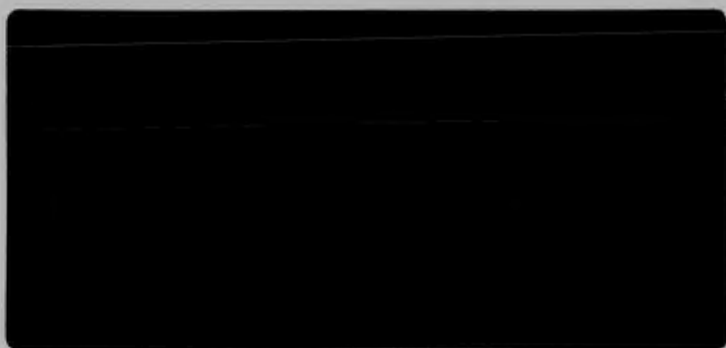


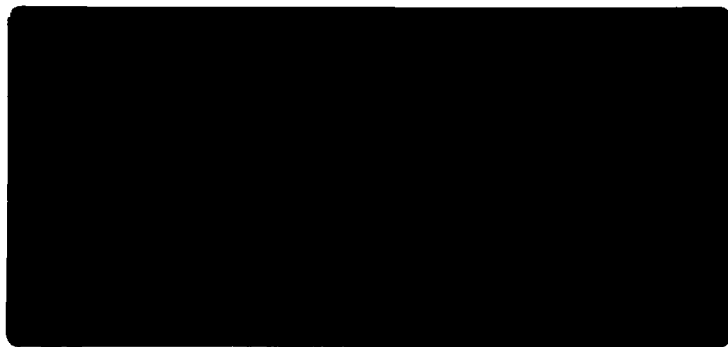
# Onderzoeksmemorandum

## Research Memorandum



Centraal Planbureau | 's-Gravenhage





**C P B Onderzoeksmemorandum**

De verantwoordelijkheid voor de inhoud van dit artikel blijft voor rekening van de auteur(s).

**C P B Research Memorandum**

The author takes sole responsibility for the contents of this article.

No. 59

CENTRAL LOCATIONS IN THE EUROPEAN COMMON MARKET

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### Abstract

The completion of the European Common Market in 1992 may lead to a relocation of economic activity. The proximity of the Common Market as a whole, in stead of separate national markets, might prove to be a relevant factor in this process. In the present paper an assessment is made of the relative centrality of European regions from this point of view.





1. Introduction

In view of the forthcoming completion of the European Common Market in 1992, locational choice is likely to become a key issue in entrepreneurial decision making. This can be explained as follows.

Firstly, as a result of the abolition of borders and institutional barriers between member states, considerable changes on the supply side of the economy are expected to take place. According to studies undertaken by the European Commission (Emerson et al (1988)) and the Central Planning Bureau (1989), these changes will take the form of restructuring the manufacturing sector resulting in an increased scale of production and of increasing competition in both the manufacturing and service sectors. These processes will undoubtedly result in an increase in the number of locational decisions to be made.

Secondly, when borders between countries of the Community cease to impede the exchange of goods and services, the size of national markets will no longer be a major factor determining the choice of plant location. In many cases the proximity of the Common Market as a whole will become a relevant factor instead. Locations with a central position in the Community offer relatively fast communications and low transport cost, and may therefore become more attractive. Consequently, the realization of the internal market may result in new preferences as regards plant location within the Community.

In this paper a concept of 'market distance' is developed and implemented, so as to obtain an impression of the relative position of the different regions of the Community, as far as proximity of the Common Market as a whole is concerned. Possible trends such as the supposed southward shift of the economic centre of gravity of the Community are briefly discussed. Special attention is given to the regions where major sea- and airports are located. It must be emphasized, that for actual decision making the information given is of too general a nature. However, the same approach may prove to be useful, using more specific data with respect to markets and transport systems.

2. Methodology

2.1 The concept of market distance

Though the present exercise is not based upon a specific location theory, the assumption of cost minimization offers a starting point. With respect to costs, a distinction can be made between production costs and transport costs. Transport costs depend - among other things - on the geographical dispersion of demand. Here we concentrate on the case in which demand is distributed all over the Community in accordance with economic activity. The removal of barriers between countries in the EC and the concentration of production due to increased economies of scale, will make this case especially relevant.

The basic concept is that of 'market distance', which is defined as the weighted average geometrical distance to all regions of the Community; the weight used is gross value added, serving as an indicator of overall economic activity. Geometrical distance serves as an indicator of transport costs - handling and associated costs excluded. Regions for which this market distance is relatively low can be considered as centrally located.

