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**ECONOMIC IMPACTS OF THE CONSTRUCTION OF A TRANSPORT
CORRIDOR: a multi-level and multi-approach case study for the construction
of the A1 highway in the Netherlands**

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March 1995

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Introduction

Low levels of transport infrastructure investments in the 1980's in most industrialized countries have stimulated discussions about the need to increase investment levels in the 1990's. In addition to environmental aspects that have become increasingly important in such discussions recently also the economic aspects have received much attention here.

Basically three approaches can be distinguished in the discussion about the economic impact of transport infrastructure. The first approach is the well known social cost benefit analysis (CBA) with consumer surplus as the main object. This approach is firmly based on efficiency objectives in welfare economics and has been widely used in various countries.

More recently a second approach has emerged where consumer surplus is no longer the basic concept, but productivity (cf. Aschauer 1989). Implicit in this approach seems to be that CBA is sometimes regarded too broad because its outcome may strongly depend on travel time savings of households which do not have implications for GDP. On the other hand CBA outcomes are sometimes regarded as too narrow because in the calculations of the benefit the strategic long term macro economic benefits in terms of GDP are only partially taken into account.

The third approach even moves further away from CBA by focusing on employment. This happens especially in countries with high levels of structural unemployment where job creation is considered of prime interest. In this approach the spatial dimension is often relevant: transport infrastructure investments have spatially differentiated impacts on employment.

Of course, the three approaches are not entirely independent; they are partially overlapping, partially conflicting, and partially complementary.

In the present paper we will not go into these interrelationships, but mainly contribute to the third approach by focusing on employment aspects of transport infrastructure; in addition some attention will be paid to the second approach.

After a brief discussion in which the relationship between transport infrastruc-

ture and spatial patterns of **economic** activities is **sketched** from a theoretical perspective (section **2**), the focus of the article shall shift to some methodological issues (section 3). As **will** be shown, a variety of approaches at different spatial levels of aggregation have been applied in research in this field. The results obtained with those approaches are **rather** diffuse. In sections 4-6 the empirical results are presented of a study on **economic** impacts of the construction of **the** transnational A1 highway on Dutch regions. In this study various methods have been used at various levels of spatial detail.

2 Theoretical framework

In Figure 1 the complex relationship between transport infrastructure and regional **economic** development is presented (Bruinsma 1994). The construction of transport infrastructure **influences** the transport costs by **means** of a reduction of distances **and/or** a **higher average** speed (relation 1). This **will** lead to **changes** in the choice of transport mode, route choice, **time** of departure (in case of congested networks) and the generation or attraction of new movements per zone (relation 2).

The reduction in transport costs combined with the **changes** in the patterns of movements of households and **firms will** lead to an increase in the productivity of the zones involved (relation 3 **and** 4). Another **consequence** is an increase of the accessibility (relation 5). The accessibility of a zone depends on **all** possible efforts necessary to visit or leave this zone.

The increase in productivity and accessibility in a certain zone **may result** in an expansion of the **economic** activities **and/or** population within the zone (relation 6 and 7).

Until now only direct links between the construction of transport **infrastructure** and the spatial pattern of **economic** activities are **discussed**. **However**, there are **also** a number of indirect - feedback - relations which are important.

A **first** feedback concerns **the** relocation of **economic** activities, which results in **changes** in **the** masses of the zones involved. This **may** again have its impact on

