Lei da gravidade

"Todos os objetos no Universo atraem todos os outros objetos com uma força direcionada ao longo da linha que passa pelos centros dos dois objetos, e que é **proporcional** ao produto das suas massas e inversamente proporcional ao quadrado da separação entre os dois objetos.“ (Newton)

Modelo gravitacional

$$X_{ij} = \gamma \frac{F_i^{\alpha} F_j^{\beta}}{U(R_{ij})}$$

em que i e j são os países (áreas) considerados, Xij são as exportações de i para j, F traduz a dimensão do comércio externo e R a resistência ao comércio, e α e β são parâmetros de escala.

Modelo gravitacional-versão inicial

MODELO GRAVITACIONAL

$$X_{ij} = \gamma \frac{Y_i^{\alpha} Y_j^{\beta} N_i N_j}{h(R_{ij})} u_{ij}$$

$$\log X_{ij} = \alpha_0 + \alpha_1 \log Y_i + \alpha_2 \log Y_j +$$

$$+ \alpha_3 \log N_i + \alpha_4 \log N_j +$$

$$+ \alpha_5 \log D_{ij} + \ldots + u_{ij}$$

Figure 2-2

The Size of European Economies, and the Value of Their Trade with the United States

Source: U.S. Department of Commerce, European Commission.

