Obstacles to openness of border regions in Europe.

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Abstract

Border related obstacles appear to play a large role in international transport flows. The present paper gives a typology of possible backgrounds of such obstacles. Empirical results are shown for various transport modes: car, bus (public transport), train, plane. Special attention is given to business and freight transport because these are most accurately reflecting the effects of borders on the organization of economic activity at different sides of borders. We find some evidence that border effects are smaller for business and freight transport than they are for other travel motives. This seems to be an indication that the development of openness in regional development has proceeded further than is sometimes thought. However, the gap between domestic commercial interaction and cross-border commercial interaction remains significant.

1. Introduction

The ongoing process of economic integration in Europe leads to a reduction of the importance of borders as a factor discouraging spatial interaction in terms of flows of goods, persons and information. Borders do have various implications for spatial interaction. They correlate with fiscal and institutional differences, but also with cultural and language differences. Fiscal differences can be changed relatively easily by changing fiscal laws. But other types of differences are much more difficult to change. Therefore it is interesting to investigate more carefully the impact of borders on spatial interaction, and more specifically the impact of changes in the nature of borders as they take place in Europe nowadays. This leads to the question of what types of border effects remain after the process of European integration which has emphasized the harmonization of fiscal and legal dimensions.

Borders tend to function as obstacles in spatial interaction since interactions with foreign neighbour regions tend to be weak. It would be too easy to conclude that this will always have a negative economic impact on a border region, however. Borders will lead to a certain degree of isolation (interpreted as high transport costs) which discourages interregional trade. Firms producing in a border region are relatively isolated and hence do not face competition of firms at the other side of the border. Hence border regions may experience a certain level of protection because of their location. Indeed, borders have often been constructed as a means to provide protection against alien forces at the other side, the Chinese wall being an excellent example.

As outlined in Rietveld (1994) the higher degree of competition implied by reducing the obstacle effect of a border has various effects. Some sectors will be hurt by the increase in competition and may decline. Other sectors may find new opportunities to export. In terms of employment effects the balance is not clear. For consumers a similar result obtains: some products will become cheaper because of increased competition, but other products may become more expensive when the firms located in the region find that it is more profitable to export their products to other countries. For the aggregate of consumers and producers in all regions the reduction of obstacles to trade is beneficiary (in terms of consumer surplus and profits), but the distribution of the two may be uneven across regions.

The above reasoning is based on a simple interregional trade model. This does not exhaust the relevant economic perspectives on borders, however. Other relevant economic aspects of border regions concern the markets for inputs, labour and knowledge. For example, borders will induce difficulties in cross-border commuting. They may also discourage cross-border cooperation between firms. The latter would imply that borders also function as obstacles to the diffusion of knowledge that may hamper the

vitality of firms located in border regions.

The term 'border region' actually covers a wide variety of regions according to sectoral composition, income levels and infrastructure endowment. At the European level there is certainly no reason to equate border regions with problem regions. If one considers the problem regions in the various EU countries, one observes that many of them are not border regions (cf., Armstrong and Taylor, 1993). Concerning the position of border regions in transport networks and trade flows we observe that particular places near borders which are suitably located have the potential to become export nodes. These locations may benefit from borders because they function as gateways to the neighbour country so that a concentration of economic activity is induced. Such a gateway position is only possible for a limited number of places, however. Most places in border regions will not have such an opportunity and will have to search for other strong points to exploit.

Our conclusion is that the impact of borders on economic activity in a region can attain many forms varying from positive to negative. In studies of the impact of borders on regions one should take into account differences among sub-regions. Reduction of the obstacle effects of borders as taking place in the EU provides a challenge to the firms involved to exploit the opportunities offered. An appropriate term seems to be the managing of openness.

