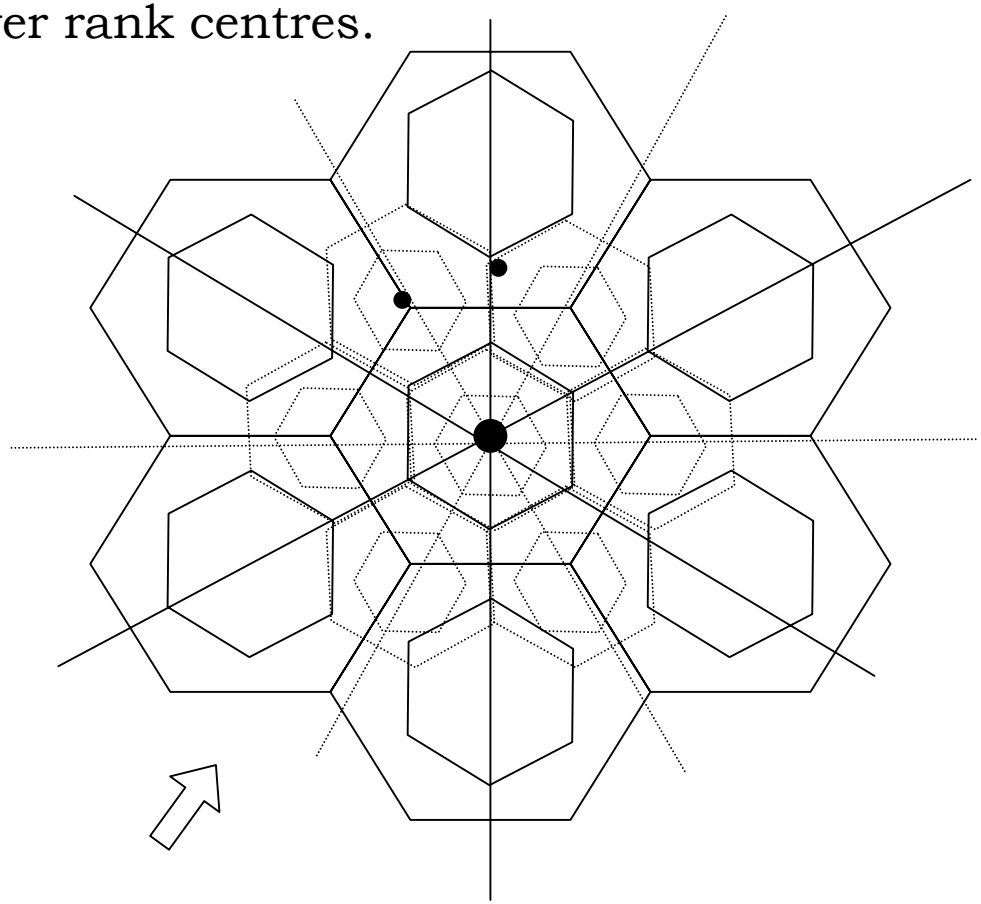
$R = r(p-c) - rtd$

where: R = total land rent
r = (unitary) land rent;
p - c = (unitary) profit
t = transport costs
d = distance (from the centre)
$r_1 > r_2 > r_3$

The theoretical distribution of locations, according to the *Central Place Theory*

- Centres are ranked: centre of rank *i* provides its own rank goods and all the goods provided by lower rank centres.





N.B.
- demand effects;
- input localisation;
- administrative rules;
- axis of transport;

The exact distribution of centres in the network depends on which of these effects is elected as the most relevant...

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Problem: it does not explain city formation!

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Problem: (micro) fundamentals!

TRADE AND LOCALISATION THEORIES

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  - M.2 - Thick markets
  - M.3 - Market size effects

Regional economics [Hoover (1933), Perroux (1950), Isard (1956), Pred (1966), Harris (1954),...]
(demand linkages)

Problem: => Spatial Impossibility Theorem!

CENTRIPETAL FORCES

'Marshallian triad' - Marshall (1890):

M.1 · Pure external economies: concentration => 'information spillovers'
all firms take advantages from agglomeration

"The mysteries of the trade become no mysteries; but are as it were in the air, and children learn many of them unconsciously. Good work is rightly appreciated, inventions and improvements in machinery, in processes and the general organization of the business have their merits promptly discussed: if one man starts a new idea, it is taken up by others and combined with suggestions of their own; and thus it becomes the source of further new ideas"
[Marshall (1890), Ch. X: Industrial Organization Continued.
The Concentration of Specialized Industries in Particular Localities, 3]

it is easier to monitor and manage activities in an established centre where firms know and can benchmark each others (Venables, 2001).

M.2 · Thick labour markets:
concentration => employees and employers are readily matched;

M.3 · Market-size effect: (home-market effect) -> demand and cost linkages
(also called backward and forward linkages).

local concentration => large local market

'demand linkages'
(i.e. sites close to large markets are preferred location for the production of goods)

'cost linkages'
(i.e. the local production of intermediate goods lowers the production costs of other producers);

URBAN ECONOMICS

Von Thünen (1826) started:

- Isolated Town [Beckman(1957), Wingo (1961), Alonso (1964,1967), Mills (1967), Muth (1969),...]

Problem: it does not explain city formation!

- Central Place Theory [Christaller (1933), Lösch (1940),...]

Problem: (micro) fundamentals!

TRADE AND LOCALISATION THEORIES

- Transport costs [...Loria (1898), Hall (1902), Weber (1909),...]
- Economies of scale [Marshall (1890)]
  - M.1 - Technological externalities
  - M.2 - Thick markets
  - M.3 - Market size effects

Regional economics [Hoover (1933), Perroux (1950), Isard (1956), Pred (1966), Harris (1954),...]
(demand linkages)

Problem: => Spatial Impossibility Theorem!

Spatial Impossibility Theorem...

⇩

2 theroetical solutions: - Models with only Technological Externalities (M.1)
- Models with Pecuniary Externalities (...M.3)

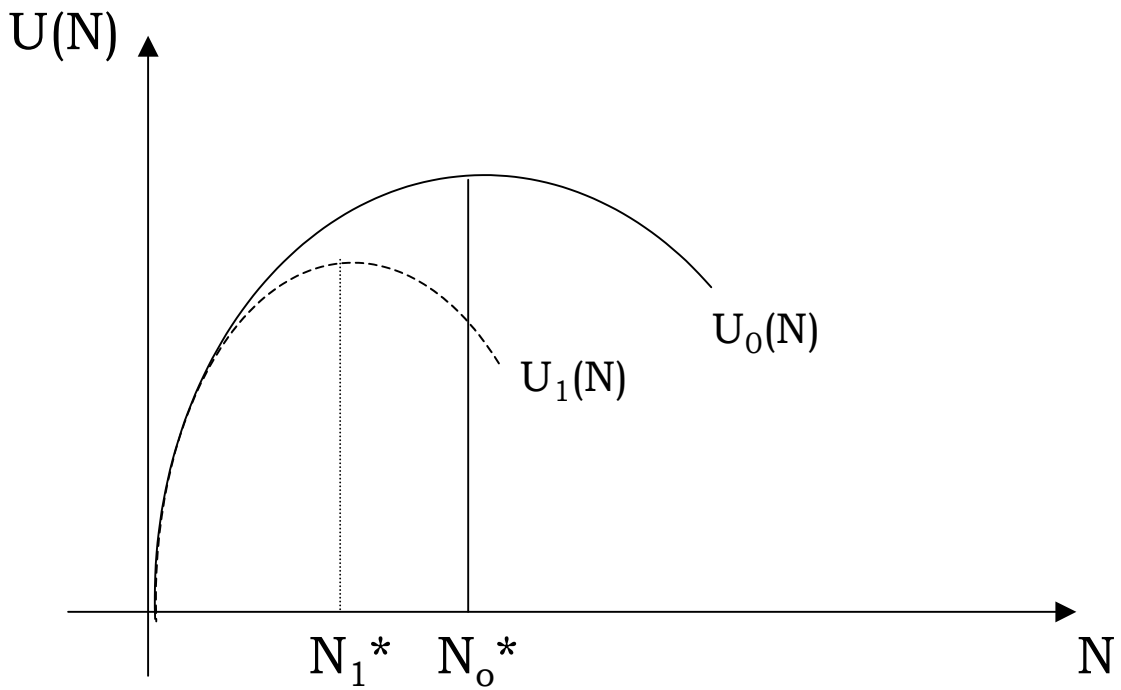
Following *Scitovsky (1954)*:

Let $y_i = f(z_i, h)$ be firm's i production function, in which z_i are inputs used and h is a component related to other enterprise's choices. Writing this latter as $h = h(y_{-i}, z_{-i})$, the profit function assumes the form:

$$\Pi_i(p, w, h) = py_i(z_i(p, w, h), h) - wz_i(p, w, h). \tag{1}$$

In this formulation, h influences firm's i production (both directly and through demand function), thus giving rise to "technological externalities". On the other hand, we have to consider that the action of other firms may influence firm's i profit function also through "market interactions" affecting the price of goods p and/or inputs w: this introduces further effects that are named "pecuniary externalities".

B - Models of Agglomeration with <u>only technological externalities</u> (the intuition)



M.1 are external to firms but internal to the industry as a whole
=> agglomeration
Crowding effects
=> dispersion (these are negative externalities, and therefore
=> over-agglomeration)

⇨ <u>Industrial Districts</u>: Becattini, etc.

⇨ <u>Cities</u>: Henderson (AER,1970)

B - Models of Agglomeration with pecuniary externalities

(Monopolistic Competition (=>LOV)) + (IRS)

Urban Economics

...without trade

Rivera-Batiz (RSUE,1988),
Fujita (RSUE,1988),
Abdel-Rahman (RSUE,1988)

Trade Theory

...with trade (intra-industry)
=> New Trade Theory (NTT)
[Krugman (AER,1980), Krugman and Venables (1990)]

...with trade (intra-industry) + cumulative causation...
-> demand linkages [Krugman (1991)]
-> cost linkages [Venables (1996)]
-> factor accumualtion [Baldwin (1997)]

=> New Economic Geography (NEG)

(...agglomeration is endogenous in presence of integration...)

Increase in concentration => opposite effects:

- Market Crowding (Competition Effect) => CENTRIFUGAL
  ...local competition is fiercer => lower profits => some firms leave the market...
  stronger if: i) goods are good substitutes, ii) TC are high.

+

if firms *are* vertically linked: => CENTRIPETAL

- Cost Linkages: fiercer competition
  ...lower input costs => higher profits...

or

if firms *are not* vertically linked: => CENTRIPETAL

- Demand Linkages (Home Market Effect, or Market Size Effect):
  ...part of the income produced locally is spent locally => higher local demand...

Moreover:

- Price-Index Effect:
  ...more products are produced locally (so facing lower TC) =>
  => higher wages => immigration... => CENTRIPETAL

CENTRIFUGAL FORCES
(always involving some form of costly transportation or congestion costs)

Following Krugman (1998):

1 · Immobile factors (land, natural resources, and, to some extent, labour):

- on the demand side => industries have to go where factor owners are…
- on the supply side => industries have to go where factors are…

2 · Land rents:
concentration => higher cost of land => disincentivates further concentration.
(…in fact, most of the land-consuming manufacturing activities have left the urban areas);

3 · Pure external diseconomies:
concentration (economic activities + population) => congestion costs (increased traffic, pollution, crime, etc…)

…thus, the interaction between centripetal and centrifugal forces determines the relative attractiveness of alternative production sites!!!

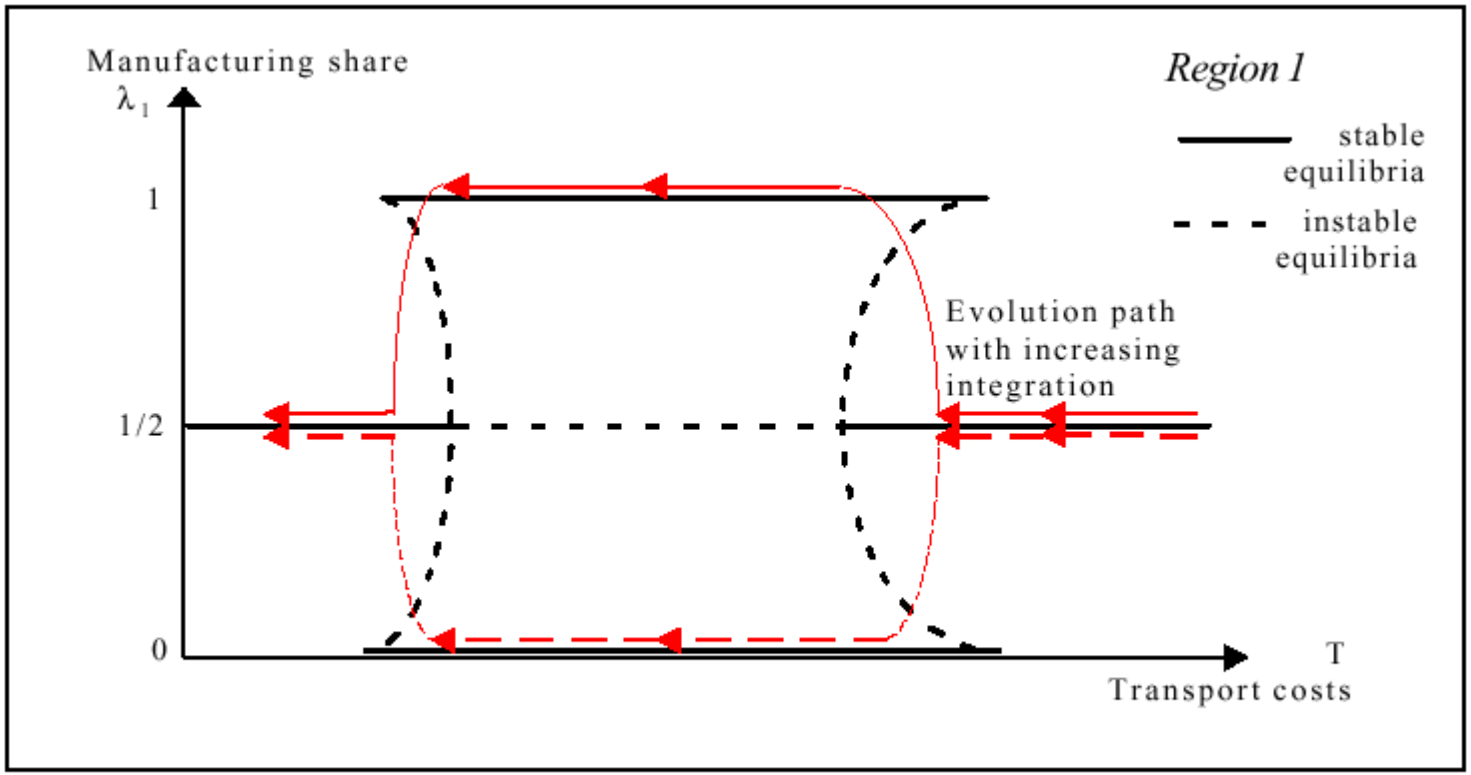
⇩

centripetal and centrifugal forces are both influenced by transport costs

⇩

relationship between *concentration* and *integration*
(measures of integration: transport costs, accessibility, etc…)

The U-shaped relationship between *concentration* and *integration:*



Source: Fujita, Krugman, Venables (1999). - Ottaviano and Puga (1997). - Own illustration.