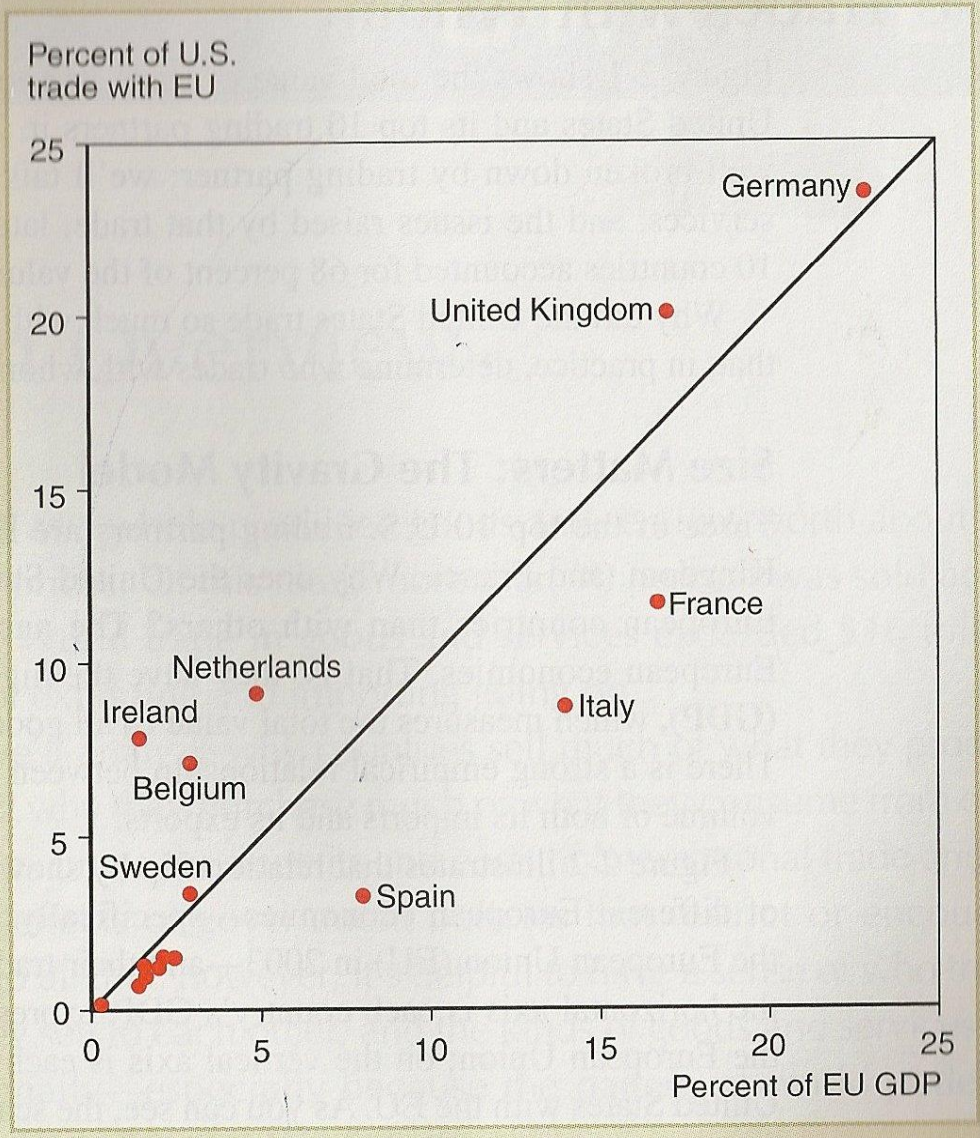
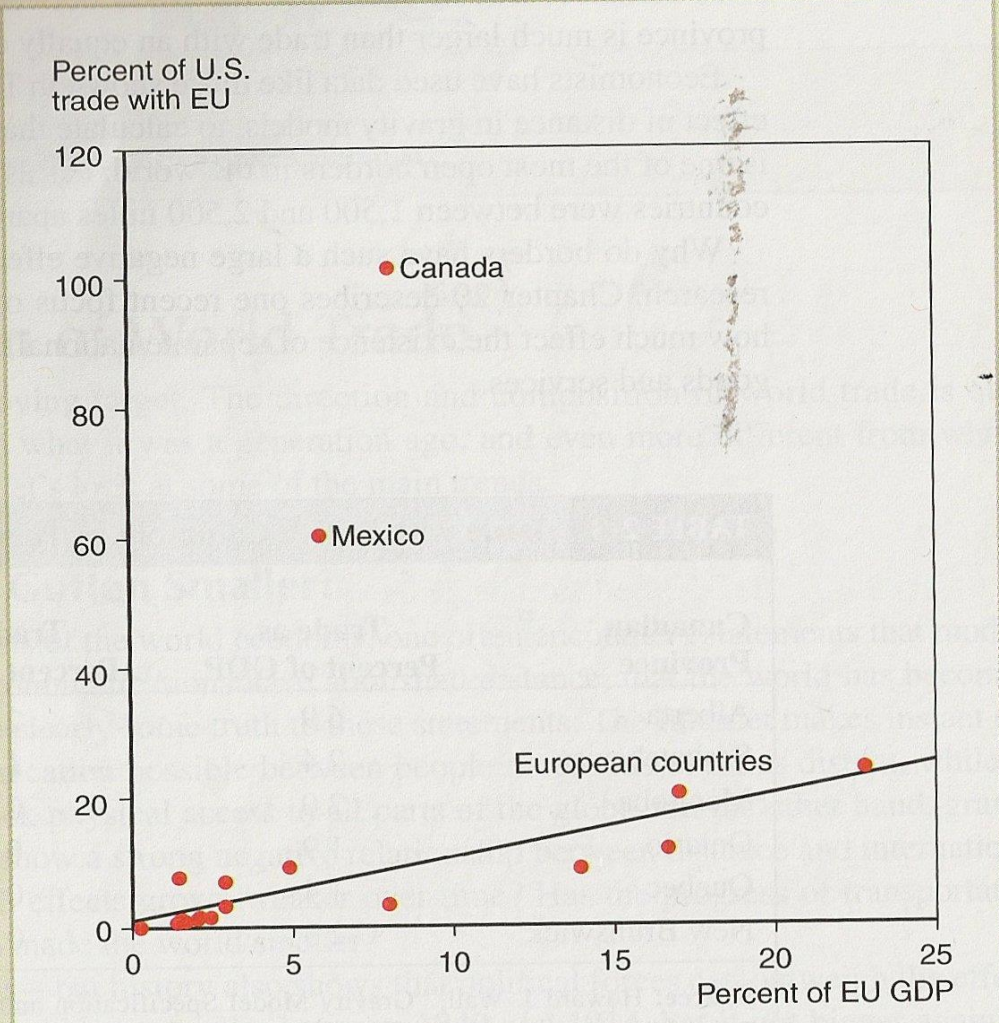


Figure 2-3

Economic Size and Trade with the United States

The United States does markedly more trade with its neighbors than it does with European economies of the same size.

Source: U.S. Department of Commerce, European Commission.



Modelo gravitacional: Objetivos

- Introdução de fatores de inserção teórica complicada
- Estimar o efeito de criação de comércio e o potencial de comércio
- Estimar a centralidade espacial/económica

Aplicação 1: ex. de análise da criação e “desvio de comércio”

Aplicação de um modelo de gravitacional às trocas do Magrebe com a UE

Ana Lúcia Luís

Objetivo desta análise empírica :

- Analisar, através de um modelo gravitacional, se o comércio euro-magrebino foi prejudicado pelos acordos de associação da UE com os Países da Europa Central e Oriental (PECO)

Análise Empírica

Dados:

- 15 países membros da UE (Suécia, Áustria e Finlândia incluídos).
- 2 países magrebinos: Marrocos e Tunísia.
- 5 PECOs: Bulgária, ex-Checoslováquia, Hungria, Polónia e Roménia.
- Anos: 1992 e 1997

Pretende-se analisar se ocorreu:

- *criação de comércio* no comércio dos PECO com a UE.