In this respect it is useful to point at a certain bias in the discussions on border regions. If borders are interpreted as semi-permeable lines in space which discourage interaction with neighbour regions, seacoasts can be given a similar meaning. Coastal regions even have a bigger disadvantage compared with regions located at national borders, since the communication partners at the other side of the line are virtually absent, whilst with border regions they are not absent, but only more difficult to reach. Of course, a location at a seacoast gives certain advantages to a region: coastal regions have a good location to exploit sea related resources (e.g., oil, fish, tourism); in addition they may host seaports. But, especially given the declining economic importance of sea transport relative to other transport modes, coastal regions may be in a less advantaged position compared with in land border regions (cf. Rietveld and Boonstra, 1995).

The aim of the present paper is to investigate the nature of the obstacles implied by borders. In addition we will do some empirical investigation of the level of the border effect: to what extent do borders really discourage spatial interaction between regions? This paper is organized as follows. In section 2 a typology of border related obstacles will be discussed. In sections 3 and 4 We will present results on obstacle effects of borders for the European aviation and railway sector, respectively. Section 5 will be devoted to the impact of border

related obstacles on business traffic by car. In section 6 results will be presented for the role of borders on border crossing car and public transport trips.

2. A typology of border related obstacles.

A framework to analyze the impact of borders has been developed by Cattan and Grasland (1992). In this framework (see Figure 1), two factors have been distinguished which have an impact on places in space: distance and borders. The impacts of distance and borders is specified for two types of variables: *state variables*, relating to the situation in a certain place, and *flow variables* relating to the interaction between different places.

Two possible effects of borders are considered. They lead to:
1. non-homogeneities among places at different sides of the border, and
2. discontinuities in flows between places at different sides of the border.
Distance has a similar impact on places and interaction, but its effect is much more gradual.

Figure 1. A methodological framework for the analysis of obstacles and discontinuities (Cattan and Grasland, 1992, adapted)

In research activities attention is usually focused on the upper part of Figure 1. For example, the impact of distance (or travel costs) on transport flows F_{ij} has been widely studied in the context of spatial interaction models. Spatial autocorrelation analysis has been a similar tool in the investigation of similarities between places. In this case the dependent variable is a similarity index S_{ij}. The role of borders has usually been neglected in this context. For similarity indices it would mean that similarity does not only depend on distance, but also on whether or not two places are at the same side of a border. For flows, borders would also have a potential impact in addition to distance.

The two aspects: similarity of places, and flows between places are clearly related. For example, places may be different because one place may have adopted an innovation the other did not adopt. An improvement of communication will usually stimulate equal patterns of innovation adoption. Thus a reduction of the obstacle effects of borders may lead to an

increase in similarities between places at different sides of the border. Such a parallel development is not guaranteed, however. For example, a reduction in trade barriers will usually stimulate specialization in production processes, which will lead to a decrease in similarity of economic structure between places or regions.

In the present paper we will focus on the impacts of borders on flows, i.e. on obstacle effects of borders. The impacts on similarities will not be treated here (for an example in the field of demographic fertility indices refer to Decroly and Grasland, 1992).

Border related obstacles can be defined to exist when the intensity of interaction in space suddenly drops at places where a border is crossed. Various reasons of the existence of obstacle effects of borders can be distinguished (see also Geenhuizen et al., 1996). Table 1 contains some main reasons.

Table 1. Reasons of existence of obstacle effects of borders.

1. Weak or expensive infrastructure services in transport and communication for international links
2. Preferences of consumers for domestic rather than foreign products and destinations
3. Government interventions of various types
4. Lack of information on foreign countries

The first type of border related obstacle effect concerns the **supply of transport and communication services.** This effect expresses itself in the form of various types of costs. If one would compute generalized costs, one would observe a discontinuity in these costs when a border is crossed. The generalized costs consist of two main components: monetary expenditures and time related costs.

An example where there is an extra **monetary** burden related to international transport compared with domestic transport is in the airline sector. The reason is that international regulatory agreements often limit the supply of international services so that tariffs are higher. In international roadtransport cabotage and quota systems may lead to inefficiencies and hence to high tariffs. In international railtransport the lack of cooperation between national railway companies leads to relatively high international tariffs. In telecommunication a similar tendency can be observed: international tariffs are often much higher than long distance domestic tariffs, even though the distance between the communication partners may be very much the same.

