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Bruinsma, F.; Rietveld, P.

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Infrastructure and Metropolitan Development a European Comparison

F. Bruinsma
P. Rietveld

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INFRASTRUCTURE AND METROPOLITAN DEVELOPMENT

a European comparison

Frank Bruinsma Piet Rietveld

Department of Economics
Free University
De Boelelaan 1105
1081 HV Amsterdam
The Netherlands

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1. Introduction

Infrastructure is increasingly recognized as a key factor in regional and metropolitan development. Most European countries experienced a rapid economic development during the second half of the 1980's, but infrastructure investments were clearly lagging behind. As a result, bottlenecks manifest themselves in various ways. Especially in highway systems at the metropolitan level congestion problems have become evident.

Given the ongoing process of European integration, infrastructure is expected to play an important role as a comparative advantage (or disadvantage) in international trade. This holds true for infrastructure at both the metropolitan and intermetropolitan level. Several European countries are in the process of proposing large infrastructure plans to improve the competitive position of their national economies and their main metropolitan areas in particular. These opinions and policy proposals are in general not based on a strong theoretical and empirical foundation about the contribution of infrastructure to metropolitan development, however. As indicated in Rietveld (1989), our knowledge about the economics of infrastructure is rather limited. There is a clear need for a better understanding of the economic impacts of infrastructure of types on metropolitan development. The present paper reviews some of the recent work in this field.

Section 2 reviews a number of cross-national studies on infrastructure in European metropolitan areas. Some of these studies also investigate the contribution of infrastructure to metropolitan development. In section 3 a more detailed account is given of a study on the relationship between infrastructure improvement and economic development in eight European metropolitan areas. The conclusion is rather undecisive. Section 4 addresses the role of international infrastructure networks in metropolitan development. The conclusion is that in international networks national borders exert a discouraging effect on international interactions. Part of the effect can be inferred from the low density of infrastructure near borders. But it is plausible that the influence of non-physical factors is dominant. It may be concluded that expansion of physical networks is not the only way to improve international communication between metropolitan areas.

2. Cross-national Comparative Studies on Urban Infrastructure

Cross-national comparative studies on the quality and/or impact of urban infrastructure are rare. In this section we will discuss five of those comparative studies which deal with various aspects of infrastructure of European cities (Bruinsma et al, 1991).

2.1 The attractiveness of European cities from the viewpoint of multinational firms: the NEI-study

NEI (1987) carried out an exploratory study for 7 West European urban agglomerations: Randstad, London, Paris, Hamburg, Frankfurt, Muenchen and Brussels/Antwerp. The study focussed on the attractiveness of the locational profiles of these agglomerations from the viewpoint of internationally oriented firms. Five groups of activities were distinguished: corporate headquarters, research and development establishments, high-tech production, distribution establishments and producer services.

The data problems, which inevitably arise in such international comparisons have been solved by using qualitative (ordinal) data, based partly on secondary data and partly on expert judgement. Ordinal data are also used in the weighting process of these factors. The various locational factors received a rank ranging from 1 (most important) to 6 (least important). Infrastructure components obviously play a prominent role in the locational profile, especially of distribution establishments. Network aspects of infrastructure are emphasized. Also tariffs for the use of infrastructure play a role. Multicriteria analysis has been used to generate a final ranking of urban agglomerations on the locational factors.

Table 1 gives the ranking of the urban agglomerations for the types of economic activities distinghuised. For each activity a specific list of location factors and the corresponding weights has been used.

The most striking aspect of the table is the very favourable result for London: it is unambiguously ranked first for three of the five activities. Relatively favourable results are also found for the Randstad, Frankfurt and Paris. The profiles of Hamburg, Muenchen and Brussels/Antwerp are least favourable.

Among the weak aspects of this study are the soft character of the data used and the lack of an

Table 1: Attractiveness of urban agglomeration as a location for international economic activity (1: most attractive)

	Randstad	Londen	Paris	Hamburg	Frankfurt	Muenchen	Brussels
Corporate headquarter	3-4	1	2	7	5-6	5-6	3-4
R&D	6-7	1	2-5	2-5	2-5	2-5	6-7
High-tech	1-2	5-7	5-7	3-4	1-2	3-4	5-7
Distribution	1	2-6	2-6	2-6	2-6	7	2-6
Producer services	2-5	1	2-5	7	2-5	6	2-5

Source: N.E.I. (1987)

empirical basis for the weights. No efforts have been made to reinforce the analysis by linking these data to actual behaviour of internationally oriented firms. Thus, it is impossible to say whether firms will indeed evaluate urban agglomerations according to the rankings presented in Table 1. An attractive aspect of this study concerns the sectoral detail used. It is also surprising that no push effects (e.g., high social costs, low environmental quality, congestion) are taken into consideration, so that some reservations in interpreting the results are necessary.