As total costs rather than transport costs will be decisive in the choice of a location, centrally located regions are likely to be preferred only, if transport costs are relatively high and alternative locations are not too attractive in terms of production costs.

Though transport costs may be of importance to certain branches of industry and distribution, it is only one of the factors to be mentioned in connection with a preference for central locations. Other factors such as short communication lines and even psychological reasons might play a role as well.

Calculations were carried out on the basis of a subdivision of the Community into 143 regions. Markets outside the EC, which may be of interest as well, were not taken into account. The market distance in kilometres for all 143 regions was calculated, and transformed into an index number. This created the possibility of ranking and comparison of individual regions or groups of regions e.g. countries. The 143 Community regions are displayed on a map in Appendix A. The statistical data were derived from Eurostat publications (1987, 1988). Information about the calculation of distances can be found in Appendix B.

## 2.2 Market distance and transport costs

Geometrical distance, as used in the market distance calculations, serves as an indicator of transport costs - handling and associated costs excluded. Actual transport distances will always be higher, but as long as these differences are more or less proportional, the relative figures will not be much different. The accuracy of geometrical distance depends on the prevailing mode of transport.

In case of road transport some special problems can be mentioned: Infrastructure characteristics may differ considerably between different origin-destination pairs; extra costs apply in case of tolls and when the Swiss or Austrian borders have to be crossed; in case of sea crossings extra costs for ferry transport are to be accounted for.

In case of air transport geometrical distance seems to be more appropriate. However, for this mode of transport another complication should be mentioned: The airline network offers services between only a limited number of regions and consequently additional road transport over considerable distances may be necessary in many cases. This will lead to additional differences in transport costs.

Among the complications mentioned the problem of sea crossings seems to be the most important. For this reason some additional calculations were carried out with respect to this subject, the results of which can be found in section 4.4.

From the previous discussion it will be clear, that for actual decision making the present approach may be too rough and additional data should be included in the analysis. For a first and general assessment however, it seems to be quite appropriate.

3. Principal results

One way of looking at the results is from a national point of view. By grouping regional figures per country and determining a weighted average and minimum and maximum values per country, a manageable set of figures is obtained. A relatively wide gap between minimum and maximum values means that different parts of the country concerned may be evaluated differently. Results may be presented in kilometres or in relative figures such as index numbers. Though the former are less abstract and therefore easier to grasp, they may be misleading in case the reader has some specific mode of transport in mind. For this reason index numbers are preferred for presentation in this text.

Table 1 Market distance<sup>a</sup> EC-regions

	weighted average <sup>b,c</sup>	minimum <sup>b</sup>	maximum <sup>b</sup>
			Index (EC-minimum = 100)
Luxemburg	100	100	100
Belgium	104	101	107
Netherlands	113	103	125
France	114	100	153
Germany	118	101	152
United Kingdom	140	119	204
Italy	156	115	240
Denmark	175	161	178
Ireland	185	185	185
Spain	204	162	447
Portugal	260	232	465
Greece	289	266	360

<sup>a</sup> Weighted average distance per region to all EC-regions;  
Weight = regional gross value added (KKS, 1985).

<sup>b</sup> Of regional figures per country.

<sup>c</sup> Weight = regional gross value added (KKS, 1985).

The results per country are presented in Table 1 and the underlying regional figures in Appendix C. Roughly speaking the twelve EC-countries can be subdivided into three groups.

The first group which can be characterized as 'central' contains the Benelux countries, France and Germany. However it must be stated, the latter two countries also contain less centrally located regions.

The second group which may be called 'intermediate' consists of Italy and the United Kingdom. These countries contain regions which are rather centrally located; but because of their geographical features, they contain more peripheral regions as well.

The third group, to be characterized as 'peripheral', shows a clearly larger market distance, varying from about 50 to 400 % above the EC-minimum. As far as Spain and Portugal are concerned, it should be born in mind that their maximum values refer to the remote Canary Islands and Azores respectively.

In order to get a sharper picture of what might be called the centre of the European Community, a list of the 40 most centrally located regions of the Community is given in Table 2. These correspond roughly to the regions with a market distance of notmore than about 10% of the EC-minimum. The area covered by the regions in table 2 encompasses the heart of the European coal mining and steel industries. Due to the process of industrial decay over the past decades however, it has lost some of its significance. But on the other hand the area includes some of the most important economic centres of Europe such as: Brussels, Paris, Lyon, Frankfurt, Stuttgart and Rotterdam. They will probably become even more important, when the Internal Market will be a fact.