Most cases of supply related transport costs concern the **time** component. Take as an example the road network. International links are underdeveloped in the road system, as can be seen for

example in the Alps region. This leads to detour factors which may be somewhat higher in international transport compared with domestic transport. In railway infrastructure one observes that countries start investments in high speed rail for domestic links (France, Germany, Spain). Only at a later stage international links are added. This means that the speed of services between major links in the same country is faster than between comparable links in different countries. Another example can be found in the field of telecommunication. There is a lack of supply of telecommunication infrastructure in the former USSR. This leads to high failure rates when one wants to establish contacts with another country and this means that one loses much more time compared with calls to other destinations. Another example in the field of telecommunication is found in certain developing countries where international calls are not automatic which also leads to time losses.

The above examples concern time related obstacle effects due to the absence of a sufficient infrastructure. A somewhat different obstacle effect is due to the way infrastructure is used. For example, train services at international links usually have lower frequencies than at comparable national links. This means that the international traveller faces higher interarrival times which lead to higher waiting times or a less efficient use of time abroad. A similar case holds true for international airline services. Rail transport provides other examples of obstacle effects. Technical incompatibility in railway systems due to differences in gauge (for example between Spain and France) or voltage (for example between Germany and The Netherlands) lead to time losses when passing the border because one has to change carriages and/or locomotives.

The second group of obstacle effects concern a **preference of consumers and producers** for domestic interactions compared with international interactions. Such a preference may be based on taste: for example in food consumption one can observe clear differences in national habits, leading to a disincentive for the international trade in certain food products. Language, ethnical and cultural differences can lead to a strong preference for trade or communication partners from the own country compared with other countries. This does not only hold true for consumers, but also for firms. As indicated by Hofstede (1980), there are substantial cultural differences between certain groups of countries which makes cooperation between firms in different countries difficult. Another example is found with governments in their role of final consumer which may give priority to producers from the own country in the procurement of equipment, weapons, business services, etc.

The third group of border related obstacle effects concerns **regulations or interventions of national governments.** These interventions can have both a monetary and a time effect. Examples of monetary effects are the costs of getting a visa or special taxes levied on people crossing the border. An interesting example of the latter is found in Indonesia where

every Indonesian citizen leaving the country has to pay an amount of some us$ 100. This tax was imposed in order to discourage cross border shopping in Singapore. Another well-known example of a monetary effect occurs with fiscal obstacles where import duties lead to a disincentive to import products from abroad. A similar effect occurs when excise duties of particular products are different.

Another example of a regulation leading to higher costs when trade takes place internationally is related to currencies. The possible introduction of the European ECU aims at removing this cost, but as long as this has not yet been realized, banks will continue to charge customers for the change services they provide. In addition hedging costs of firms operating at international markets may be substantial. For the introduction of particular new products in a country firms have to follow certification procedures. If each country has its own procedure this will lead to additional costs and possibility of delays. A related problem is that countries often differ in the specification of the requirements certain products must satisfy. This leads to the need to adapt products to particular national standards which obviously has a cost increasing effect. A well known example is the difference between the UK and other European countries in the choice of which side of the road is used leading to differences in automobile design.

Time related obstacles of an institutional nature concern the waste of time due to getting visa, waiting at customs offices, waiting at borders etc. Avoidance of border delays is very important for firms working with a just-in-time concept. It may induce the selection of domestic rather than international suppliers. To these time losses must be added the time needed for extra paper work in the case of international trade.

The fourth reason for the existence of obstacles relates to **lack of information on foreign destinations.** Lack of information always plays a role in the intensity of spatial interaction, but in border-crossing interactions it is more severe. For example many newspapers, data banks and information systems have a clear national orientation. Acquiring additional information is possible, but it gives rise to costs in terms of money and time. Personal information networks also often have a domestic bias. The information people have is strongly influenced by interaction patterns in the past. Thus information related obstacles to international interactions depend on the other types of obstacles mentioned above. They can be said to reinforce them. Since the stock of information is built gradually, the historical component of obstacle effects may be expected to be substantial.