2.2 Measuring and explaining the performance of the EC's urban regions: the Cheshire Study.

Urban problems are multidimensional and the construction of an aggregate index to measure the intensity of urban problems is a difficult task, accordingly. One possibility is to apply a priori weights to individual problem indicators in order to arrive at an aggregate problem index. But it is not easy to find a sound basis for such weights. Another approach is followed by Cheshire, Carbonaro and Hay (1986). They estimate the weights of individual problem indicators on the basis of expert opinions about which EC cities are healthy and which are unhealthy. The statistical tool used by Cheshire et al. is discriminant analysis (cf. Hand, 1981), which enables one to estimate coefficients (weights) which minimize the variance within both groups of cities and maximize the variance between the groups.

In a more recent study, Cheshire (1990) gives an update for 1988 where also cities from Spain and Portugal are included. The main pattern observed is rather stable. An important element is that an explanatory analysis is given of the urban problem index, or rather the **change** in the problem index between 1971 and 1988. The results are shown in Table 2.

The negative sign of the population variable indicates that, ceteris paribus, the problems of large cities have been mitigated compared with smaller cities during the period considered. Another Table

2: The changing incidence of urban problems, 1971-88 (t values in parentheses)

Independent variable		
Constant	17.2	
Log total population (1981)	-.96	(-2.95)
Change in economic potential	-4.82	(-5.31)
Percentage of labour force in industry in wider region, 1975	.067	(2.16)
Percentage of labour force in agriculture in wider region, 1975	.169	(1.86)
Percentage of labour force in agriculture in wider region, squared, 1975	.0056	(-2.44)
Dependence of local economy on port	.63	(3.85)
Dependence of local economy on coal	1.21	(3.42)
Natural rate for population change	.174	(2.75)
Country dummies		
Adjusted R^2	.80	

source: Cheshire (1990)

explanatory variable is the change in economic potential, measured by means of the gravity model. Major reasons for changes in economic potential are changes in the composition in the EC and changes in the transport network. This result means among others that cities in the Northern and Western periphery of the EC have been facing increasingly severe urban problems.

Most of the other variables relate to economic structure. Cities in regions with a strong orientation on industry, agriculture and coal mining experienced increasing urban problems. A similar result holds true for cities with a large natural population change. There is only one **infrastructure** variable among the independent variables and it has an increasing influence on urban problems: the dependence of the local economy on ports (measured on a scale from 0 to 4 to indicate the volume of seaborne trade). This reflects the negative influence of containerisation on employment in ports during the period considered. The loss of employment may relate both to the substitution of labour by capital and to indirect effects on processing industries since containerisation means that ports loose their initial locational advantage compared with other cities (Cheshire, 1990).

The overall pattern emerging from Table 2 is that skill-based cities have fared better than cities with a basis in natural resources. Infrastructure plays an explicit role in the explanation via the port variable. Further, Cheshire indicates that it may play a role in the unexplained variance. He suggests for example that favourable developments in cities such as Paris (and more recently) Rotterdam are due to coherent strategic plans for development and modernisation of its transport infrastructure. In addition, infrastructure plays an implicit role in the economic potential variable, since this variable depends on transport costs which in its turn depends on the infrastructure network.

In Table 3 some numerical results are presented for a set of larger cities in the North Western part

Table 3: Incidence of urban problems in European cities

	urban problem index (1981)	change in urban problem index (1971-1988)
Kobenhavn	-2.14	n.a.
London	-4.35	3.92
Amsterdam	-8.16	-.22
Rotterdam	3.19	.69
The Hague	-.05	.19
Antwerp	-2.11	-.89
Brussels	-10.59	-5.09
Paris	-1.71	-.98
Milano	-4.94	1.66
Duesseldorf	-8.25	4.06
Muenchen	-10.67	3.29
EC average	-.17	3.29

Source: Cheshire (1990)

of the EC. Most of these cities considered have a problem index below the EC median in 1981, i.e. they are relatively healthy. Also from the viewpoint of change most of the cities perform well compared with the EC average. The worst development observed occurs with London and some cities in Northern and Central Germany.

2.3 The performance of European Cities; the DATAR Report.

In 1989, a French study (DATAR, 1989) was published on the socio-economic performance of 165 European cities with a population of more than 200,000 inhabitants. Data relate to functional urban regions. The performance of the cities is measured by means of 16 indicators which can be classified as follows:

1-2 population (size, growth)
3-5 infrastructure (airports, ports, telecommunication)
6-9 skills (high tech industry, R&D, skills of labour force, universities)
10-12 knowledge exchange (congresses, exhibitions, press)
13-14 international relations (seats of multinational firms, financial institutions)
15-16 cultural (museums, festivals, etc.)

The cities have been rated on a scale from 1 (least attractive) to 6 (most attractive). An index of the aggregate socio-economic performance of cities is constructed by unweighted summation. Thus, infrastructure variables contribute 3/16 of the aggregate index. The results for a subset of cities are presented in Table 4. According to this table London and Paris have by far the highest scores, followed by Milan.