Table 2 Centrally located regions in the EC

Rank	Region	Country <sup>a</sup>	Index <sup>b</sup>	Rank	Region	Country <sup>a</sup>	Index <sup>b</sup>
1	Champagne-A.	F	100	21	Koblenz	D	105
2	Luxembourg	L	100	22	Rheinhesen	D	105
3	Lorraine	F	101	23	Freiburg	D	105
4	Luxembourg	B	101	24	Karlsruhe	D	106
5	Trier	D	101	25	Köln	D	106
6	Namur	B	102	26	W.-Vlaanderen	B	107
7	Saarland	D	102	27	Düsseldorf	D	107
8	Hainaut	B	102	28	N.-Brabant	NL	107
9	Liège	B	102	29	Darmstadt	D	108
10	Brabant	B	103	30	Zeeland	NL	108
11	Limburg	NL	103	31	Centre	F	108
12	Limburg	B	104	32	H.-Normandie	F	109
13	Ile-de France	F	104	33	Tübingen	D	109
14	Alsace	F	104	34	Stuttgart	D	109
15	Bourgogne	F	104	35	Z.-Holland	NL	110
16	Picardie	F	104	36	Giessen	D	110
17	Calais	F	104	37	Gelderland	NL	111
18	Franche-Comté	F	105	38	Utrecht	NL	112
19	O.-Vlaanderen	B	105	39	Arnsberg	D	112
20	Antwerpen	B	105	40	Rhône-Alpes	F	113

<sup>a</sup> B = Belgium  
D = Germany  
F = France  
L = Luxemburg  
NL = Netherlands

<sup>b</sup> Weighted average distance to all EC regions  
Weight = gross value added (KKS, 1985)  
EC-Minimum = 100

4. Special topics

4.1 Market distance versus wage level

As might be expected there is a trade-off between transport costs and production costs, or more specifically wages. This follows from Table 3. Transport costs as measured by market distance are between 150 and 250 percent higher in the more peripheral countries than in the more central countries, while on the other hand wages are at least 50 percent lower. The only exception to this rule is offered by Denmark, which scores relatively high for both.

Table 3 Market distance and wage-level per country

	Market distance <sup>a</sup>	Wage level <sup>b</sup>
		Index (EC-minimum = 100)
Luxemburg	100	479
Belgium	104	572
Netherlands	113	593
France	114	531
Germany	118	617
United Kingdom	140	386
Italy	156	454
Denmark	175	520
Ireland	185	384
Spain	204	239
Portugal	260	100
Greece	289	173

<sup>a</sup> Weighted average of regional figures per country  
Weight = regional gross value added (KKS, 1985);  
(For definition of regional figures see Table 1, note a)

<sup>b</sup> Hourly wages manufacturing industry (ECU, 1984)



It should be noted, that difference in wage level may partly be explained by differences in the quality of labour e.g. the level of education. Furthermore hourly wages do not reflect difference in labour productivity, which may exist even on the same level of education. For these reasons the wage level figures presented here give only a rough indication of differences in labour costs.

#### 4.2 Shifting centre of gravity

Gross domestic product per capita is about twice as high in the centre of the Community than it is in the periphery - with the exception of Denmark. Within certain countries, like Italy and the United Kingdom, there are considerable

Table 4 Market distance for:

- actual spatial distribution of value added
- equal value added per capita in all EC-regions

	GDP per head <sup>a</sup>		market distance <sup>b</sup>	
	actual	equal	actual	equal
				Index (EC-average =100)
Luxemburg	125	100	100	101
Belgium	103	100	104	104
Netherlands	108	100	113	112
France	112	100	114	110
Germany	115	100	118	116
United Kingdom	102	100	140	135
Italy	103	100	156	150
Denmark	114	100	175	167
Ireland	65	100	185	171
Spain	73	100	204	181
Portugal	52	100	260	221
Greece	57	100	289	254

<sup>a</sup> KKS, 1985

<sup>b</sup> Weighted average of regional figures per country  
 Weight = regional gross value added (KKS, 1985);  
 (For definition of regional figures see Table 1, note a)

differences in gross regional product as well. It is not unlikely that these differences will eventually diminish. As the majority of the poorer countries or regions can be found in Southern Europe, this process may be associated with the southward shift of the 'economic centre of gravity' of the Community, which is supposed to take place. It must be kept in mind however, that factors other than a more equal distribution of economic activity, may contribute to this phenomenon as well. The effects of a perfectly equal regional distribution on market distance are presented in Table 4. Even in this rather extreme case the effects are modest.

As might be expected the peripheral countries improve their relative position, but the changes are not very impressive. These results suggest that the shift of the 'economic centre of gravity', will have only limited effects on the relative position of regions as far as market distance is concerned.