In the above list of factors leading to obstacle effects of borders we find both symmetric and a-symmetric effects. Symmetry occurs when spatial interaction is reduced in both directions to the same extent. There are also examples where the effect is a-symmetric. The reduction takes place in both directions, but not

to the same extent. Still another possibility is that borders lead to a decrease in interaction in one direction and an increase in the other direction. In this case one might speak of an adverse border effect. Cross-border shopping is an example. Another example can be found in tourism, where certain tourists prefer foreign locations above otherwise identical domestic locations because they are more interesting. In the context of Figure 1 this means that spatial heterogeneity stimulates international flows.

Border related obstacles are not the only obstacles which may exist in space, however. For example, migration flows in a country with several ethnical or language groups, each having their own home region will be biased towards the own region (see Cattan and Grasland, 1992 for an example in former Czecho-slavakia). Also telecommunication flows may be biased within countries towards regions with the own language, as found for example by Klaassen et al. (1972) for Belgium and Rossera (1990), and Donze (1993) for Switzerland. In the present paper we will focus on border related obstacles, however.

3. **Obstacle effects of borders in the airline network.**

Consider two airports at a certain distance from each other. Then frequencies of flights between these airports tend to be higher when they are located in the same country compared with the situation that the two airports are in different countries. There are two main reasons why this is true. The first one relates to the demand side. Demand for international air traffic along a certain distance is smaller than demand for domestic air traffic along the same distance. This is a consequence of the various obstacle components of borders discussed in section 2. The second reason relates to the supply side. Regulation in the airline system tends to reduce the number of flights in international linkages.

In this section we give a numerical estimate of the extent to which these effects occur. The method to be used is the quasi experimental approach. In this approach one compares a pair of airports (A,B) with another pair (A,C). The airports B and C have been chosen in such a way that they are identical in all relevant economic characteristics. In addition, the distance between A and B is equal to that between A and C. The only difference is that A and B are located in the same country, which is not the case with A and C.

By comparing the frequency of flights between A and B with that between A and C one can isolate the impact of borders. One of the factors which has to be controlled in the approach is the availability of all alternative transport modes. For example, the number of flights between Brussels and London is much larger than between Brussels and Paris. The reason is that no rail or road connection exists between Brussels and London so that the share of air traffic on this link is very high. Thus, an obstacle in a certain mode (road) appears to function as an

incentive to use another mode (air). Another factor which might interfere is the different position of airports in hub and spoke networks.

The advantage of the quasi experimental approach is that one does not need to formulate and estimate a model to isolate the border effect. An obvious disadvantage of this approach is that one will never find airports which are entirely identical according to all relevant features. One is forced therefore to use airports which are only approximately identical which produces noise in the outcomes. We applied the approach outlined above for some 20 pairs of airports in Europe (cf. Rietveld, 1993). The reduction factor for international flights is in all cases smaller than 1: international flights are consistently less frequent than domestic flights. The average value of the reduction factor is about .30. This means that against ten flights a day on a certain domestic connection there are only about three international flights to a similar destination at a similar distance. This is a clear indication that in aviation networks border effects play a role.

4. Obstacle effects of borders in rail transport.

For rail transport we have followed an approach similar to the one used in section 3. In Table 2 we present the results of frequencies for a number of comparable city pairs in Europe. Among a set of 10 comparisons there 8 where the international frequency is clearly lower than the domestic frequency; for two pairs we happen to find equal frequencies: Hamburg-Essen with Hamburg-Arhus, and Nurnberg-Heidelberg with Nurnberg-Linz. The reason for the high score of the international link in these cases may be that it is part of an important international corridor. For example, Nurnberg-Linz is part of the corridor Frankfurt-Vienna. Based on a larger set of data, Boonstra (1992) finds that the average reduction factor is equal to 0.44. This means that against ten trains a day on a certain domestic route there are about four or five international trains to a similar destination at a similar travel time away.