The story: with high trade costs (low integration), competition effect dominates centrifugal forces, but with the integration process going on, further reductions in transport costs determines the market effect dominating dispersion forces => concentration in the core.

Therefore: if we assume that transport costs are sufficiently low (medium-high level of integration), the theory tells us that:

further INTEGRATION ⇒ ↑ AGGLOMERATION
[Krugman (1991)]

…but!

further INTEGRATION ⇒ ↑ DISPERSION
[Krugman and Venables (1996)]

(is this the case of Europe?)

low FM
high CC

high FM
low (or no) CC

Key-elements [Puga (1999)]:
…factor (i.e. labour) mobility (…FM)!
…commuting costs (within city transport costs and congestion (…CC)!

INTEGRATION

Tabuchi - Thisse - Zeng (2002)

⇓ Under high labour mobility!

- when trade costs are high, their decrease triggers an agglomeration process in which each large region attracts workers and firms from the small regions which shrink.

- when trade costs are small, the large cities lose workers and firms, while the small cities grow.

- when trade costs take intermediate values, medium size cities lose workers and firms, while large and small cities grow.

To sum up:
- agglomeration takes place in the early stages of economic integration, while re-dispersion should occur in the late stages of the economic integration process.
- small cities shrink in the early stages, medium size cities shrink in the next stages, and large cities shrink in the late stages of the process of economic integration.

⇓

<u>DISPERSION</u>

C - The relationship between integration and concentration in modern location theory

Remark 1. In both approaches (technological and pecuniary externalities):

- N is an inverse function of the externalities;
- N (relative to other cities) is a function of production technology (i.e. of inputs and goods in which firms specialise);
- market N > optimal N
- "city corporations" (in case of technological externalities) or subsidies (in case of pecuniary externalities) => optimal N

Remark 2. The two approaches lead to the same aggregate production function and to the same wage function. Therefore, the difference is only in policy recommendations [Abdel-Rahman and Fujita [(JRS,1990)]

Remark 3. Role of the spatial mobility of production factors:

Puga (EER,1999) => territorial mobility makes centripetal forces stronger; with an high degree of integration, territorial immobility acts as a centrifugal force.

Remark 4. NEG does not allow welfare analysis => Ottaviano, Tabuchi and Thisse (IER,2002)

Integration in Europe and the spatial distribution of economic activities. Where do we stand, and what can we expect?

or better: WHAT DO WE KNOW ABOUT THAT?

1 - Specialisation

2 - Concentration

3 - Spatial Integration
- Economic Integration
- the 'European Spatial Policy'

Let's start form the the spatial distribution of economic activities: *specialisation* and *concentration*.

Knarvik, Overman, Redding and Venables (2000) - Hallet (2000) - Brülhart (WE,1998a,b, 2001a,b) - Amiti (WA,1999)

Remark S.1 Specialisation seems to be positively correlate with Spatial Integration in the US.

Remark S.2 The degree of specialisation in the US is higher than in the EU. This is evident dating at least from the 1970s.

Remark S.3 Though there is not univocal evidence, EU countries seem to become slightly more specialised.

Remark S.4

big core EU countries = least specialised;	France-Germany-UK
small core countries = slightly more;	Austria-Belgium-Netherlands
scandinavian countries = more sp;	Sweden-Denmark-Finland
2 cohesion countries = most sp.	Greece-Ireland-Portugal

outliers: Italy = core country with medium-high specialisation
Spain = cohesion country with low specialisation

Remark S.5 At the state of the art, it is still not possible to compare the regional specialisation pattern characterising different EU countries.

Table 2: Specialisation patterns in the EU

Country	1970-73	1980-83	1988-91	1994-97
Austria	0.314	**0.275**	0.281	0.348
Belgium	**0.327**	0.353	0.380	0.451
Denmark	0.562	**0.553**	0.585	0.586
Spain	0.441	**0.289**	0.333	0.338
Finland	0.598	**0.510**	0.528	0.592
France	0.204	**0.188**	0.207	0.201
Great Britain	0.231	**0.190**	0.221	0.206
Germany	0.319	**0.309**	0.354	0.370
Greece	**0.531**	0.580	0.661	0.703
Ireland	0.701	**0.623**	0.659	0.779
Italy	**0.351**	0.353	0.357	0.442
Netherlands	**0.508**	0.567	0.547	0.517
Portugal	0.536	**0.478**	0.588	0.566
Sweden	0.424	**0.393**	0.402	0.497
Weighted average	0.326	**0.302**	0.33	0.351

Note: Minimum values for each country in bold font. Calculations based on four year averages at the dates indicated.

D - EU Integration

Knarvik, Overman, Redding and Venables (2000)
Hallet (2000)
Brülhart (WE,1998)

Remark C.1 There is no sufficient evidence for stating that concentration is positively correlated with spatial integration (both in the EU and the US).

Remark C.2 The degree of concentration in US is higher than in EU. This is evident dating at least since the 70s.

Knarvik, Overman, Redding and Venables (2000)
Brülhart and Traeger (mimeo,2002)

Remark C.3 There is no sufficient evidence for stating that *spatial* concentration is positively correlated with spatial integration.

Remark C.4 Large differences emerge from the comparison of the degree of concentration in different sectors across EU countries.

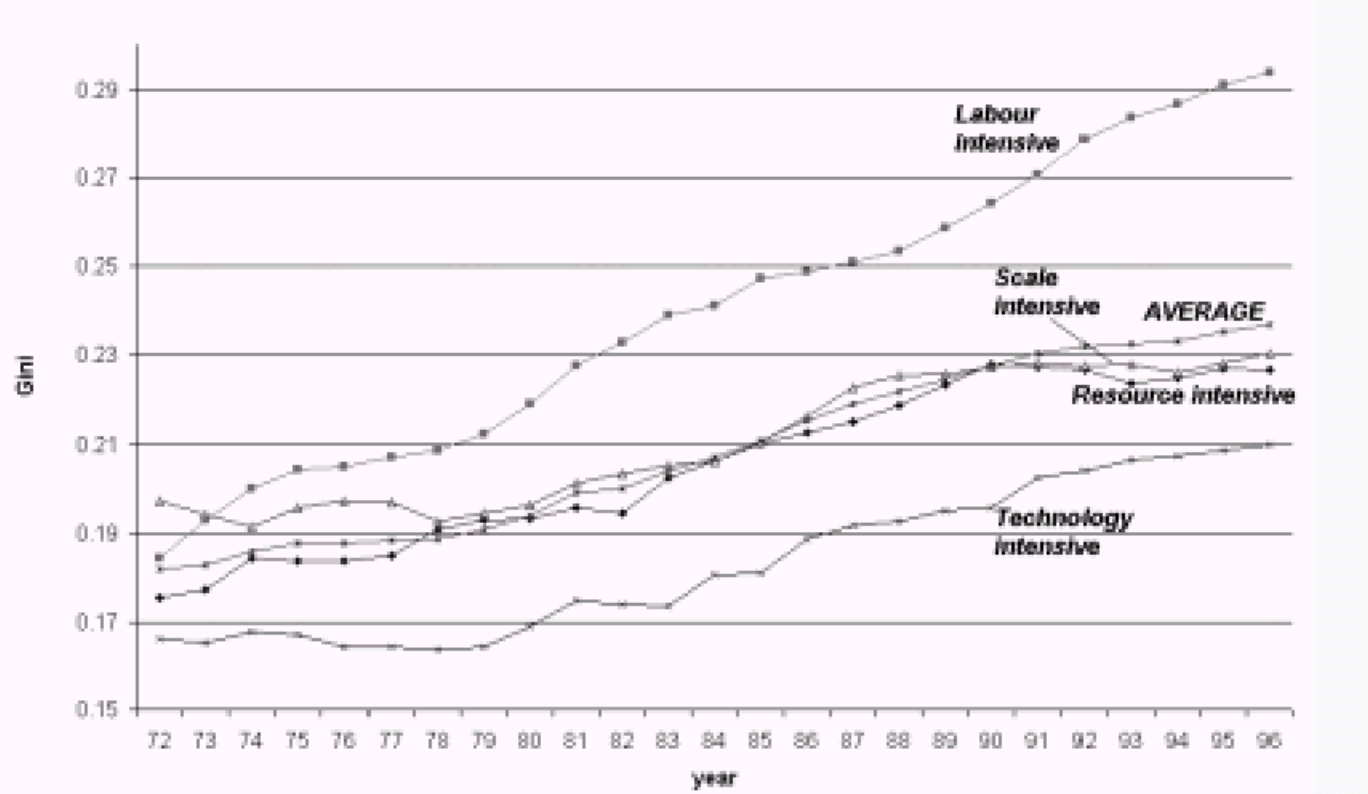
Table 3: Industrial concentration across EU countries