Although the DATAR report brings together interesting information, it can be criticized for various reasons. First, it is not made clear what the aggregatre index actually stands for. Second, for several

Table 4: Aggregate performance of European cities.

Kobenhavn		56
London	83	
Amsterdam		63
Rotterdam		55
The Hague		44
Antwerp	44	
Brussels		64
Paris		81
Milan		70
Duesseldorf		44
Muenchen		65
EC(average)		28

Source DATAR (1989)

of the underlying variables quantitative data are readily available so that an unneccessary loss of information occurs when one used a scale such as (1, 2, 3, 4, 5, 6). Third, no basis is given for the assumption of equal weights, although the DATAR report mentions that sensitivity analysis reveals that other assumptions lead to approximately the same results. Fourth, the definition of the variables is not always mutually consistent. Most of the variables relate to absolute figures. Thus, Paris and London score 5 or 6 for most variables simply because of their size: these cities host most people, they have the biggest airports, most students, etc. Thus, it is no surprise to see that the figures in Table 4 are closely related to population size. Such an approach is defendable, but it is not easy to understand why in some cases a standardization is used. For example, the university variable is based on the absolute number of students but the labour force skill variable is based on the **share** of people in the labour force having certain skills.

2.4 Contact potentials in the European system of cities: the Erlandsson Study

This study, which took place in 1976, focusses on contact potentials of particular nodes within the European communication system. As specialised occupational groups and decision-makers show the tendency to cluster in larger urban areas, cities down to the size of 500,000 citizens should represent the most important elements in the contact network.

Opportunities for direct personel contacts between 98 European urban centers are studied in two different ways. The first study investigates the different possibilities of round trips in a given day by different means of transport (car, train, boat and airplane) between each of the urban centers. The maximum lenght of stay time within the destination center which still enables a return home on the same day is used to evaluate these possibilities. Investigated are the travel opportunities from (outbound accessibility) and towards (inbound accessibility) each urban center in respect of all other centers (Erlandsson, 1977).

In the second investigation a weighting procedure is used by relating the results to the size of the urban population as a surrogate for the contact requirement. Erlandsson realizes that the larger urban areas have a higher percentage of concact requirement than the smaller ones, but suffers with the problem of lack of data needed for a better wheigthing process. So the questions put forward were: what is the potential number of individuals who can be reached from city A during a day visit for a 4 to 8 hours stay (weighted outbound accessibility), and what is the potential number of individuals who can travel to city A during a day visit for a 4 to 8 hours stay (weighted inbound accessibility)? The time interval of 4 to 8 hours was chosen since it is assumed to be required in order to accomplish a day's work and make a single day trip worthwhile.

The indicators defined above can be interpreted as indicators of the quality of infrastructure for inter-metropolitan communication.

The most favourable zone for outbound accessibility occurs within an area delimited by lines drawn between Paris-London-Hamburg-Muenchen-Milan-Lyon-Paris. The only urban centers that show corresponding high values outside this 'Primary European Center' are West Berlin, Vienna, Rome and Manchester (Table 5). The inbound accessibility shows roughly the same pattern, although in certain cases a striking difference occurs, as is the case for Copenhagen. Copenhagen, located outside the 'Primary European Center', has consideraly better inbound than outbound accessibility within Europe.

Table 5: Accessibility of European cities (unweighted and weighted for population size)

	unweighted outbound accessibility	unweighted inbound accessibility	weighted outbound accessibility	weighted inbound accessibility
Kobenhavn	48	63	43	65
London	76	79	80	87
Amsterdam	84	76	90	84
Rotterdam	82	60	85	59
Antwerp	93	71	96	71
Brussels	91	79	95	84
Paris	100	97	100	100
Milano	74	78	72	75
Duesseldorf	72	84	67	79
Muenchen	62	67	63	55

Source: Erlandsson (1977)

This is in contradiction with most of the existing schedules of train and air traffic in Europe which seem to be planned in such a way that there are better opportunities to travel into the Primary European Center than in the opposite directions: the inbound accessibility in peripherally located urban areas tends to be lower than their outbound accessibility.

For the weighted outbound accessibility the same 'Primary European Center' exists as shown for the unweighted outbound accessibility. The group of cities outside this area which show corresponding high values is enlarged with Dublin and Birmingham. Compared with the weighted outbound accessibility, again Copenhagen has a much more favourable position in its weighted inbound accessibility. It appears that - with exception of Copenhagen - the gap between the 'Primary European Center' and the other cities has been enlarged for the weighted inbound accessibility. For cities outside the 'Primary European Center' weighted outbound accessibility are clearly more favourable than weighted inbound accessibility.

It appears that Western Europe has a higher accessibility than Eastern Europe, regardless whether the area is densely populated (East German cities and Prague). Within almost all European countries, one or two urban centers have significantly better accessibility than the others in the country. From an accessibility point of view the cities under study can be arranged in a national hierarchy in which one or two national centers have a superior position to the other cities. These other cities are primilary nodes in a domestic transport system and, therefore, they are connected to the European network via one or two national centers.