In most cases crossing a border in Europe means that one also crosses a linguistic border, but there are exceptions. A further analysis of the data reveals that the reduction factor is indeed different for countries where the same language is spoken (average value 0.57) and countries where different languages are spoken (average value 0.38) (cf Boonstra, 1992).

Table 2. Frequencies of railway connections between equivalent pairs of European cities.

railway station pair	country pair	frequency per day	reduction factor
Amsterdam-Groningen	NL-NL	20	
Amsterdam-Oberhausen	NL-DE	14	0.70
Hamburg-Essen	DE-DE	14	
Hamburg-Arhus	DE-DK	14	1.00
Essen-Hannover	DE-DE	19	
Essen-Amsterdam	DE-NL	12	0.63
Innsbruck-Salzburg	AU-AU	25	
Innsbruck-Augsburg	AU-DE	6	0.24
Saarbrucken-Koln	DE-DE	17	
Saarbrucken-Paris	DE-FR	6	0.35
Koln-Mannheim	DE-DE	33	
Koln-Utrecht	DE-NL	12	0.36
Nurnberg-Heidelberg	DE-DE	9	
Nurnberg-Linz	DE-AU	9	1.00
Paris-Metz	FR-FR	23	
Paris-Courtrai	FR-BE	6	0.26
Paris-Nancy	FR-FR	14	
Paris-Courtrai	FR-BE	6	0.43
Lyon-Nancy	FR-FR	6	
Lyon-Torino	FR-IT	4	0.67
Wurzburg-Erfurt	DE-DE	8	
Bremen-Groningen	DE-NL	3	0.38

Source: Thomas Cook (1992)

5. Cross border obstacles to business trips.

From the perspective of border effects on economies of regions business trips are an interesting case. Data on business trips are fragmented; there is no common data base on cross border business trips in Europe. This obviates a European wide analysis. In the present paper we will present some results on cross border business trips and obstacle effects of borders for trips originating from the Netherlands.

Before discussing the border effects we first have to pay some attention to transport modes chosen for business trips.
The car is the main mode of domestic business trips (85%) in the

Netherlands. The train mainly takes the other 15%. The share of the train increases with distance. The share of air transport is negligible given the small size of the country. In international business trips originating in the Netherlands the share of the car is still substantial (78%). This indicates that most of the international business trips will have a destination in neighbour countries at short distance. Note that the travel time by car from the Dutch Randstad to large cities in Belgium (Antwerp, Brussels) and Germany (Ruhr area) varies from some 1.5 to 2.5 hours only.

The effect of borders on the intensity of business trips of Dutch firms has been estimated by means of a spatial interaction model. In this model we include as explanatory variables:
-mass indicators (gross domestic product, GDP) of regions of origin and destination,
-travel distance between centres of gravity of the regions,
-a dummy indicating when a national border is crossed.
To estimate the model we combine data on interregional domestic business trips in the Netherlands (132 flows between all pairs of 12 provinces) and data trips between Dutch regions (4 cluster of provinces) and a number of European regions (66 pairs). The domestic travel data are collected regularly by the Dutch Central Bureau of Statistics. The international data were collected in a special survey by INRO (1990) for business trips by car crossing the Dutch-German border in 1990. The estimation results are presented in Table 3.

The conclusion of model version 1 (based on all 198 observations) is that distance decay is substantial in business trips by car. Other things equal the number of business trips between two cities at a distance of 100 km is 4 to 5 times as large compared with two cities at a distance of 200 km.
The border effect is quite large according to the first model version: it means that crossing a border to another EU country reduces the number of trips by car to only 16% (exp(-1.83)) of the number of trips one would expect without a border crossing. For a business trip to a country outside the EU one even finds a reduction factor of 5% (exp(-3.07)).