- *desvio de comércio* da UE do Magrebe para os PECO.

Análise Empírica

O modelo escolhido (logaritmizado) foi:

$$X_{ij}=\alpha_0+\alpha_1 DIST_{ij}+\alpha_2 PIB_i+\alpha_3 PIB_j+\alpha_4 PIBpc_i+\alpha_5 PIBpc_j+\alpha_6 EUR+\alpha_7 X_{m\text{-}EU}+\alpha_8 X_{p\text{-}EU}+\alpha_9 M_{m\text{-}EU}+\alpha_{10} M_{p\text{-}EU}+\varepsilon_{ij}$$

Análise Empírica – variáveis *standard*

$\mathbf{X_{ij}}$ representa o valor das exportações totais do país *i* para o país *j*.

$\mathbf{DIST_{ij}}$ representa a distância em Km entre as capitais dos países *i* e *j*.

$\mathbf{PIB_i}$, $\mathbf{PIB_j}$, $\mathbf{PIB}\boldsymbol{pc}_\mathbf{i}$ e $\mathbf{PIB}\boldsymbol{pc}_\mathbf{j}$ representam respetivamente os PIB e os PIB *per capita* dos países *i* e *j*.

Análise Empírica – variáveis *dummy*

EUR= 1 se os países i e j pertencem ambos à UE;

= 0 noutros casos.

$\mathbf{X_{m\text{-}EU}}$= 1 se o país exportador i é um país magrebino e se o país importador j é um país pertencente à UE;

= 0 noutros casos.

$\mathbf{M_{m\text{-}EU}}$= 1 se o país importador j é um país magrebino e se o país exportador i é um país pertencente à UE;

= 0 noutros casos.

Análise Empírica – variáveis *dummy*

$\mathbf{X_{p\text{-}EU}}$= 1 se o país exportador i é um país pertencente aos PECO e o país importador j é um país pertencente à UE;

= 0 noutros casos.

$\mathbf{M_{p\text{-}EU}}$ = 1 se o país importador j pertence aos PECO e se o país i exportador pertence à UE;

= 0 noutros casos.

Análise Empírica – variáveis *dummy*

- Os coeficientes **p-EU deverão aumentar em valor absoluto** (caso sejam positivos) se, de facto, o comércio UE/PECO se estiver a reforçar, ao passo que se os acordos europeus estiverem a prejudicar o comércio mediterrânico num sentido que evidencie desvio de comércio, os **coeficientes m-EU deverão diminuir**, se forem positivos.

Limitação do método de captar criação de comércio

Esta expansão do comércio engloba quer a criação quer o desvio de comércio, já que não distingue se o aumento das trocas com países parceiros provém da substituição da produção interna ou da redução das importações de terceiros (Balassa designou-a por *criação bruta de comércio*).

	1992	1997
Constante	-19,95** -5,65	-15,37** -4,53
Distância $_{ij}$	-0,87** -8,90	-0,89** -9,74
PIB$_i$	0,82** 18,39	0,85** 20,81
PIB$_j$	0,96** 19,34	0,91** 20,82
PIBpc$_i$	0,90** 3,40	0,36 1,38
PIBpc$_j$	0,11 0,45	0,52E^{-02} 0,02
EUR	3,62** 4,95	4,10** 7,22
X$_{m\text{-}EU}$	2,62** 5,09	2,94** 6,45
X$_{p\text{-}EU}$	2,31** 4,79	3,14* 7,11
M$_{m\text{-}EU}$	1,95** 3,78	2,94** 6,12
M$_{p\text{-}EU}$	1,56** 3,08	3,16** 6,73
R^2	0,86	0,87
Estatística –F	266,278	278,602

Resultados da Análise Empírica

O aumento do coeficiente $\mathbf{X_{p\text{-}EU}}$ (de **2,31** para **3,14**) traduz uma dinâmica de criação de comércio na EU após a entrada em vigor dos acordos europeus.

Nota: esta expansão do comércio engloba quer a criação quer o desvio de comércio (à Viner)

Resultados da Análise Empírica

O aumento do coeficiente de $\mathbf{X_{p\text{-}Eu}}$ não corresponde à diminuição do coeficiente de $\mathbf{X_{m\text{-}EU}}$ que também aumenta, ainda que para valores inferiores (de **2,62** para **2,94**)

⇨ não se confirma a hipótese de um desvio de comércio por parte da EU do Magrebe para os PECO.

Resultados da Análise Empírica

Relativamente aos coeficientes das importações, **Mm-EU** e **Mp-EU**, os dois coeficientes aumentam em ambos os anos, mas os acréscimos verificados para os PECO (de 1,56 para 3,16) são, mais uma vez, superiores aos verificados para o Magrebe (de 1,95 para 2,94).