2.5 Stated preferences about infrastructure in European cities: the Healey and Baker survey

Healey and Baker (1990) study the attractiveness of European cities as a location for large companies. A stated preference approach is followed by interviewing 500 senior managers of large companies in industry, trade and services from nine European countries. The respondents are asked to rate the three cities which are the best locations in terms of various location factors including infrastructure, office space, quality of life, etc. Thus, the responses relate to perceptions of the attractiveness. Table 6 presents the results for a limited subset of cities and quality indicators.

The overall indicator underlines the dominant position of London and Paris as an attractive location for company headquarters in Europe. But also cities such as Frankfurt, Brussels and Amsterdam receive a favourable rating. According to the respondents, London and Paris have the best performance for to the infrastructure indicators: quality of telecommunication, city transport infrastructure and easy access to markets. For city transport infrastructure this is to a certain extent surprising. London and Paris are well-known to be plagued by heavy congestion in the road network. It seems that this has been compensated by a fine-meshed metro network. Also the "easy access to markets, customers, clients" outcome for London is somewhat surprising in view of its ec-centric location in Europe. There are two possible exploinations for this result. First, in the airline network, London has a favourable position which compensates for its eccentric location. Second, the relevant customers and clients are not uniformly spread all over Europe, but they are located in the large cities. This is the well-known urbanisation economies argument: London is an attractive location for a large company since many large companies are located there.

One may wonder to which extent also diseconomies of urbanisation occur in the perception of the respondents. This can be investigated by means of the fourth colomm of Table 6. This table shows that there are no clear signs of diseconomies of urbanisation: quality of life for employees is even judged

Table 6: Attractiveness of European cities as a location for large companies (measured as an index)

	easy access to customers, markets or clients	quality of telecommu-nications	transport infra-structure	quality of life for employees	overall index
London	.93	1.13	1.17	.47	.83
Amsterdam	.50	.34	.48	.39	.44
Brussels	.63	.36	.56	.56	.52
Paris	.91	.95	1.29	.90	.76
Milano	.42	.09	.21	.27	.24
Duesseldorf	.39	.38	.39	.28	.31
Muenich	.19	.20	.24	.68	.21
Frankfurt	.82	.91	1.06	.21	.64

Source: Healey and Baker (1990)

Table 7: Essential factors for locating business

Location factor	Percentage of all firms which considers location factor as absolutely essential
Easy access to markets, customers or clients	60
The quality of telecommunication	59
Transport infrastructure	57
Cost and availability of staff	35
The climate governments create for business through tax policies and the availability of financial incentives	30
Availability of space	27
Value for money for space	22
Languages spoken	17
The quality of life for employees	14

Source: Healey and Baker (1990)

to be highest in Paris. For London it is much lower, however.

Respondents also indicated which location factors are absolutely essential when deciding where to locate their business. From the results (see Table 7) it appears that infrastructure policies are most important for national and metropolitan authorities when they want to attract investments of large companies.

What is the value of the stated preference approach as used by Healey and Baker (1990)? The perceptions observed in this way are a relevant piece of information since they play a role in company location decisions. Of course, these perceptions do not necessarily reflect reality. It may for example be that the attractiveness of well-known prestigeous cities is overrated by certain respondents. It would be interesting to analyze how the perceptions relate to objectively measurable features of cities. Certain measurement problems should be mentioned with data of this kind. First, the set of countries from which respondents are interviewed is limited to nine, whereas cities from 12 Western European countries are taken into account. This may produce a bias against cities in certain countries. A more general problem is that familiarity with a certain location may lead to a bias for that location. It is difficult to correct for such a bias. A third problem inherent to stated preferences is that there is no guarantee that it is followed by actual location behaviour. Nevertheless, stated preference data are an interesting complement to the objectively measurable indicators, or revealed preference data commonly used in this context.

2.6 Retrospect

Five studies on metropolitan infrastructure and its role on urban development have been reviewed in this section. The types of data used are quite different in the studies. Also in terms of results, the studies are different. Concerning the role of infrastructure, Cheshire finds that it has a rather limited influence on urban development. In the NEI study, infrastructure is assigned a very important role as a location factor, but no statistical testing is carried out. The role of infrastructure in the DATAR study is more limited, but also here statistical tests are not used. In the Healey and Baker study, infrastructure plays a dominant role.

The studies considered here each give rankings of European cities in order of attractiveness or accessibility. These rankings express different things, and it is therefore no surprise to see that they may be so different. For example the largest metropolitan areas London and Paris have very high scores in the Healey & Baker, NEI and DATAR studies, but in the Cheshire study their rank is much more mediocre.