Table 3. Estimation of interaction model for interregional business trips from and in the Netherlands (dependent variable measured as log of number of trips)

explanatory variable	model 1	model 2
constant	-10.7 (-6.86)	-7.76 (-5.34)
log GDP (region of origin)	0.84 (14.33)	0.78 (13.99)
log GDP (region of destination)	0.90 (14.48)	0.78 (14.08)
log distance	-2.25 (-21.04)	-2.25 (-23.81)
dummy EU	-1.83 (-7.67)	-0.51 (-1.70)
dummy other countries	-3.07 (-9.76)	-
R^2	.884	.888
number of observations	198	140

(t-values in parentheses)

The problem with model 1 is that it ignores mode choice of business travellers. The share of train and air will increase with distance. Hence, if we would have data on the total number of travellers aggregated across all modes, we would find substantially higher figures for the number of trips to destinations in countries located further away. However, we do not have data on the number of international business travellers by train for combinations of regions. We solve this problem by confining our attention only to short distance international business trips. In the context of the present data set these are the trips to the German regions of Nieder Sachsen and Nord-Rhein Westfalia. We may safely assume that for these international destinations the car is still the dominant travel mode, just as it is for domestic business trips in the Netherlands. The result are presented in Table @@@ as model 2. Most parameters are not substantially affected by the change in data set, but the border effect certainly is. According to model 2, crossing the border to a German region implies a border factor of some 60% (exp(-

0.51)). This figure is much more modest than the result of model 1.

We conclude that a careful analysis of border effects on business trips by car reveals that crossing the Dutch-German border leads to a reduction from a level of 100 (indexed) to about 60. This means that obstacles to interaction still exist between neighbour regions that both have been part of the EU for decades. It is interesting to observe, however, that the obstacle impact of the border is smaller in this case of car based business trips than in the cases of rail and aviation presented in the preceding chapters.

6. Border effects on local border crossing transport (road and bus)

That borders function as obstacles for transport can also be observed from traffic intensities on and near borders. The general tendency is that flows on borders are much smaller than they are at some distance from the border. In this section we will present some results for the Netherlands. Major express ways linking large cities like Amsterdam and Rotterdam with neighbour countries display large differences in traffic intensities: near the large city they are very high, on the border they are much smaller. For example, in 1996 the A1 express way linking Amsterdam with Berlin has an intensity of about 140.000 cars per 24 hours near Amsterdam. The intensity at the German border some 160 km further away is only 14.000 (a reduction to 10%). Indeed the major difficulties in so called hinterland connections of large cities do not appear near the border, but near the cities themselves. Of course the large difference in intensity depends considerably on the high population density around the large cities leading to a high demand there. In order to identify a border effect it is better to compare traffic intensities on borders with intensities near borders (say some 20 km away). The ratio between the two captures much better the obstacle effect of borders. In Table 3 we give the results for some highways in the Netherlands.

Table 4. Obstacle effects of borders on some major Dutch highways (1996).

highway	border effect	share of trucks on border	share of trucks near border
A1	35%	43%	24%
A7	48%	25%	19%
A16, A58	37%	32%	19%

Source: AVV (1997)

Table 4 shows that *on* the border the major highways have intensities that are clearly smaller (reduction factors of some 40%) than *near* the border. Thus, the major use of international road transport corridors is for domestic purposes. There appears a difference, however, between trucks and passenger cars. We observe that the percentage of trucks *on* the border is clearly larger than *near* the border. This indicates that freight transport is more long distance oriented and less sensitive to borders than passenger transport.

Another way to study obstacle effects of borders is to consider border crossing public transport by bus. This gives an indication of the extent to which local economies across the border are integrated. For the year 1993 we compare service levels of border crossing bus services with service levels at other places. For a selection of bus routes we compare the frequency on the border with the frequency at a place some 10 km away from the border. Some results are shown in Table 5.

Table 5 Daily frequencies of public transport busses on and near borders in the Netherlands.

Border crossing point	frequency per day on border	frequency per day near border
Nieuw Schoonebeek	29	74
's Heerenberg	42	61
Winterswijk	9	95
Putte	51	89
Luyckgestel	27	67
Eede	27	104

Source: schedules of public transport operators, 1993.