Resultados da Análise Empírica

- Confirma-se criação de comércio (“bruta”) tanto dos PECO como do Magrebe com a UE.
- A criação de comércio é superior no Centro e Leste da Europa.
- A análise feita não permite identificar se se deve à redução das importações de países terceiros ou a uma criação de comércio “líquida”.

Aplicação 2
Estimação do potencial de comércio

“Trade in the enlarged European Union: a new approach on trade potential”

- Foreign trade flows involving EU25 members in 2002
- Gravity model estimated with Pseudo-Maximum Likelihood Estimator)

Groups of EU countries in the analysis (see “specific group-pair dummies)

- CEEC- Central and Eastern European countries
- CC- Cohesion countries
- UE11-remaining EU countries

A.2.1 Dependent variable

M—Nominal Import (cif) flows of manufactured products (covering Comext's 2-digit Combined Nomenclature, codes 16 to 98), measured in thousands of euro, 2002. Source: European Commission's Comext Database.

A.2.2 Independent variables

- DIST—*Absolute Distance*: the geodesic distance between capitals (in the case of The Netherlands, Amsterdam substitutes Den Haag), measured as the surface distance between two points of latitude and longitude (great circle distance), expressed in kilometers. Source: *www.wcrl.ars.usda.gov/cec/java/lat-long.htm*.
- MGDP/XGDP—*Importer/Exporter country's Nominal Gross Domestic Product at Market Prices*, expressed in thousands of euro, 2002. Source: Eurostat's *New Cronos* Database, Nov. 24th, 2003.
- MPOP/XPOP—*Importer/Exporter country's Population*, expressed in thousands of people at the end of 2002. Source: Eurostat's *New Cronos* Database, November 24th, 2003.
- NEIGH—*Neighbouring Dummy Variable*: equal to one if two trading partners share a land or sea border, zero otherwise. Source: CIA's *World Factbook 2003* on *www.cia.gov/cia/publications/factbook/index.html*.
- IDIOM—*Common Language Dummy Variable:* equal to one if two trading partners share a same official language, zero otherwise. Source: CIA's *World Factbook 2003* on *www.cia.gov/cia/publications/factbook/index.html*.
- ETHN—*Ethnic Dummy Variable:* equal to one if there is in one of the countries an ethnic minority of the other country that represents more than

Independent variables (cont.)

- CCT—*Commodity composition of trade* (*COS Variable*): complementarity measure of trading structures. See formula in the text. Covering 6-digit CN yearly data of manufactured products for 2002. Source: European Commission's Comext Database.
- EURO—*Euro Dummy Variable*: equal to one if both countries involved in the trade flow share the euro as a common currency, zero otherwise.
- RECI(−1)—*Reciprocity*: the opposite trade flow of the dependant variable (2-digit of the Combined Nomenclature), measured in thousands of euro. Source: European Commission's Comext Database, 2001 and 2002.
- GERMAN—*German Dummy Variable*: equal to one if one of the countries involved in the trade flow is Germany, zero otherwise.

Independent variables (concl)

- MLOCK/XLOCK—*Landlockedness Dummy Variable for the Importer/ Exporter country*: is equal to one if the importing country has no direct connection to sea, zero otherwise.
- Specific group-pair dummies: CEEC-CEEC; CEEC-CC; CEEC-EU11; CC-CEEC; CC-CC; CC-EU11; EU11-CEEC; EU11-CC and EU11–EU11. Equal to one if the exporting country belongs to the first group and the importing country to the second group, zero otherwise.

Results for the estimation of the gravity model

Foreign trade flows involving EU25 members in 2002 were **positively** influenced by:

- **The exporter´s and importer´s GDP**
- **Import´s population**
- **Common language**
- **The commodity composition of trade**
- **Common euro currency**
- **German bias**
- **Lagged reciprocal flow.**

And **negatively** influenced by:

- The distance
- The exporting country´s population
- The exporting country being landlocked

“Group pair dummy”- interpretation of the coefficient

- Group-pair dummy: a negative (positive) coefficient for EU11-CC means that on average exports from countries in EU11 to countries in CC are smaller (higher) than exports of countries in the base group.