3. Infrastructure and Urban Development in Europe

3.1 Introduction

In this part of the paper we will present some results of a cross-urban comparative study on the relation between infrastructure and urban development in Europe (Bruinsma and Rietveld, 1991). In the study the development of eight urban areas is compared with its growth of infrastructure over the period 1975-1988. Several problems with data collection exist in this field of cross-national studies. First, it is hard to find comparative data on employment or production when sectoral subdivision is requested. Second, data on infrastructure are limited. Data on the supply of physical infrastructure are available but data on the quality of infrastructure and the actual use of infrastructure, are sometimes difficult to find. International comparative data on urban congestion or on urban investments in infrastructure are absent. Another problem concerns the lack of synchronisation. It is very hard to get comparative time series of data. This last problem has been solved by using interpolation or extrapolation techniques. A fourth problem concerns the lack of uniformity in the delimitation of urban areas across countries.

Eight urban areas in Western Europa are chosen as case-study areas (Table 8). With one exception all of them are located within the area which is sometimes considered as the central urban axis within Europa (the Blue Banana (Datar, 1989)): London, Paris, the Randstad, Brussels/Antwerp, Milano, Duesseldorf/Duisburg and Muenchen. The exception from this central European urban axis is Copenhagen, which is chosen as one of the cities which at the moment taken considerably efforts to improve its relative position towards this central axis.

The analysis has taken place at two spatial levels; urban agglomeration and the broader urban region (Eurostat, level II). Some imcompatibility problems occur. First, some urban agglomerations had to be defined as the central municipality because of the lack of data for a broader urban unit. Second some urban regions become rather large compared with the other urban regions. To overcome those

Table 8: Urban regions included in the study

Country	Region (Eurostat, level II)	Agglomeration
Denmark	Hovestadsregion	Kobenhavn
England	South East	Greater London
The Netherlands	North and South Holland	Randstad (Amsterdam/Rotterdam/The Hague)
Belgium	Brabant and Antwerp	Brussels/Antwerp
France	Ile de France	Paris
Italy	Lombardia	Milano
Germany	Duesseldorf	Duesseldorf
Germany	Oberbayern	Muenchen

spatial problems most information is given for both levels and in growth indices (1975-1988) instead of absolute figures. The use of urban regions as well as urban agglomerations is also necessary to cover the spatial effects of urban expansion.

3.2 General impression of the urban areas

As shown in Table 9 over the period 1975-1988 the population growth in nearly all urban agglomerations considered lags behind the regional as well as the national population growth. In

Table 9: Population and housing in 8 European agglomerations

Country	Population		Housing stock	
	1975	index 75-88	1975	index 75-88
England		101		114
Greater Londen	17.3	102	6.2	113
London	6.8	95	2.6	107
France		106		123
Ile de France	10.7	107	4.5	112
Paris	9.0	105	4.0	---
The Netherlands		108		130
North and South Holland	5.6	104	2.2	120
Randstad	3.0	114	1.3	126
Belgium		101		111
Brabant and Antwerp	3.8	101	1.5	113
Brussels/Antwerp	1.9	95	0.8	106
Germany		99		119
Duesseldorf	5.1	96	2.3	110
Duesseldorf	0.6	92	0.3	106
Oberbayern	3.7	103	1.6	119
Muenchen	2.3	101	1.0	110
Italy		103		131
Lombardia	8.9	101	3.6	122
Milano	1.5	88	0.7	107
Denmark		101		115
Hovestadsregion	1.7	97	0.8	109
Kobenhavn	1.2	90	0.6	104

Table 10: Employment and unemployment in 8 European agglomerations

Country	Employment 1975	Employment index 75-88	Unemployment 1975	Unemployment index 75-88
Greater London	7.5	103	494	286
London	3.5	92	249	192
Ile de France	4.7	100	435	227
Paris	---	---	---	---
North and South Holland	1.9	117	283	489
Randstad	1.2	114	183	489
Brabant and Antwerp	1.3	97	61	52
Brussels/Antwerp	0.9	93	36	57
Duesseldorf	2.1	98	191	226
Duesseldorf	---	---	---	---
Oberbayern	1.8	108	69	144
Muenchen	1.1	---	43	130
Lombardia	3.7	107	273	489
Milano	1.7	104	---	---
Hovestadsregion	0.9	105	65	206
Kobenhavn	0.6	102	48	181

certain cities the slow growth or decrease of the population of the urban agglomerations is compensated by the relatively strong growth of the urban region. After about 1985 a different trend can be observed: since that year a slight growth of the population of all urban agglomerations can be observed. It seems that the phase of suburbanisation is shifting towards a phase of re-urbanisation. The same could be said for the development of the housing stock. In the first period the growth of the urban housing stock was lagging behind the national and regional development, but in recent years the urban housing stock starts to show higher growth rates.