We observe a substantial difference in frequency of bus services on and near the border. Compared with a frequency of 100 in a standard border region, cross-border links on average achieve a score of some 35 to 40.

7. Conclusions.

With the ongoing process of economic integration in the EU certainly not all border related obstacles have been removed. This is no surprise given the various economic and non-economic dimensions of the obstacles surveyed in section 2. The major bottleneck is in general not the lack of infrastructure for

cross border links, although along some borders there are indeed problems (in the Alp countries). The major problems here relate to the high construction costs of infrastructure in mountain areas and to regulatory measures of national governments involved. The latter point underlines the importance of institutional aspects in the obstacle effects of borders.

Our analysis of cross border transport services by various modes of collective transport reveals a double effect of borders. The first effect concerns the demand side: because demand for cross border interaction is lower than for other destinations, the supply frequencies are lower. This supply effect will have an additional negative effect on cross border interaction because of the lower frequencies. Thus, we observe the phenomenon that (demand related) **obstacles** to cross border transport flows **create** additional (supply related) **obstacles**.

A policy implication of the statement that barrier effects of borders are mainly related to the *demand side* is that there is not much reason to invest large amounts of money in international links. Most of the problems in international transport relate to congestion near the large metropolitan areas, not to insufficient capacity in border regions. This would call for a careful analysis of Trans European Network proposals.

In those cases where the *supply side* dominates the barrier aspects of borders, transnational initiaves may be essential. The reason is that the benefits of removing the border will accrue to various countries. Given the national bias in usual project analysis (positive effects on economies in other countries are usually ignored) a transnational perspective would be needed. Also tolling of the use of the transnational infrastructure is a way to overcome this problem: by the tolls the willingness to pay of users from other countries becomes transparant.

Our conclusion that national borders exert a strong influence on cross border transport flows holds true for all spatial ranges. For example, for the *short range*, cross border *public bus* services have frequencies that are on average some 35-40% of the level they are in other parts of border regions (section 6).
For the *short to medium range* we find for *road transport* on average an obstacle factor of a similar magnitude. A tendency exists that freight traffic is less sensitive to borders than passenger traffic. In addition, our analysis of business traffic shows that also business trips are less sensitive. Here we find a reduction to about 60% of the normal non-border level (section 5).
For *medium to long distance* we find for *rail transport* services that cross border frequencies are reduced to some 44% (section 4).
The *long distance* connections are mainly served by *airlines*. We observe here a reduction to some 30% for cross border links. It is not impossible that this figure will increase as a consequence of increased competition in the European aviation

market (section 3).

Our results for business trips (by car) and for freight transport by road imply that in the fields of trade and production the effects of barriers are more modest than in the other fields. This may be an indication that the development of openness in regional development has already proceeded further than is sometimes thought. However, the gap between domestic interaction of firms and cross-border interaction of firms remains significant.

Data problems are substantial in the field of border effect studies. Therefore some of the results reported here have been based on limited evidence only. Nevertheless it is striking that the results are rather similar for most types of transport modes. With the increasing use of information technology the prospects for alleviating the data problem are favourable. The prospects would even be better when the increased use of information technology would be accompanied by an increase in organizational efforts at the international level to achieve further standardization of data bases.

We have identified at least two *paths for further research* on the theme of openness and borders. First, a point often overlooked in the analysis of border regions is that coastal regions may have a comparable lack of interaction with neighbours. The limited opportunities of coastal regions for interaction with other regions is a theme that deserves more attention in future research.

The second path relates to the distinction between state variables and flow variables in the context of border related obstacles. We note that the concepts of interregional flows and interregional similarity discussed in section 2 are closely related to the two basic types of regional concepts commonly used: homogeneous regions and functional regions. A systematic treatment of the spatial delimitations for both types of regions at the European level to find out the different roles of borders versus distance (proximity) is called for.

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Figure 1. A methodological framework for the analysis of obstacles and discontinuities (Cattan and Grasland, 1992, adapted)