Exports from countries in EU11 to countries in CC have potential for growth

Results for “group-pair dummies”

- Positive for CC-EU11; CC-CEEC; CEEC-CEEC
- Negative for CEEC-CC

Trade potential at the country level (to groups of countries)

- We calculate the ratio between fitted exports and observed exports

- A ratio >1 : the country has not been able to export to its full capacity, compared to the average behaviour of the EU25 countries ⇨ potential to expand trade

- A ratio <1: the country has exausted its current export capacities

Table 2 Ratio of potential to observed exports in terms of the PML estimator for intra-EU25 trade with confidence limits at 90%

Exporter	EU11 as importer			CEEC as importer			CC as importer		
	TP	Low	Upp	TP	Low	Upp	TP	Low	Upp
Austria	1.08	0.94	1.22	0.92	0.77	1.07	1.05	0.87	1.23
Belgium	0.88	0.79	0.97	1.11	0.97	1.25	1.04	0.89	1.19
Denmark	1.28	1.11	1.45	2.43	2.06	2.80	1.17	0.98	1.37
Finland	0.84	0.76	0.93	0.89	0.75	1.04	0.77	0.64	0.90
France	1.23	1.14	1.32	0.93	0.82	1.03	1.04	0.93	1.15
Germany	0.88	0.81	0.96	0.92	0.81	1.02	1.03	0.90	1.16
Italy	0.92	0.85	0.99	0.83	0.74	0.92	0.86	0.76	0.95
Luxembourg	1.40	1.12	1.69	1.28	0.98	1.58	0.95	0.70	1.21
Netherlands	0.81	0.74	0.88	1.18	1.06	1.31	1.11	0.96	1.26
Sweden	1.13	0.99	1.27	1.61	1.37	1.85	1.43	1.21	1.66
UK	1.24	1.21	1.35	1.92	1.70	2.14	0.93	0.77	1.10
Bulgaria	1.01	0.79	1.23	2.32	1.73	2.90	0.66	0.48	0.83
Czech R.	1.10	0.96	1.24	0.76	0.62	0.90	0.93	0.75	1.10
Estonia	1.30	1.04	1.57	1.07	0.85	1.29	1.54	1.20	1.88
Hungary	0.74	0.64	0.83	1.26	1.04	1.48	0.70	0.57	0.82
Latvia	1.00	0.77	1.23	1.31	0.95	1.67	1.32	0.96	1.68
Lithuania	1.63	1.37	1.90	1.76	1.41	2.12	2.59	2.06	3.11
Poland	0.96	0.82	1.10	0.88	0.73	1.04	0.96	0.77	1.14
Romania	0.59	0.46	0.73	1.29	0.97	1.62	0.82	0.62	1.02
Slovakia	1.03	0.88	1.19	0.66	0.54	0.79	1.51	1.21	1.80
Slovenia	1.95	1.51	2.40	2.28	1.66	2.89	3.70	2.72	4.69
Greece	3.17	2.55	3.80	1.11	0.90	1.32	3.36	2.69	4.04
Ireland	0.69	0.61	0.77	1.50	1.18	1.82	0.61	0.51	0.71
Portugal	1.07	0.90	1.24	1.65	1.36	1.94	1.56	1.27	1.86
Spain	1.22	1.10	1.34	0.79	0.66	0.92	0.60	0.51	0.69

We report the trade potential ratio (TP) of each country with each of the three groups of countries considered. Predicted (potential) exports were calculated with the PML estimator of the reduced model (PML Red in Table 2). We report also the confidence limits for the trade potential ratio where Low stands for the lower limit and Upp for the upper one. Variance was calculated with the Delta method. We consider evidence of trade potential whenever the lower limit is higher than one. Evidence on trade potential is ambiguous whenever the lower limit and the upper limit point to a different conclusion

Leitura com intervalos de confiança

- A existência (ou não) de “trade potential” é validada se o valor mínimo (low) e máximo (upp) do intervalo de confiança confirmarem a leitura da coluna TP

Aplicação 3: *Market potential*

Purpose: to encapsulate the real spatial economy

Indices: two broad types:

- a group that measures the degree of concentration (agglomeration) of economic activity in a location unit;

- a group comprising accessibility and peripherality (identical to low accessibility) indices, aiming to describe a particular location taking into account “opportunities, activities or assets in other areas and the area itself” (Wegener et al., 2002).

Market potential index

It is based on a gravity model to estimate “economic”/ “market” potential.

- In its traditional formulation, the potential for economic activity of a location is a function both of its proximity to other economic centers and of their economic size or "mass“ (Keeble, 1982,1988). Potential is thus interpreted as a measure of interactions with the regions making up the system.

- Later, Frost and Spence (1995) added the role of self-potential, i.e. the effect of size and the level of economic activity of a location on its own peripherality index.

Keeble, Owens, Thompson (1982) e Keeble, Offord, Walker (1988)

$$P_i = \sum_h \frac{M_h}{\delta_{ih}}$$

$$C_i = \frac{l_i}{\delta_{ii}} + \sum_h \frac{l_h}{\delta_{ih}}, i \neq h$$

Frost & Spence (1992) added the role of “self potential “

Spatial Centrality: an approach with sectoral linkages

Nuno Crespo, M. Paula Fontoura and Nádia Simões

Purpose

- To build a measure to evaluate the degree of centrality (advantage) of a sector located in a region considering
  -internal and external components;
  -economic and geographic aspects.