#### 4.3 Position of air- and seaports

For many industries in the Community, trade relations with other parts of the world are of vital importance. This favours locations in the neighbourhood of international airports and main seaports. In this section the focus is on the relative position of air- and seaports with respect to market distance.

In Table 5 the market distance index is given for the major EC-airports with respect to freight transport. These are major airports for passenger transport as well, with the exception of Brussels, which should be substituted by Copenhagen. Brussels, Paris and Frankfurt turn out to have excellent positions. Market distance for Amsterdam is only about 10 % longer, while the figure for London is only slightly higher. It should be borne in mind however, that in case of connecting road transport to and from the continent, additional costs for ferry transport should be taken into account; these extra costs will probably be less when the Eurotunnel becomes available in the early nineties. To conclude with: the position of Rome is clearly less favourable with about 70 % longer distance.

Table 5 Market distance<sup>a</sup> for major airports in the EC with special reference to freight transport

	Index (EC-minimum = 100)
Brussels	103
Paris	104
Frankfurt	105
Amsterdam	114
London	119
Rome	173

<sup>a</sup> Weighted average distance to all EC-regions;  
Weight = regional gross value added (KKS, 1985)

Table 6 Market distance<sup>a</sup> for major seaports in the EC with special reference to container transport

	Index (EC-minimum = 100)
Antwerp	105
Le Havre	109
Rotterdam	110
London	119
Genova	129
Bremen	129
Hamburg	130
Marseille	135

<sup>a</sup> Weighted average distance to all EC-regions;  
Weight = regional gross value added (KKS, 1985)

Similar information about seaport locations is given in Table 6. Eight major European seaports with respect to containertransport are evaluated there. This type of transport seems to be especially relevant for modern industry.

Antwerp, Le Havre and Rotterdam are clearly ahead, while London follows within close distance. As was mentioned with respect to airports, the position of London will be less favourable, if sea crossings have to be taken into account.

4.4 Sea crossings

In the previous sections the costs of sea crossings were mentioned several times, as a complicating factor when interpreting the market distance figures presented. In order to obtain a more balanced appraisal, some additional calculations were carried out, the results of which are presented in Table 7. In order to take account of the extra costs associated with ferry transport an additional 150 kilometres were added for sea crossings. This corresponds to the minimum value applied in a study by Keeble, Owens and Thompson (1981); they indicate that there is some empirical basis for this figure.

The effect of the Eurotunnel on the costs of sea crossings is very difficult to estimate. Its advantage over sea ferries will depend strongly on

Table 7 Market distance<sup>a</sup> EC-regions based upon alternative assumptions with respect to sea crossings

	including ferries	including ferries + Eurotunnel	geometrical distance only
			Index EC-minimum = 100)
Luxemburg	100	100	100
Belgium	104	104	104
Netherlands	112	115	113
France	113	114	114
Germany	117	118	118
United Kingdom	152	141	140
Italy	155	157	156
Denmark	179	186	175
Ireland	220	212	185
Spain	200	204	204
Portugal	252	259	260
Greece	280	288	289

<sup>a</sup> Weighted average of regional figures per country  
Weight = regional gross value added (KKS, 1985);  
(For definition of regional figures see Table 1, note a)

waiting time at shuttle train stations, while the rates to be charged will be a decisive factor as well. As a rule of thumb it was assumed that the Eurotunnel will be used - and no additional 150 kilometres were applied - except in case the latitude of both the origin and the destination is above 51.5°.

In Table 7 the weighted average market distance per country is given for three alternative sets of assumptions:

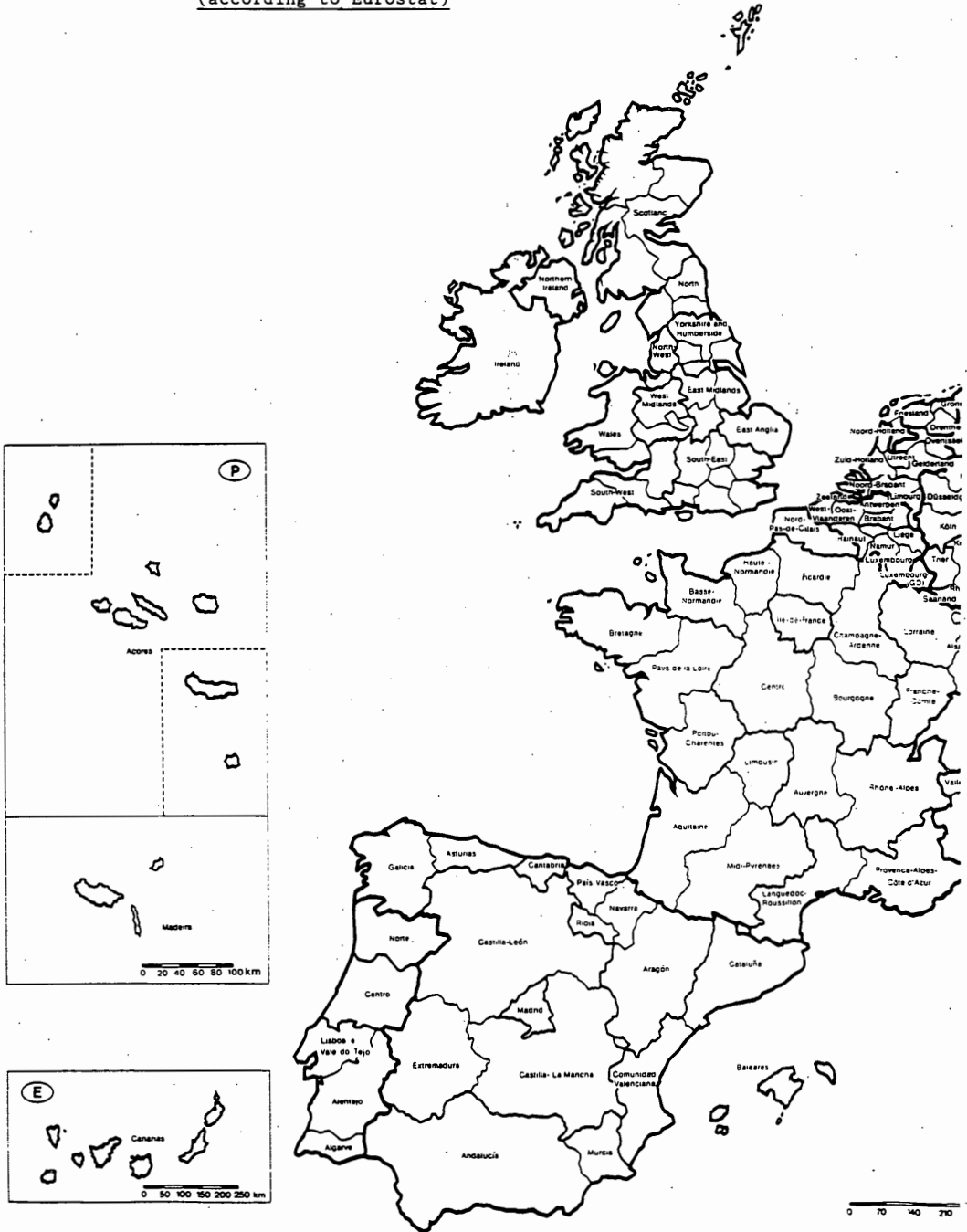
- 150 additional kilometres for sea crossings to account for ferry transport,
- idem, except for origin-destination pairs for which the Eurotunnel is likely to apply (see above),
- geometrical distance (see also Table 1).

The introduction of additional kilometres for sea crossings leads to a considerable increase in market distance for countries which are entirely (United Kingdom, Ireland) or to a large extent (Denmark) separated from the continent by sea. For the United Kingdom this effect will be compensated for, when the Eurotunnel becomes available.