Industry	Gini	Change	Industry	Gini	Change
Motor Vehicles	0.703	0.009	Furniture & Fixtures	0.596	0.028
Pottery & China	0.695	0.071	Machinery & Equipment nec	0.592	-0.071
Aircraft	0.693	0.016	Tobacco	0.592	-0.07
Leather & Products	0.685	0.138	Railroad Equipment	0.591	-0.048
Petroleum & Coal Products	0.682	0.009	Communication equipment	0.589	-0.065
Motorcycles & Bicycles	0.671	0.029	Glass & Products	0.569	-0.047
Footwear	0.669	0.075	Metal Products	0.567	-0.009
Electrical Apparatus nec	0.645	-0.023	Textiles	0.566	0.012
Transport Equipment nec	0.628	0.077	Beverages	0.557	-0.09
Rubber Products	0.624	0.005	Other Manufacturing	0.552	-0.025
Non-Ferrous Metals	0.623	0.042	Industrial Chemicals	0.546	-0.067
Chemical Products nec	0.622	-0.036	Non-Metallic minerals nec	0.542	-0.034
Petroleum refineries	0.621	-0.01	Pharmaceuticals	0.519	-0.078
Wearing Apparel	0.613	0.038	Printing & Publishing	0.515	-0.024
Iron & Steel	0.611	-0.014	Wood Products	0.498	-0.035
Office & Computing Machinery	0.608	-0.072	Paper & Products	0.479	-0.025
Plastic Products	0.6	-0.002	Food	0.46	-0.043
Professional Instruments	0.597	-0.068	Shipbuilding & Repairing	0.445	-0.022

Source: Combes and Overman (2003)

Figure 2: Employment Concentration Patterns in Five Industry Categories

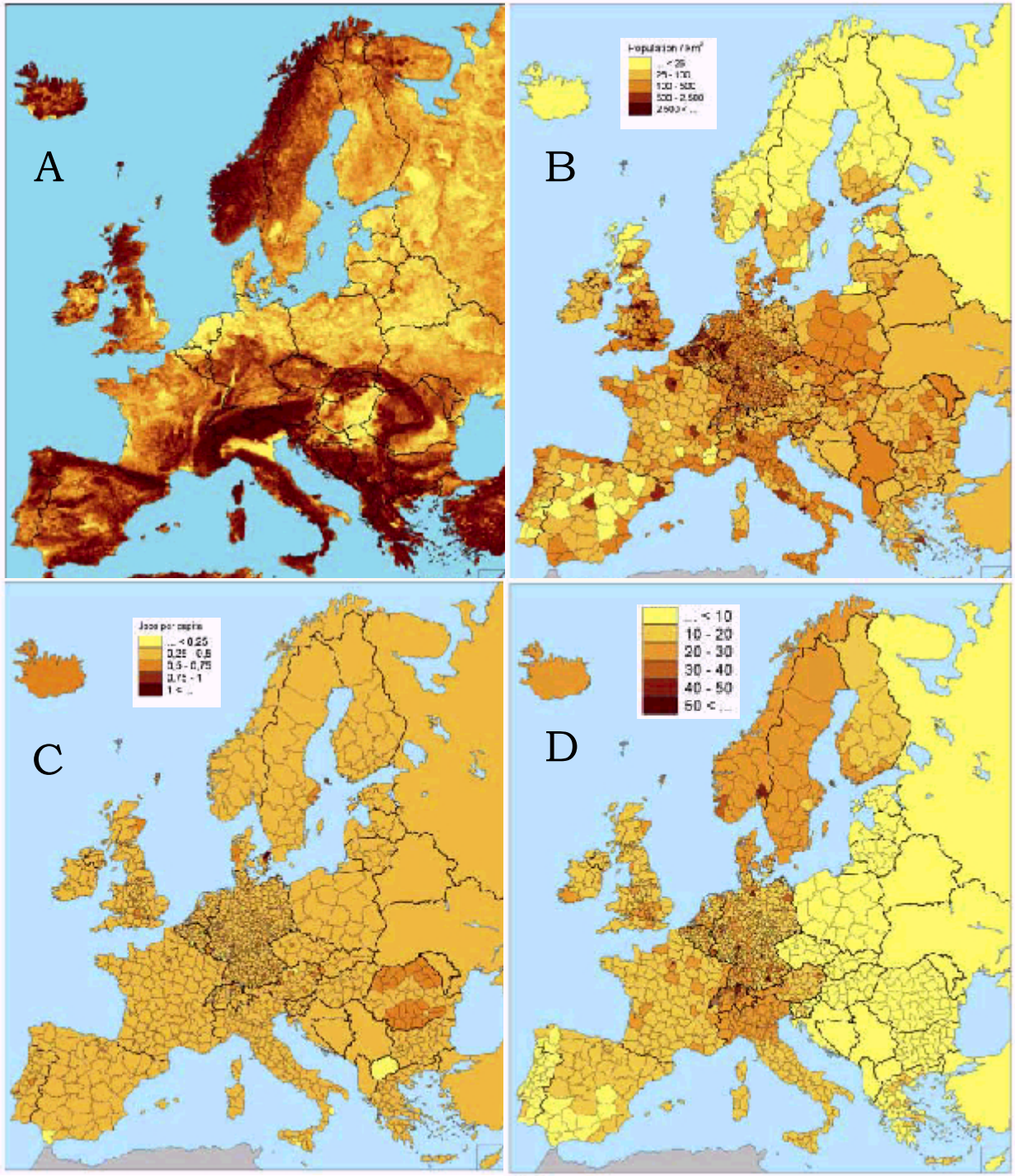
(categorisation based on OECD, 1987)



Source: Brülhart (2001a)

Why the EU specialisation and concentration patterns do not match the models?

...let's consider more in details the (spatial) integration process in Europe...



A -Physical Europe.