- The hypothesis is that the spatial centrality of a sector varies:

  - **positively** with geographic proximity to firms in the same economic sector (horizontal agglomeration) and in other sectors connected by vertical linkages (vertical agglomeration)

  -**negatively** with inter-regional distance.

Channels through which a firm may benefit from linkages with firms closely located

- Intra-industry agglomeration: demonstration/imitation, labor mobility and competition.

- Inter-industry agglomeration:Vertical relationships that firms establish with suppliers (backward linkages) or customers of intermediate inputs produced by them (forward linkages).

The two effects will be considered both in the region of location of the sector under analysis and in the other regions related to it.

An index with a double reading

It allows to identify:

- The sectors in which the region has a higher/lower degree of centrality
- The regions with a greater degree of centrality in this sector.

To illustrate the method, we include an example for the Portuguese economy at the county level (275 regional units).

The index

$$C_{ji} = \underbrace{\frac{l_{ji} - 1/N}{\delta_{ii}}}_{(1)} + \underbrace{\sum_h \frac{l_{jh} - 1/N}{\delta ih}}_{(2)} + \underbrace{\frac{\sum_f [l_{fi} - 1/N]\gamma_{fj}}{\delta_{ii}}}_{(3)} + \underbrace{\sum_h \frac{\sum_f [l_{fh} - 1/N]\gamma_{fj}}{\delta_{ih}}}_{(4)}$$

$$+ \underbrace{\frac{\sum_s [l_{si} - 1/N]\theta_{sj}}{\delta_{ii}}}_{(5)} + \underbrace{\sum_h \frac{\sum_s [l_{sh} - 1/N]\theta_{sj}}{\delta_{ih}}}_{(6)}$$

First term: horizontal internal component

$$\underbrace{\frac{l_{ji} - 1/N}{\delta_{ii}}}_{(1)}$$

It measures the degree of over-representation of sector j in the region i (i.e., compared with the even distribution by all regions of that economic activity).

Usually the potential model quantifies the variable "mass" with the absolute value of the variable used for the evaluation of the economic dimension of the regions. We prefer to consider instead the *proportion* of that variable.

We divide by intra-regional distance in order to incorporate the geographic dimension of the region and the fact that the economic over-representation of the sector varies negatively with the dimension of the region.

- The higher the ratio , the greater the effect of intra-sectoral agglomeration-.

Second term: horizontal external component

$$\underbrace{\sum_{h} \frac{l_{jh} - 1/N}{\delta ih}}_{(2)}$$

- It measures the degree of over-representation of a sector in the remaining regions (forming part of the system of regional relations under analysis), assuming that the importance of this effect varies inversely with the distance between the regions.

Third term: backward internal component (proximity to suppliers)

$$\underbrace{\frac{\sum_f \left[l_{fi} - 1/N\right]\gamma_{fj}}{\delta_{ii}}}_{(3)}$$

It measures the degree (per spatial unit) of over-representation of suppliers of the sector in the region (backward linkages) weighted by the importance of these suppliers to the sector.

Fourth term: backward external component (proximity to suppliers)

$$\underbrace{\sum_{h} \frac{\sum_{f} \left| l_{fh} - 1/N \right| \gamma_{fj}}{\delta_{ih}}}_{(4)}$$

It comes to a similar analysis of the third but in the remaining regions.

The geographic effect is the “distance decay”, as in the second term.

Fifth term: forward internal component (proximity to buyers)

$$\underbrace{\frac{\sum_s [l_{si} - 1/N]\theta_{sj}}{\delta_{ii}}}_{(5)}$$

It measures (per spatial unit) the degree of over-representation of buyers of the sector in the region (forward linkages) weighted by the importance of these buyers to the sector.

Sixth term: forward external component
(proximity to buyers)

$$\underbrace{\sum_h \frac{\sum_s [l_{sh} - 1/N]\theta_{sj}}{\delta_{ih}}}_{(6)}$$

This term comes to a similar analysis of the fifth term but in the remaining regions.

The geographic effect is the “distance decay”, as in the second term.

Empirical example

- Statistical information for the Portuguese economy (excluding Madeira and Azores) in 2006
- Level of the county (*concelho*). Portugal is divided into 275 counties (with an average area of 323.79Km^2).
- As for sectors, we considered the manufacturing industry sectors at 2 digit level (23 sectors)
- The dimension of a sector in each region is evaluated by the proportion of that sector located in each county, measured in terms of employment.
- We consider inter and intra-regional distances between all counties – 75350 bilateral distances and 275 internal distances .

  -Inter-regional distances – are obtained in kilometers (km).