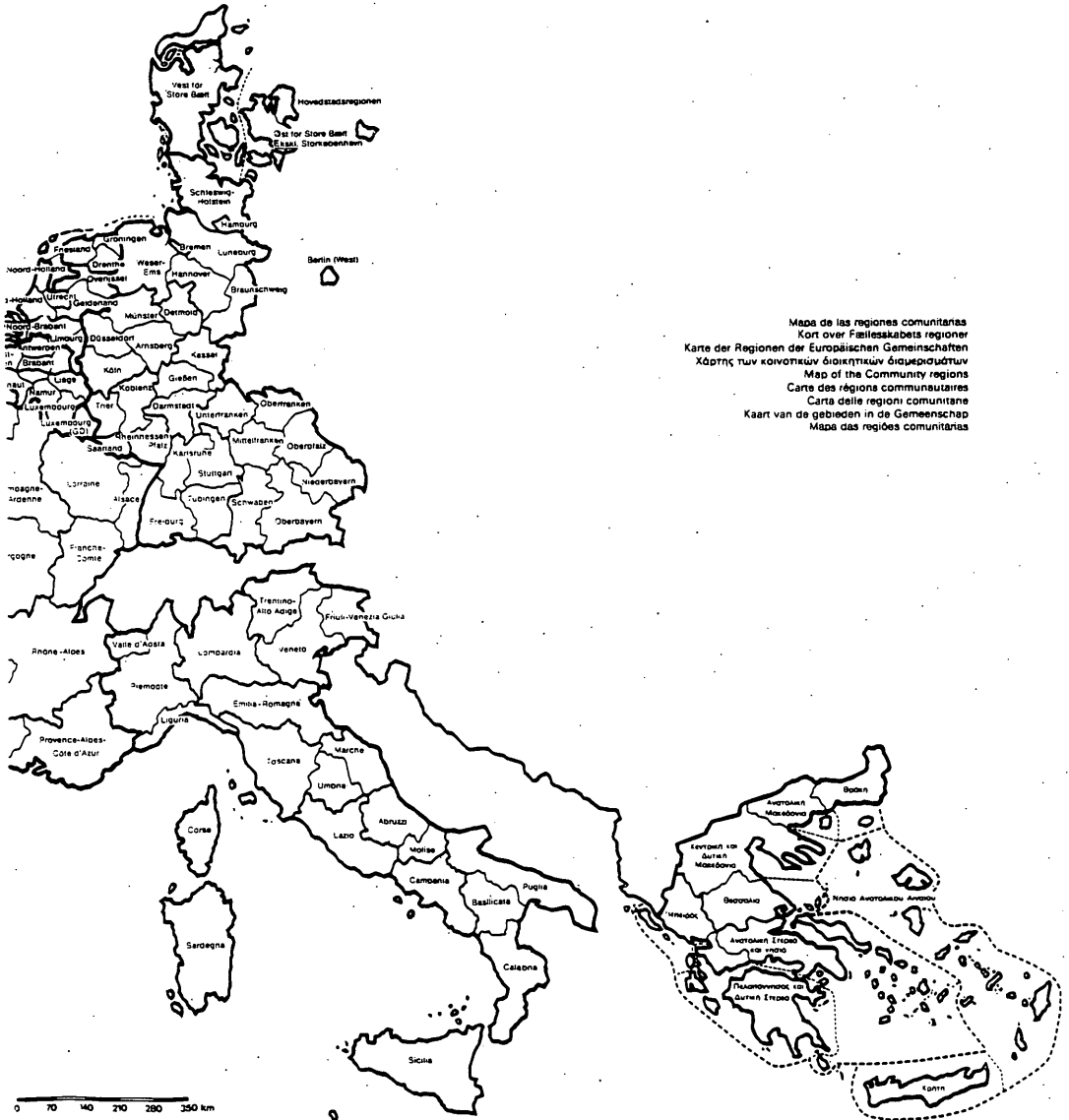
5. Conclusions

- The completion of the European Common Market in 1992 is expected to lead to an increase in the number of locational decisions to be made.
- As borders and institutional barriers between member states will disappear, the proximity of the Common Market as a whole in stead of separate national markets, is likely to become an important factor in locational choice.
- The proximity of the Common Market was quantified for all 143 regions of the Community. Weighted averages of regional figures per country lead to the following picture:
  - The Benelux-countries, France and Germany can be classified as centrally located.
  - The United Kingdom and Italy take in intermediate positions.
  - The remaining countries may be classified as peripheral; their distance to the market is on average between 75 and 300 % longer than for the centrally located countries.
- There seems to be a trade-off between market distance and wage-level.
- A shift of the economic centre of gravity due to an equalization of GDP per head, would not result in a major change in the results presented above.
- Brussels, Paris and Frankfurt are the most centrally located major airports in the Community, while Antwerp, Le Havre and Rotterdam are the most centrally located among the main seaports.
- The position of the United Kingdom is rather sensitive to the possible effects of the Eurotunnel.

Appendix A Regional subdivision of the European Community  
(according to Eurostat)



Appendix A (continued)





Appendix B Technical note

Interregional distance was calculated using spherical trigonometry, or more in particular the 'Law of Cosine' for a spherical triangle (see for instance Abramowitz and Stegun (1968)):

$$\cos BC = \cos AC \cdot \cos AB + \sin AC \cdot \sin AB \cdot \cos \alpha \quad (B.1)$$

where  $\alpha$ ,  $\beta$  and  $\gamma$  are angles of a spherical triangle ABC with BC, AC and AB as respective opposite sides measured as angles from the centre of the globe.

If B and C were two points on the Northern hemisphere with given latitude and longitude expressed in radians, then the distance between these points could be calculated as follows. Taking A to be the North Pole, equation (B.1) could be applied to the spherical triangle ABC, for which:

$$AB = 0.5\pi - \text{latitude B};$$

$$AC = 0.5\pi - \text{latitude C};$$

$\alpha = \text{longitude B} - \text{longitude C}$  (This follows from the Law of Cosine applied to the triangle formed by both half meridians and the equator).