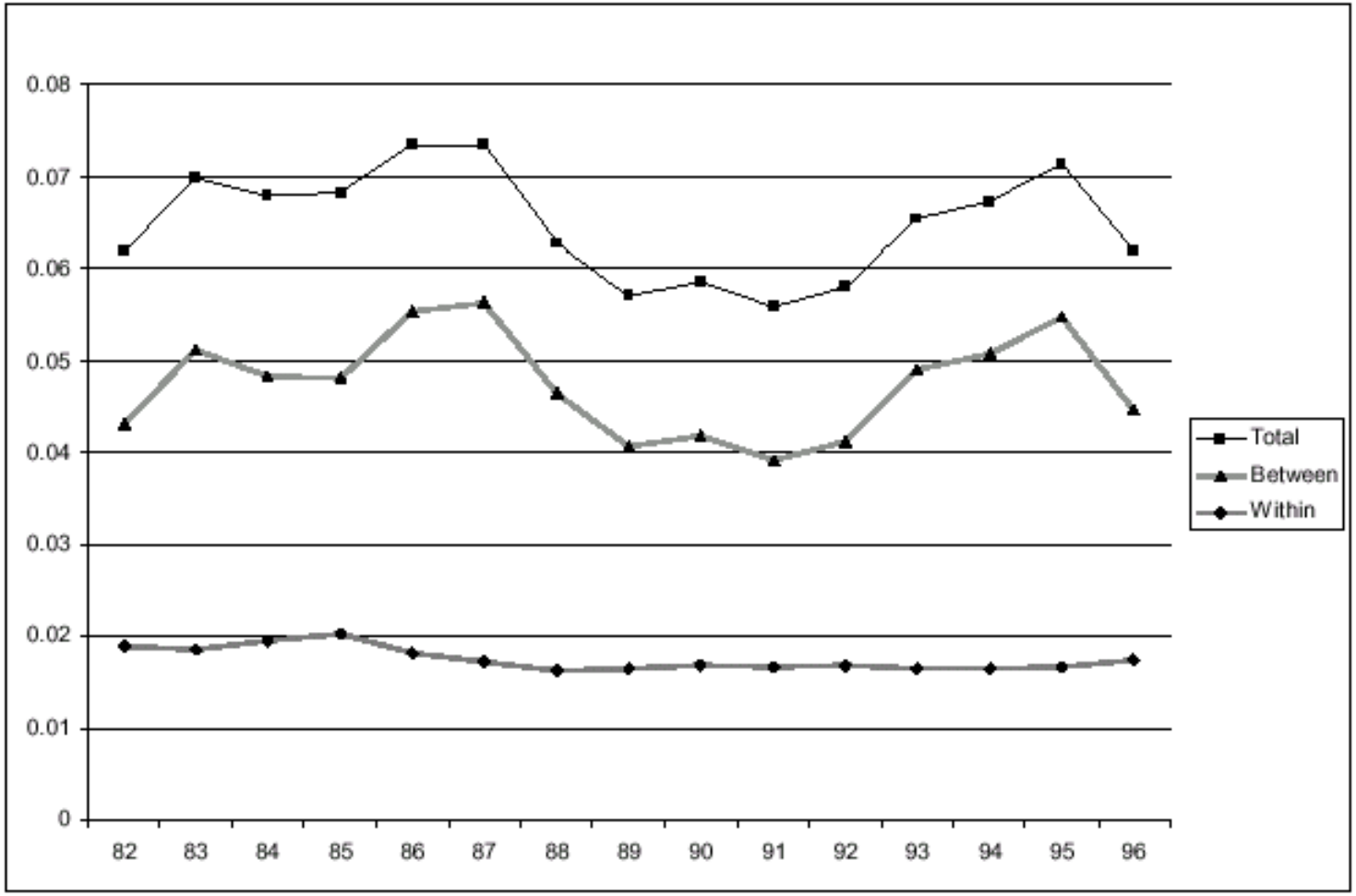
2002:

B -Population density
(NUTS-3 regions)

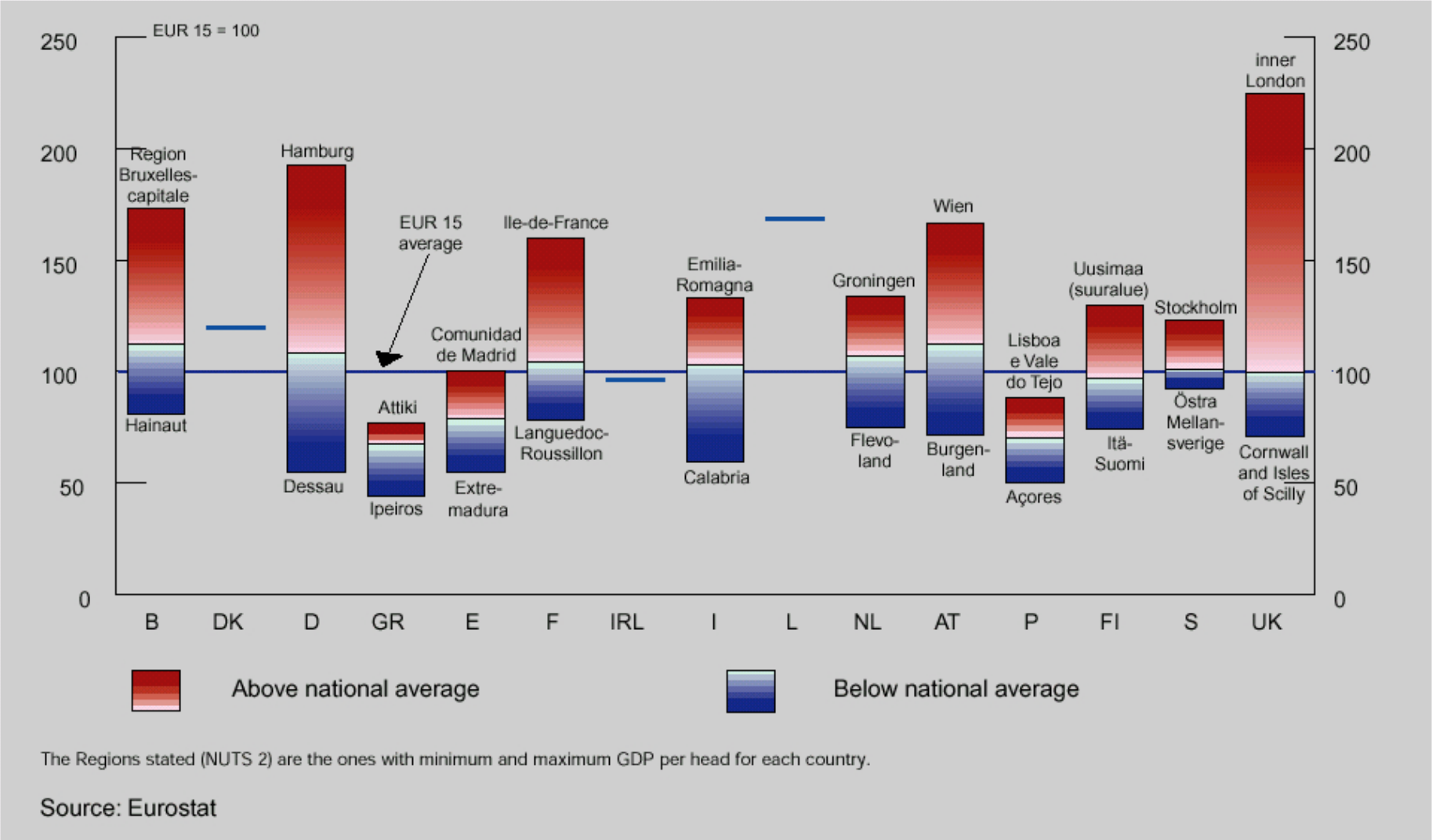
C - Jobs per capita
(NUTS-3 regions)

D - GDP per capita in Euro
(NUTS-3 regions)

Figure 2: Theil Index for regional GDP per capita (EU12)



Source: Combes and Overman (2003)



Regional disparities in GDP per capita, 1996

Priority projects adopted in 1996

1. High-speed train/combined transport north–south
2. High-speed train PBKAL (Paris–Brussels–Cologne–Amsterdam–London)
3. High-speed train south
4. High-speed train east
5. Conventional rail/combined transport: Betuwe line
6. High-speed train/combined transport, France–Italy
7. Greek motorways, Pathe and Via Egnatia
8. Multimodal link Portugal–Spain–Central Europe
9. Conventional rail link Cork–Dublin–Belfast–Larne–Stranraer (*completed*)
10. Malpensa airport, Milan (*completed)*
11. Øresund fixed rail/road link between Denmark and Sweden (*completed)*
12. Nordic triangle rail/road
13. Ireland/United Kingdom/Benelux road link
14. West coast main line (rail)

Priority projects proposed by the European Commission in 2001 (*new projects and extensions*)