In the period 1975-1988 not only the growth of population and housing stock were higher in urban regions as in urban agglomerations, also the employment developed in favour of the urban regions (Table 10). More interesting than the total employment is the development in the sectoral subdivi-sion of employment. Lack of data compatibility forced us to use a rather elementary subdivision into profit services sector, non-profit services sector and a rest group (industry, construction, agriculture). For Muenchen even this subdivision was not possible. Table 11 shows that the shift in sectoral subdivision of employment in urban agglomerations (and regions) implied a decrease of the share of the industry group in the period 1975-1988. In general employment in industry did not only decrease in a relative but also in an absolute sense. The sector which has gained most is not always the same.

Table 11: Sectoral development of employment in 8 European agglomerations (1975-1988)

	Change in share			Growth rate
	Profit service sector	Non-Profit service sector	Rest	Profit service sector
Kobenhavn	++	-	--	++
Paris	++	0	--	+
London	++	+	--	+
Milano	+	+	--	++
Duesseldorf	+	+	--	+
Brussels/Antwerp	+	++	--	+
Randstad	0	++	--	++

In Kobenhavn, Paris and Londen the share of the profit service sector grows relatively fast: on the other hand, in Brussels/Antwerp and the Randstad it is the share of the non-profit service sector which grows fast. One must keep in mind that these figures are shifts in shares. Nevertheless bearing in mind that the profit service sector has a much stronger international orientation than the non-profit service sector, the shift of shares of employment in Kobenhavn, Paris and Londen is most favourable from an international viewpoint. However, as indicated in the last column of table 11, in growth rates Kobenhavn, Milano and the Randstad have the fastest growing profit service sector.

3.3 Infrastructure and urban development

- *Infrastructure and the development in the sectoral subdivision of employment*

In the period 1975-1988 there has been a substantial change in the sectoral subdivision of employment. Employment in industry has decreased. Only highly qualitative industry and service oriented industry is located in urban areas. Both the profit and the non-profit service sector show a sharp rise in employment in absolute terms. Compared with the industrial sector, the service sector partly needs other kinds of infrastructure. Both need good road and public transport infrastructure but industry demands watertransport and freight traffic whereas for the service sector telecommunication services and access to international airports may be especially important. The shift towards the service sector led to a rising demand on the office market in the urban areas considered. The construction in most of the urban agglomerations was enough to fulfil demand. Only in Paris and London there is some friction on the office market. There is a shortage of construction sites in the historic innercity of Paris and the office quarter La Defense is near completion. The office market in London can still expand in the Docklands.

Nearly as important as the quantity is the quality of the offices. During the past 20 years the requirements formulated for office buildings have changed considerably for many firms. An office building needs a good location (preferably near a highway or international airport), be representive and offer good telecommunication facilities. As a consequence there is a tendency that office buildings built in the sixties are left for new buildings near de city border with a good sight location, good access to highways, new representive architecture, enough parking place and modern telecommunication facilities.

A recent development is that governments in the urban areas considered start to shift the focus in office location from a highway orientation towards a public traffic orientation. They start to stimulate the construction of office buildings near (metro-)stations and discourage the development of new office buildings near highways.

- Infrastructure and urban development

What general inferences can be drawn from this case study on urban areas within Europe? Are there any relations between infrastructure and urban development at the agglomeration level? In this section we will measure urban development by the development of employment, both total employment and profit service sector employment (as an indicator for international orientation). The growth indices of urban agglomerations and urban regions for total employment as well as for employment in the profit service sector leads - in all cases - to the following division. The growth indices for total employment and profit service sector employment for North-South Holland, Oberbayern, Lombardia and Hovestadregionen score above median and South East, Ile de France, Duesseldorf and Brabant/Antwerp score below median, in an absolute sense. In the following analysis we shall compare growth indices of employment and infrastructure elements.

In Table 12.1 results are shown for the relation between the growth indices of employment and highways. A perfect relation would have been achieved when an above median growth of employment also implied an above median growth of the highway network and vise versa. As shown in table 12.1 the results are rather dispersed: there is no significant correlation between urban development and the development of the highway network. The relation between the growth of passengers of urban traffic systems and the growth of employment relates more closely to the expected pattern. However, the large investments in the London Underground led to a sharpe rise in the number of passengers

Table 12: Comparison of employment growth and infrastructure development in 8 European agglomerations (1975-1988)

1 High-way	Employment growth > Median	Employment growth < Median
growth high	N-S Holland Hovestadsreg.	South East Ile de France
median		
growth low	Oberbayern Lombardia	Brabant/Antwerp Duesseldorf

2 Public traffic	Employment growth > Median	Employment growth < Median
growth high	Lombardia N-S Holland	South East
median		
growth low	Oberbayern	Ile de France Brabant/Antwerp

3 Airport passenger	Employment growth > Median	Employment growth < Median
growth high	Oberbayern Lombardia	South East Ile de France
median		
growth low	N-S Holland Hovestadsreg.	Duesseldorf Brabant/Antwerp

4 Airport goods	Employment growth > Median	Employment growth < Median
growth high	N-S Holland	Ile de France Brabant/Antwerp South East
median		
growth low	Lombardia Hovestadsreg. Oberbayern	Duesseldorf

5 Telephone	Employment growth > Median	Employment growth < Median
growth high	Lombardia Oberbayern	Duesseldorf
median		
growth low	Hovestadsreg.	Ile de France South East

transported without leading to a rise in employment.