According to (B.1):

$$BC = \cos^{-1} (\cos AC \cdot \cos AB + \sin AC \cdot \sin AB \cdot \cos \alpha)$$

Multiplication by 6366 (the radius of the globe) gives us the distance between B and C in kilometres.

Intraregional distance was calculated using the following formula:

$$d_{ii} = \frac{1}{3} \sqrt{\frac{a_i}{\pi}} \quad (B.2)$$

where  $d_{ii}$  and  $a_i$  represent the intraregional distance and the area of the region  $i$ , measured in kilometres and square kilometres respectively. Any calculation of intraregional distance is necessarily of an arbitrary nature. Equation (B.2) is related to regular market area analysis (Paelinck and Nijkamp (1975)). If demand were dispersed homogeneously over a circular market area, average transport distance from the centre would be twice the outcome of (B.2). If on the other hand, demand were concentrated in the centre, transport distance would be zero. Equation (B.2) represents the mean of both these extremes.

For all distances calculated - intraregional as well as interregional - a minimum of 25 kilometres was imposed.

Appendix C Market distance by region

Legend

B = Belgium  
D = Germany  
DK = Denmark  
E = Spain  
F = France  
GR = Greece  
I = Italy  
IR = Ireland  
L = Luxemburg  
NL = Netherlands  
P = Portugal  
UK = United Kingdom

Index = Index market distance (EC-minimum = 100)

Rank : criterion = index (EC-minimum = 1)

<u>Region</u>	<u>Country</u>	<u>Index</u>	<u>Rank</u>
ANTWERPEN	B	105	20
BRABANT	B	103	10
HAINAUT	B	102	8
LIEGE	B	102	9
LIMBURG	B	104	12
LUXEMBOURG	B	101	4
NAMUR	B	102	6
O-VLAAND.	B	105	19
W-VLAAND.	B	107	26
SCHLESWIG	D	149	88
HAMBURG	D	130	70
BRAUNSCHW.	D	130	71
HANNOVER	D	127	64
LUENEBURG	D	138	82
WESER-EMS	D	124	58
BREMEN	D	129	69
DUESSELDORF	D	107	27
KOELN	D	106	25
MUENSTER	D	134	75
DETMOLD	D	119	50
ARNSBERG	D	112	39
DARMSTADT	D	108	29
GIESSEN	D	110	36
KASSEL	D	118	49
KOBLENZ	D	105	21
TRIER	D	101	5
RHEINHESSEN	D	105	22
STUTTGART	D	109	34
KARLSRUHE	D	106	24
FREIBURG	D	105	23
TUBINGEN	D	109	33
OBERBAYERN	D	124	59

<u>Region</u>	<u>Country</u>	<u>Index</u>	<u>Rank</u>
NIEDERBAYERN	D	132	72
OBERRFALZ	D	128	65
OBERFRANKEN	D	124	60
MITTELFRANK.	D	117	48
UNTERFRANKEN	D	117	46
SCHWABEN	D	117	47
SAARLAND	D	102	7
BERLIN	D	152	89
HOVESTADSR.	DK	178	105
OST STOREB.	DK	161	93
VEST STORE.	DK	175	104
GALICIA	E	237	123
ASTURIAS	E	187	110
CANTABRIA	E	173	102
PAIS VASCO	E	166	98
NAVARRA	E	162	96
RIOJA	E	170	99
ARAGON	E	171	100
MADRID	E	201	115
CAST-LEON	E	195	112
C.-LA MANCHA	E	209	117
EXTREMADURA	E	228	121
CATALUNA	E	162	95
VALENCIANA	E	196	113
BALEARES	E	185	109
ANDALUCIA	E	241	127
MURCIA	E	220	120
CEUTA Y MEL.	E	273	132
CANARIAS	E	446	142
I.-DE-FRANCE	F	104	13
CHAMPAGNE-A.	F	100	1
PICARDIE	F	104	16
H-NORMANDIE	F	109	32
CENTRE	F	108	31
B-NORMANDIE	F	116	44
BOURGOGNE	F	104	15
CALAIS	F	104	17
LORRAINE	F	101	3
ALSACE	F	104	14
FR-COMTE	F	105	18
P.D.LA LOIRE	F	129	67
BRETAGNE	F	127	63
P-CHARENTES	F	133	74
AQUITAINE	F	138	81
PYRENEES	F	137	80
LIMOUSIN	F	122	54
RHONE-ALPES	F	113	40
AUVERGNE	F	116	43
LANGUEDOC	F	133	73
PROVENCE	F	135	77
CORSE	F	153	90