New projects

15. Global navigation and positioning satellite system Galileo
16. High-capacity rail link across the Pyrenees
17. Eastern European combined transport/high-speed train
18. Danube river improvement between Vilshofen and Straubing
19. High-speed rail interoperability on the Iberian peninsula
20. Fehmarn Belt: fixed link between Germany and Denmark

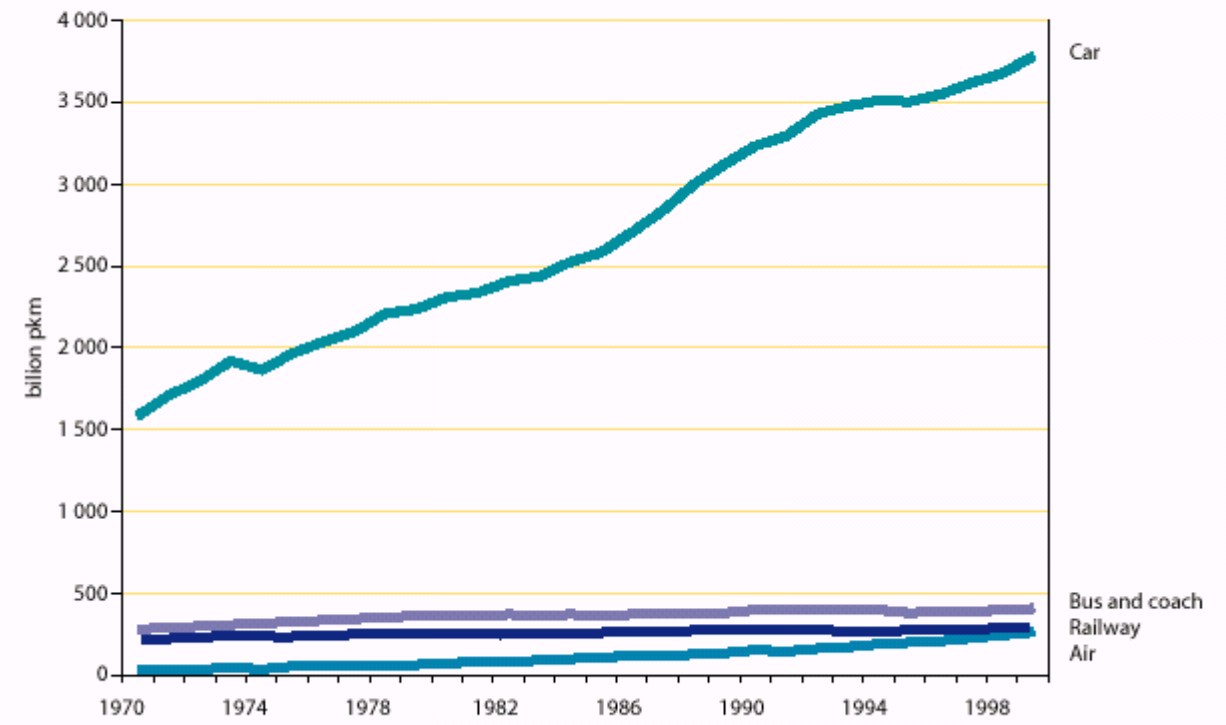
Extensions

1. High-speed train/combined transport north–south (Verona–Naples and Bologna–Milan)
3. High-speed train South (Montpellier–Nîmes)

- Adopted Rail Project
- Proposed Rail Project
- Adopted Road Project
- Proposed Road Project
- Rail Network (in 2010)
- Road Network (in 2010)

i) Travel costs and travel time:

Fig. 1 — Passenger transport — Growth of traffic by mode of transport, EU-15: 1970–1999

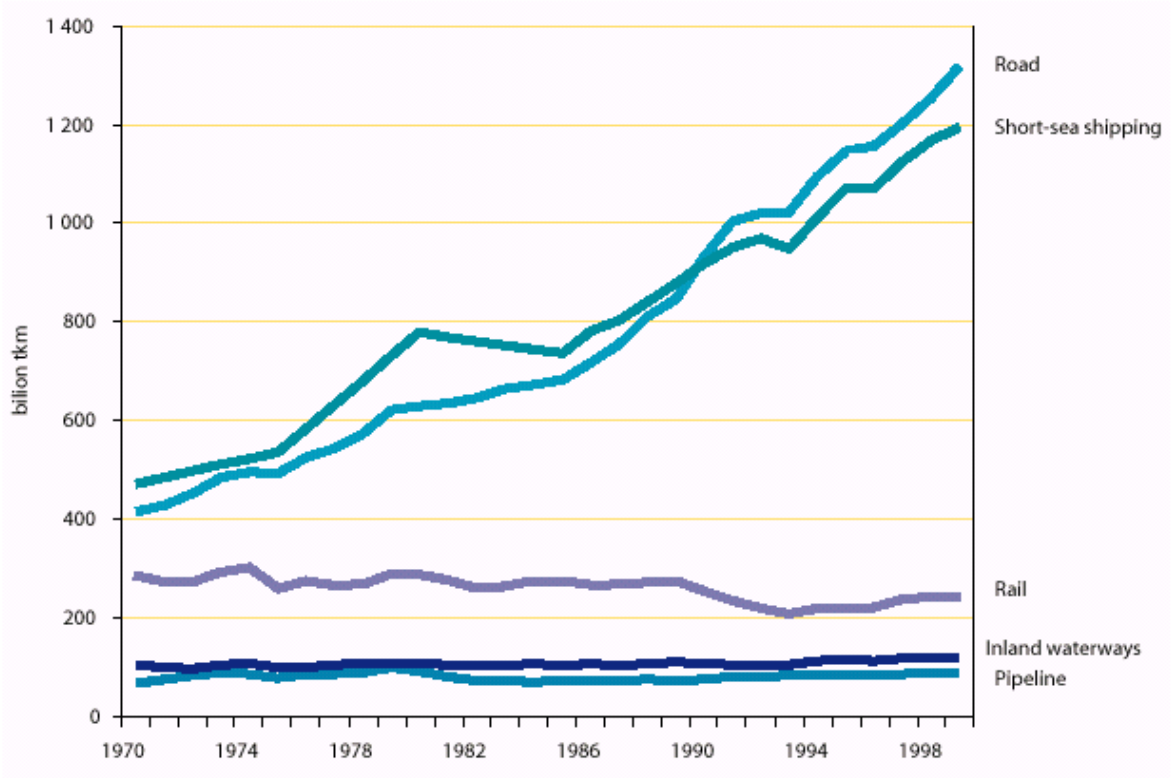


Passanger kilometre: transport of a passenger over one kilometre

Source: White Paper on the European Transport Policy (2001)

D - EU Integration

Fig. 2 — Goods transport — Growth of traffic by mode of transport, EU-15: 1970–99



Tonne kilometre: transport of one tonne over one kilometre

Source: White Paper on the European Transport Policy (2001)