The common hypothesis that airport developments have a positive influence on urban development is not proved by the facts as shown in table 12.3 and 12.4. The opposite is shown for freight transport by air. The relation with the telecommunication network is more in concordance with the expected pattern.

In general it appears that a mono-causal relation between urban development and infrastructure is not confirmed by our results. There are many forces influencing urban developments. Urban infrastructure is one of them, but its influence is not as clear or dominant as sometimes suggested.

4. Cities in International Infrastructure Networks

In the preceding section we focussed on the role of infrastructure at the metropolitan level. A sufficient supply of infrastructure is necessary for an adequate functioning of the metropolitan economy including the physical distribution of goods and services, the labour market, etc. In addition to intra-metropolitan infrastructure also inter-metropolitan infrastructure should be considered. Given the small size of most European countries this means that also international infrastructure links deserve attention.

Despite the relatively small size of most European countries and the emphasis on economic integration, planning and operation of infrastructure is predominantly done by individual countries using a narrow national perspective. Only rather recently the international dimension has grown in importance, as can be seen from initiatives such as the Channel-tunnel, a bridge between Sweden and Denmark and a highspeed railway connection between France, Belgium, Germany and the Netherlands. The existing networks display a clearly nation oriented structure.

One way to investigate the role of borders in infrastructure networks is to use a density indicator. Highway density is measured as the length of the highway network (measured in km) divided by the area of the country (measured in square km). In a densely populated country such as the Netherlands highway density is as high as 0.05 km per km^2. This means that the average length of the highways in an arbitrary area of 100 km^2 is equal to 5 km. In border areas this density is usually lower than the national average which is partly a consequence of low population densities which may occur in border

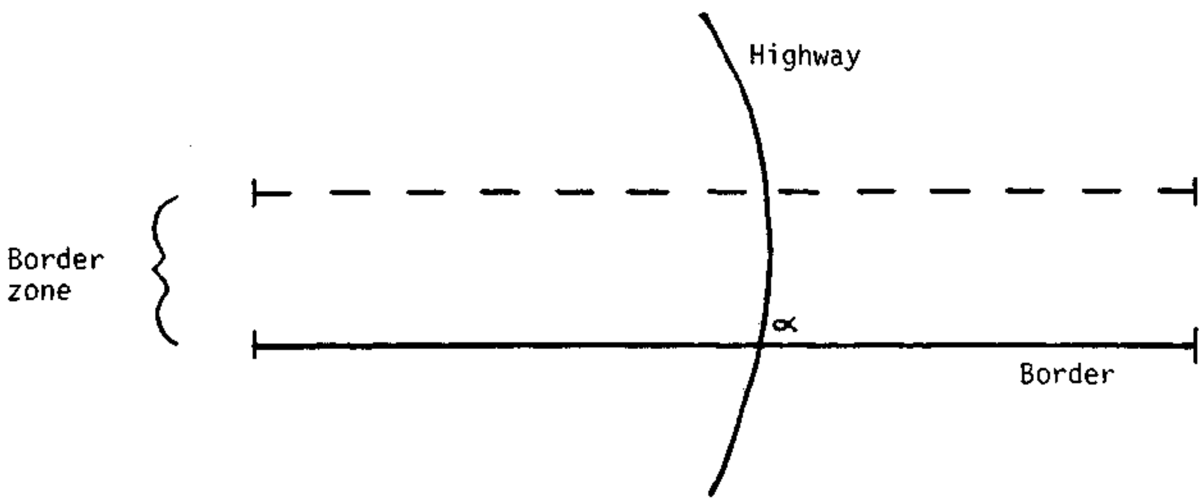

Figure 1. Highway density in a border zone

areas, and partly a consequence of the fact that borders exert a barrier effect. One way to analyse barrier effects of borders is by investigating highway densities on borders. The concept of density cannot be immediately applied in this case since the area of a border is equal to zero. By introducing a small border zone as depicted in Figure 1, we can compute the highway density in that zone. Let B denote the length of the border and x the width of the border zone. Then the area of the border zone is Bx. The length of the highway in the border zone is L(x). We assume that the length of the highway is a polynomal function of x: $L(x) = ax + bx^2 + cx^3 + \ldots$. Then the density in the border zone is L(x)/Bx. The density on the border line is defined as:

$$\lim_{x \to 0} L(x)/Bx = a/B$$

If the highway crosses the border in a perpendicular way, $\alpha = 90^o$ (see Figure 1), and a = 1. In the case of a non-perpendicular crossing, a is larger then 1. For example if $\alpha = 75^o$ or 60^o, a is equal to 1.04 or 1.15. Thus we conclude that in the case of perpendicular crossings, the highway density on a border line is equal to the number of crossings divided by the length of the border. In the case of non-perpendicular crossings, the highway density is somewhat higher. For the Netherlands, the highway density on borderlines is about 1.5 per 100 km, which is considerably below the national average of about 5.0 per 100 km.