  - Intra-regional distances are linked to the area of the region, by considering the formula of Keeble et al. (1982, 1988) and Brülhart (2001).

Employment data is from Ministry of Employment while distances are obtained from the program ROUTE 66.

There was the purpose of comparing these data with a later year. That turned out not to be done because in the meanwhile the NACE nomenclature used in this study (revision 2) has been modified and it is not possible to convert one into the other.

Presentation of results

- Given the vast number of counties analyzed, we selected those corresponding to the capital of the district (Continental Portugal is also divided into 18 districts).

- For reason of parsimony, we show the index for two sectors (disaggregating by county) and for one county (disaggregating by sector).

- The sectors: those with the highest values in terms of the total level of centrality (i.e., the sum of the several components of the centrality index) –, namely wearing apparel, dressing and dyeing of fur (sector 18) and machinery and equipment n.e.c. (sector 29)

- The county: the one with the highest (total) level of centrality in the country-Porto

Centrality by components in Porto

- Selecting the two sectors with the highest levels of centrality in Porto – office machinery and computers (30), and radio, television and communication equipment (32) –, in both cases the major component has to do with the characteristics of the region where the sector is located (respectively the economic size of the region and proximity to buyers).

- This result is consistent with the fact that Porto is the second most prosperous region of the country.

Table 3: Centrality by components in Porto

Sectors	(1)	(2)	(3)	(4)	(5)	(6)	Total
15	0.00961	0.01135	0.01983	0.01053	0.00779	0.00561	0.06472
16	-0.00246	0.01076	-0.00741	0.00303	-0.00078	-0.01285	-0.00479
17	0.00043	0.00271	0.02330	0.01190	0.00591	0.03144	0.07569
18	0.00647	0.00314	0.01857	0.01175	0.00223	-0.00318	0.03899
19	0.00118	0.00345	0.03049	0.01758	0.00130	0.01256	0.06656
20	-0.00022	0.00202	0.02255	0.01228	0.00388	0.01870	0.05965
21	0.03318	0.02376	0.02762	0.01521	0.04604	0.02275	0.16855
22	0.05596	0.03713	0.01534	0.01111	0.03239	0.00050	0.15287
23	-0.00246	0.00208	0.03250	0.01462	0.01009	0.01659	0.07833
24	0.00670	0.00700	0.01758	0.00974	0.02208	0.06051	0.12360
25	0.00862	0.00696	0.02092	0.01171	0.01777	0.03109	0.09705
26	-0.00052	0.00494	0.01393	0.00960	0.00232	0.00457	0.03587
27	0.00089	0.00190	0.03716	0.02680	0.01268	0.08179	0.16122
28	0.00611	0.00472	0.03259	0.02174	0.09438	0.01849	0.17804
29	0.00565	0.00694	0.02401	0.01964	0.03130	0.01154	0.09907
30	0.67336	0.38185	-0.01051	-0.00733	0.37986	-0.01637	0.40799
31	0.01440	0.00828	0.08153	0.03350	0.01627	0.02393	0.17790
32	0.00057	0.00414	0.01015	0.01034	0.15856	-0.00101	0.18275
33	0.02457	0.01399	0.01577	0.01379	0.00860	-0.00271	0.07401
34	-0.00024	0.00288	0.05022	0.03526	0.00071	0.02200	0.11130
35	0.01040	0.00679	0.01087	0.01746	0.00281	-0.00752	0.04081
36	0.00612	0.00438	0.03304	0.01672	0.00215	0.00188	0.06428
37	0.00179	0.00548	0.04528	0.02065	0.00179	0.00338	0.07836

Centrality by components in sector 18 (wearing apparel, dressing and dyeing of fur)

- The county with the highest centrality level for this sector is Braga .
- Only three counties (Viana do Castelo and Porto in addition to Braga), all located close to each other, reveal good conditions in terms of centrality in this sector, as the sum of the several components is negative for the remaining counties.
- Focusing on the contribution of each term of the centrality index with positive sign in Braga, by decreasing order stands out the proximity to suppliers in the region in which the sector is located (3) and in the nearby regions (4), followed by the economic dimension of the nearby regions (2) and of the region in which the sector is located (1); proximity to customers in the county (5) comes at the end of the ranking.
- Curiously enough, the qualitative results are very similar for the two other counties (Porto and Viana do Castelo), **confirming the importance of proximity to suppliers and to similar activity as relevant factors of location in the case of this sector.**