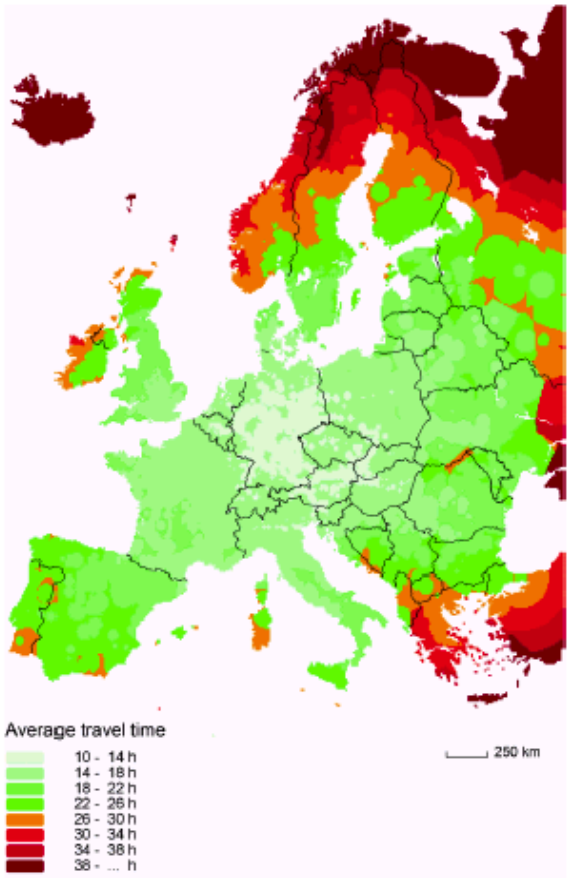
Remark 1. There is no univocal evidence about a positive correlation between socio-economic integration and the magnitude of interactions across Europe, though it is evident for road freight and passenger transport.

ii) Accessibility: Source: Spiekermann and Neubauer (2002)

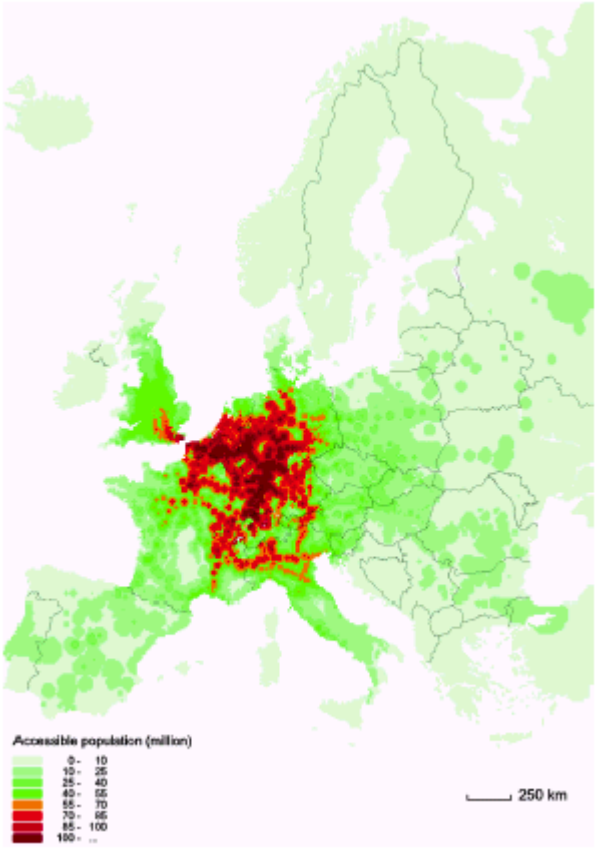
$A_i = \sum_j g(W_j)\, f(c_{ij})$	Activity function $g(W_j)$	Impedance function $f(c_{ij})$
Travel cost Travel cost to a set of activities	$W_j \mid 1 \text{ if } W_j \geq W_{min}$; $0 \text{ if } W_j < W_{min}$	c_{ij}
Daily accessibility Activities in a given travel time	W_j	$1 \text{ if } c_{ij} \leq c_{max}$; $0 \text{ if } c_{ij} > c_{max}$
Potential Activities weighted by a function of travel cost	W_j^{α}	$\exp(-\beta c_{ij})$

- Travel cost indicators measure the accumulated or average travel cost to a pre-defined set of destinations, for instance, the average travel time to all cities with more than 500,000 inhabitants.
- Daily accessibility is based on the notion of a fixed budget for travel in which a destination has to be reached to be of interest. The indicator is derived from the example of a business traveller who wishes to travel to a certain place in order to conduct business there and who wants to be back home in the evening (Törnqvist, 1970). Maximum travel times of between three and five hours one-way are commonly used for this indicator type.
- Potential accessibility is based on the assumption that the attraction of a destination increases with size, and declines with distance, travel time or cost. Destination size is usually represented by population or economic indicators such as GDP or income.

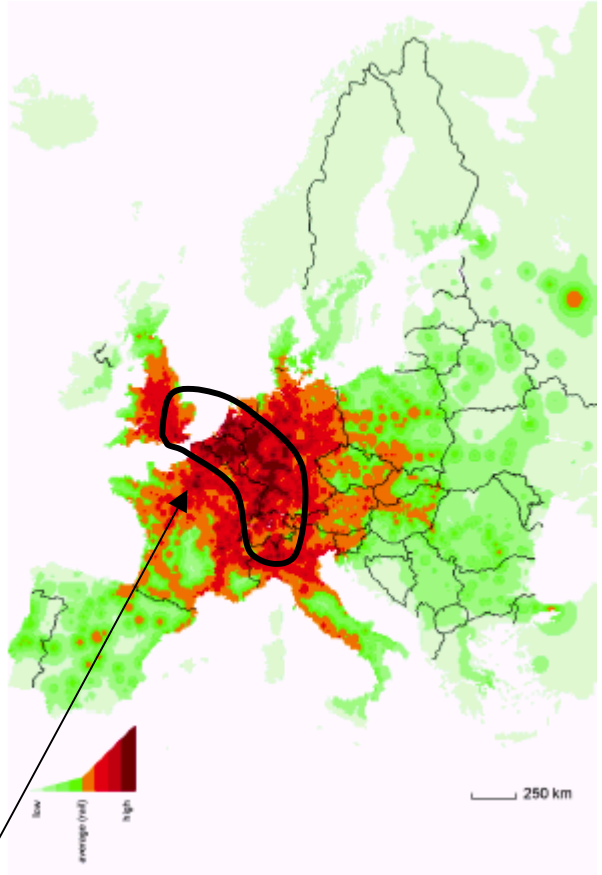
Generic type of accessibility indicators (see Schürmann et al., 1997) - 2010:



Travel cost



Daily accessibility



Accessibility potential

The "Blue Banana"

D - EU Integration

Authors	Spatial disparities
Keeble et al. (1982; 1988)	Clear core-periphery pattern
Lutter et al. (1993)	Existing, but scope depends on destination activities considered
Spiekermann and Wegener (1994, 1996)	Clear core-periphery pattern plus clear centre-hinterland disparities in all European countries
Chatelus and Ulied (1995)	Clear core-periphery pattern
Gutierrez and Urbano (1995, 1996)	Clear core-periphery pattern
Copus (1997, 1999)	Clear core-periphery pattern
Wegener et al., (2000, 2002)	Different core-periphery patterns for different transport modes
Schürmann and Talaat (2000)	Clear core-periphery pattern for road transport
Spiekermann et al. (2002)	Clear core-periphery pattern, but very different degrees of peripherality; high similarity of peripherality in national and European context

Source: Spiekermann and Neubauer (2002)

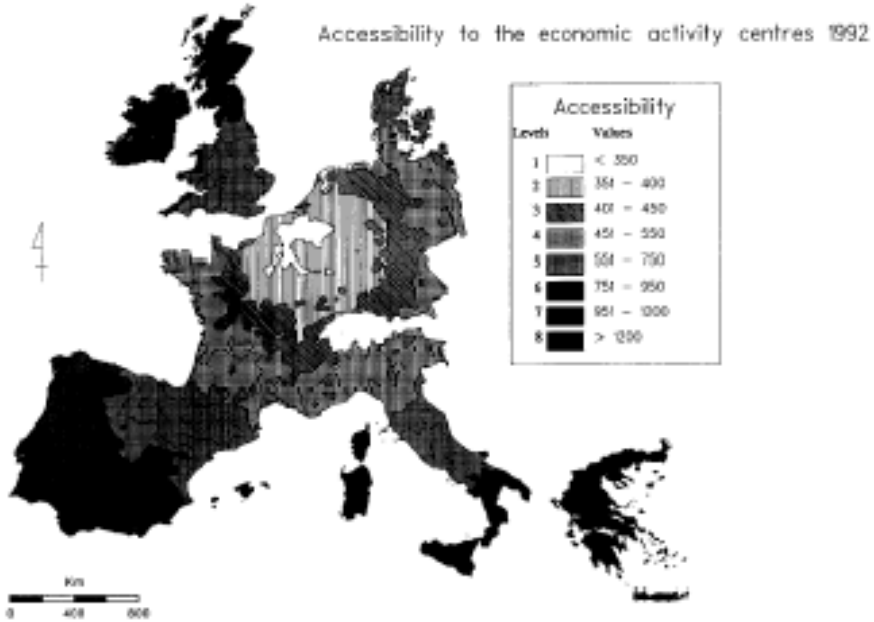
Remark 2. A clear *core-periphery* pattern emerges in almost all the studies on 'accessibility'.