<u>Region</u>	<u>Country</u>	<u>Index</u>	<u>Rank</u>
KENTRIKI	GR	268	131
THESSALIA	GR	282	134
ANATOLIKI	GR	285	135
THRAKI	GR	303	137
STEREA	GR	286	136
PELOPONNIS	GR	306	138
IPEIROS	GR	266	130
KRITI	GR	360	140
NISIA	GR	309	139
PIEMONTE	I	120	52
VAL. D.AOSTA	I	115	42
LIGURIA	I	129	68
LOMBARDIA	I	121	53
TRENTINO	I	128	66
VENETO	I	140	84
FRIULI-VEN.	I	143	85
EMILIA-ROM.	I	140	83
TOSCANA	I	146	87
UMBRIA	I	159	92
MARCHE	I	165	97
LAZIO	I	173	101
CAMPANIA	I	197	114
ABRUZZI	I	173	103
MOLISE	I	191	111
PUGLIA	I	214	119
BASILICATA	I	211	118
CALABRIA	I	238	124
SICILIA	I	240	126
SARDEGNA	I	183	107
IRELAND	IR	185	108
LUXEMBOURG	L	100	2
GRONINGEN	NL	125	61
FRIESLAND	NL	123	57
DRENTHE	NL	122	56
OVERIJSSSEL	NL	116	45
GELDERLAND	NL	111	37
UTRECHT	NL	112	38
N-HOLLAND	NL	114	41
Z-HOLLAND	NL	110	35
ZEELAND	NL	108	30
N-BRABANT	NL	107	28
LIMBURG	NL	103	11
NORTE	P	232	122
CENTRO	P	240	125
LISBOA	P	263	129
ALENTEJO	P	255	128
ALGARVE	P	278	133
ACORES	P	465	143
MADEIRA	P	412	141

<u>Region</u>	<u>Country</u>	<u>Index</u>	<u>Rank</u>
NORTH	UK	162	94
YORKSHIRE	UK	145	86
E-MIDLANDS	UK	135	79
E-ANGLIA	UK	122	55
S-EAST	UK	119	51
S-WEST	UK	135	76
W-MIDLANDS	UK	135	78
N-WEST	UK	155	91
WALES	UK	125	62
SCOTLAND	UK	204	116
N-IRELAND	UK	182	106

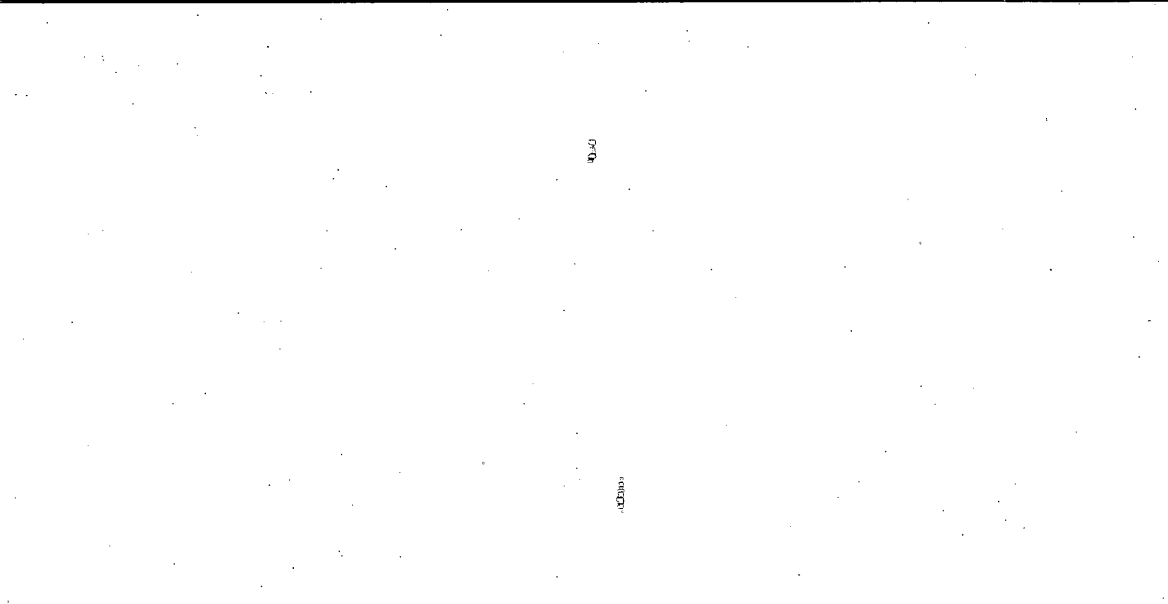
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