Low highway densities on borderlines reveal a bias in infrastructure networks against international interactions and in favour of intranational interactions. From an economic viewpoint such a bias may be fully rational since the existing demand for cross-border mobility is rather low compared with other kinds of mobility. An example is given in Figure 2, where the intensity of traffic is depicted on the main highway connecting Amsterdam with Çentral and Northern Germany. The traffic intensity at the border is only 5 % of what it is near the city of Amsterdam. This underlines that most of the use of highways is for short distance intranational trips. Capacity problems with the existing highway system are most severe near large metropolitan areas in Europe. The problems international freight transport by road experiences at borders is in general not caused by a lack of capacity of highways near borders, but by bottlenecks due to customs formalities.

We conclude that national borders exert a certain barrier effect on spatial interactions because of

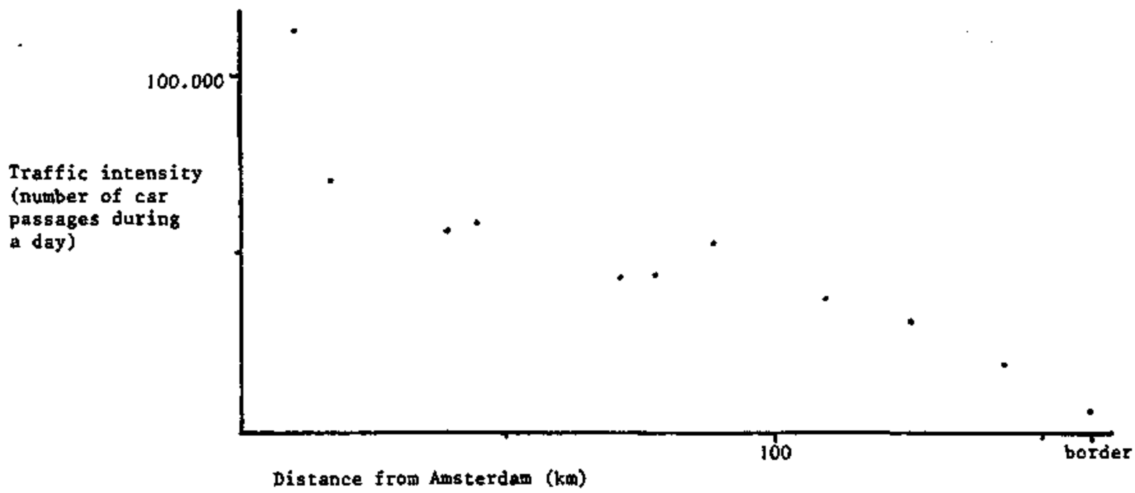

Figure 2: Barrier effect of border on highway traffic intensity (A1) between Amsterdam and the German border

Source: DVK (1990)

a relatively small number of border crossing links. This barrier effect is highest for short distance cross-border interactions because here the detour caused by the border is in general relatively large. For large distances between metropolitan areas in different countries, the share of the detour in the total distance is smaller. The above discussion suggests that it is not in the first place a lack of cross-national highways which exerts a barrier effect on cross-national interaction in Europe.

Non-physical factors seem to play an important role in the barrier effects of national borders. Among these factors are institutional, language, economic, social and cultural differences, trade barriers, tariff structures, etc. (see Nijkamp et al., 1990).

Little is known about the exact magnitude of border effects on spatial interactions between urban agglomerations in different countries in Europe. Bröcker (1984) finds that for freight transport passing a border leads to a substantial reduction of transport volumes in Western Europe. Freight flows are reduced to about 20-30 % of the volume they would be if no borders would be passed. Nuesser (1985) finds a similar reduction factor for passenger transport. For telecommunication Rietveld and Jansen (1990) find a reduction to about 30 % within Western Europe in 1983. Between Western and Eastern Europe the communication barrier was even much bigger during that year. These scarce estimates indicate that borders exert a substantial barrier effect on interaction between metropolitan areas. This even holds true for EC-member countries, which indicates that non-economic barriers are substantial.

Barriers, both economic and non-economic deserve attention in international networks of metropolitan areas (see also Keeble et al., 1982). One may expect institutional changes leading to a further reduction of barrier effects within Western Europe and even more a reduction of barrier effects between Western and Eastern Europe after 1990. It is not impossible that the reduction of these barriers will be of much more decisive importance for the future accessibility of urban areas in Europe than changes in infrastructure networks, as influenced among others by the introduction of highspeed rail connections. This does not mean to say that infrastructure networks are unimportant in the future evolution of the European system of cities. Reduction of non physical barriers will stimulate international trade and communication and this will sooner or later lead to bottlenecks in international networks. Removal of these bottlenecks will be an important element of an infrastructure

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