Table 1: Centrality by components in sector 18

	(1)	(2)	(3)	(4)	(5)	(6)	Total
Viana do Castelo	0.00488	0.00172	0.00788	0.00242	0.00160	-0.00261	0.01589
Braga	0.00875	0.00960	0.01926	0.01424	0.00345	-0.00006	0.05523
Porto	0.00647	0.00314	0.01857	0.01175	0.00223	-0.00318	0.03899
Vila Real	-0.00217	-0.00221	0.00323	-0.00375	-0.00082	-0.00555	-0.01126
Bragança	-0.00105	-0.00105	0.00052	-0.00357	-0.00039	-0.00386	-0.00940
Aveiro	-0.00070	-0.00086	0.00078	-0.00742	-0.00025	-0.00824	-0.01669
Coimbra	0.00037	-0.00017	-0.00097	-0.00897	0.00011	-0.00848	-0.01810
Leiria	0.00157	0.00027	-0.00196	-0.00928	0.00055	-0.00822	-0.01707
Viseu	0.00046	-0.00007	-0.00026	-0.00829	0.00013	-0.00807	-0.01609
Guarda	-0.00055	0.00024	-0.00060	-0.00699	-0.00015	-0.00653	-0.01457
Castelo Branco	0.00180	0.00012	-0.00154	-0.00722	0.00054	-0.00620	-0.01251
Lisboa	0.00230	0.00365	-0.00274	-0.01017	0.00096	-0.00815	-0.01414
Setúbal	-0.00123	-0.00122	-0.00251	-0.00820	-0.00045	-0.00670	-0.02032
Santarém	-0.00035	-0.00058	-0.00348	-0.01106	-0.00014	-0.00911	-0.02472
Portalegre	-0.00056	-0.00052	-0.00269	-0.00880	-0.00021	-0.00705	-0.01982
Évora	-0.00056	-0.00072	-0.00283	-0.00826	-0.00019	-0.00655	-0.01911
Beja	-0.00149	-0.00148	-0.00265	-0.00756	-0.00056	-0.00593	-0.01967
Faro	-0.00111	-0.00105	-0.00219	-0.00613	-0.00041	-0.00481	-0.01570

Centrality by components in sector 29 (machinery and equipment n.e.c)

- Considering the county with the highest level of centrality in this sector (Porto), the results highlight, by decreasing order, the internal proximity to buyers (5), the internal proximity to suppliers (3), the external proximity to suppliers (4) and buyers (6), and lastly, the external and internal economic components (2 and 1, respectively).

- Thus, **the most important factors have all an inter-sectoral type, both backward and forward. These results are in accordance with the inherent characteristics of these sectors.**

- Turning now to the 2nd county in terms of the total value of the index, Lisboa, we observe that now stand out, in descending order, the economic dimension of the nearby regions (2) and of the region itself (1), followed by internal proximity to buyers (5), which is in line with the particular attractiveness conditions of a region that hosts the nation's capital.

Table 2: Centrality by components in sector 29

	(1)	(2)	(3)	(4)	(5)	(6)	Total
Viana do Castelo	0.00278	0.00229	0.00182	-0.00321	0.00441	-0.00398	0.00410
Braga	0.01259	0.01393	0.00290	-0.00390	0.00928	-0.00485	0.02994
Porto	0.00565	0.00694	0.02401	0.01964	0.03130	0.01154	0.09907
Vila Real	-0.00170	-0.00070	-0.00054	-0.00715	-0.00114	-0.00783	-0.01906
Bragança	-0.00098	-0.00095	-0.00066	-0.00464	-0.00107	-0.00494	-0.01323
Aveiro	0.01608	0.01272	0.00498	-0.00389	0.01036	-0.00474	0.03551
Coimbra	0.00143	0.00171	0.00126	-0.00699	0.00112	-0.00740	-0.00888
Leiria	0.02309	0.01598	0.00581	-0.00420	0.01679	-0.00366	0.05380
Viseu	-0.00022	-0.00002	0.00015	-0.00794	-0.00035	-0.00855	-0.01692
Guarda	-0.00062	-0.00036	-0.00127	-0.00757	-0.00027	-0.00801	-0.01811
Castelo Branco	0.00249	0.00095	-0.00149	-0.00707	0.00104	-0.00714	-0.01121
Lisboa	0.01538	0.01671	0.00349	-0.00356	0.01389	0.00032	0.04623
Setúbal	0.00032	0.00037	0.00115	-0.00375	0.00305	-0.00267	-0.00153
Santarém	0.00006	-0.00036	0.00019	-0.00796	-0.00020	-0.00708	-0.01535
Portalegre	-0.00064	-0.00049	-0.00190	-0.00797	-0.00040	-0.00800	-0.01940
Évora	-0.00007	0.00123	-0.00147	-0.00693	0.00015	-0.00657	-0.01366
Beja	-0.00124	-0.00130	-0.00166	-0.00651	-0.00144	-0.00646	-0.01862
Faro	-0.00032	-0.00056	-0.00145	-0.00541	-0.00062	-0.00540	-0.01376