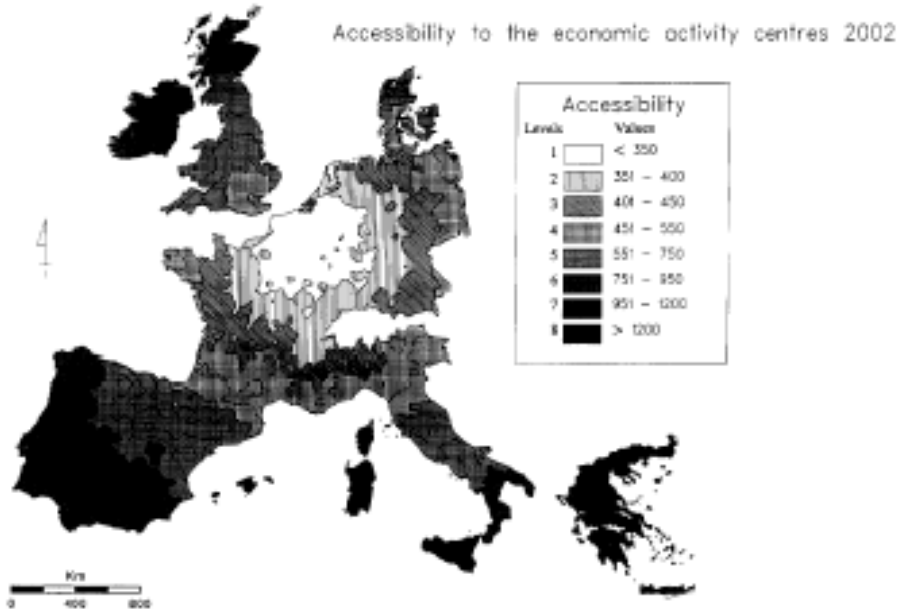
...This could explain why we do not observe an increase in the level of interactions in the aggregate...

The dynamics of the spatial integration process:

Effects in terms of 'accessibility' of the implementation of the *European Spatial Policy*:

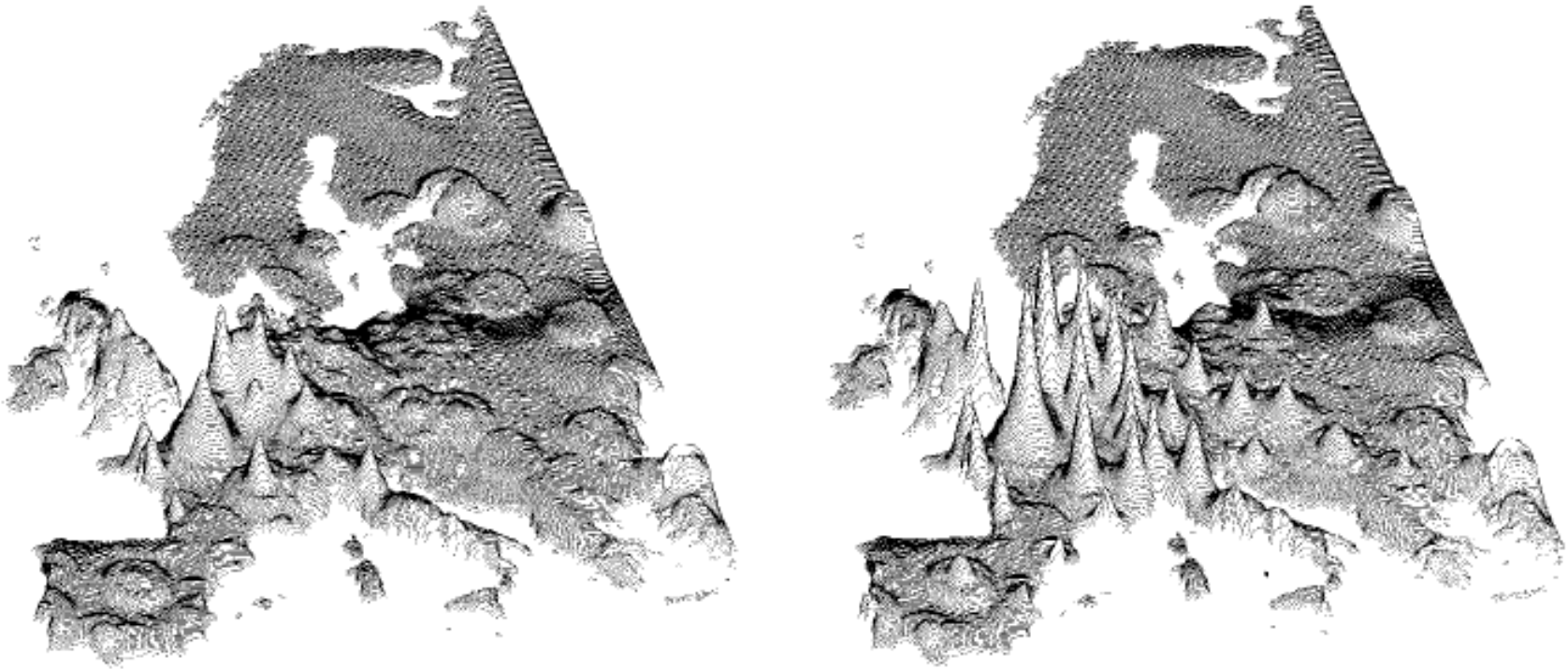
Accessibility by road (1992 - 2002)





Source: Gutiérrez and Urbano (1996)

Accessibility by rail (1993 - 2010)



Source: Vickerman, Spiekermann, and Wegener (1999)

D - EU Integration

Authors	Changing pattern through time
Keeble et al. (1982; 1988)	Disparities have increased in past periods
Lutter et al. (1993)	Travel time benefits for peripheral regions, daily accessibility increases in central regions
Spiekermann and Wegener (1994, 1996)	Increasing disparities induced by TEN
Chatelus and Ulied (1995)	Decreasing disparities
Gutierrez and Urbano (1995, 1996)	Decreasing disparities induced by TEN
Copus (1997, 1999)	Dynamics not considered
Wegener et al., (2000, 2002)	Increasing or decreasing disparities is an outcome of the indicator chosen
Schürmann and Talaat (2000)	Improvements mainly for EU candidate countries
Spiekermann et al. (2002)	Dynamics not considered

Source: Spiekermann and Neubauer (2002)

Remark 3.

- accessibility is improving in all locations in the EU;
- the accessibility of the *core regions* is improving relatively faster than regions in the *periphery*;

...however, we also observe travel cost indicators falling faster in the periphery.

Summing up (see Combes and Overmann, 2003):

The *core - periphery* pattern:
- has declined slightly since the mid 1980s (when the GDP in EU countries has converged) in the aggregate (EU);

<u>but!</u>

- has remained stable within countries;

Integration:
- is improving accessibility of all regions;

<u>but!</u>

- is improving the accessibility of the core regions relatively faster than regions in the periphery…

Political Integration and Spatial Disintegration?
(food for thought…)