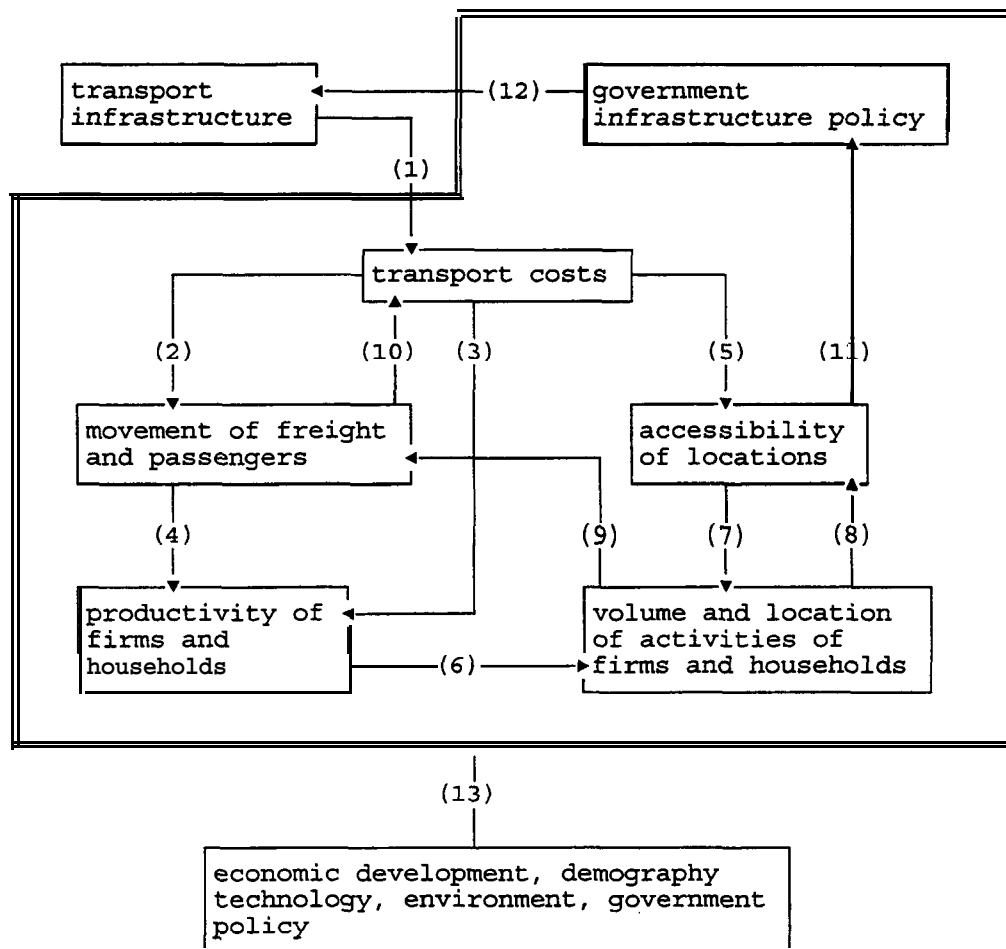


Figure 1 Conceptual model on the relation between transport infrastructure and the spatial pattern of **economic** activities

the accessibility of the zones (relation 8).

The changes in the location of **economic** activities influence the number of movements of freight and passengers in a similar way (relation 9). In case of congestion this **shift** in the number of movements of freight and passengers imply changes in transport **costs** too (relation 10).

Transport infrastructure cannot be seen as completely exogenous since it is developed by the government. The government **reacts** on changes in the transport system. The **main** target of government infrastructure policy **may** be to secure an **acceptable level** of accessibility for **each** zone (relation 11 and 12). On the other hand the **economic** policy might be oriented on the

development of additional transport infrastructure in zones with a relatively positive **economic** development, for **instance** to **overcome** congestion.

A last element in Figure 1 concerns the **fact** that not only new transport infrastructure has an important impact on the development of traffic flows and the spatial patterns of **economic** activities. In **general**, factors like technology, demography, economy, and environmental and public policy **may** be mentioned (relation 13). Those factors shape a wider context in which the relationship between transport infrastructure and the spatial **pattern** of **economic** activities has to be seen.

Thus we end up with a **rather** complex model with various feedbacks. As a **result**, the impacts of transport infrastructure improvement on the economy are not always easy to determine. This **can also** be understood from related theoretical frameworks. For example, interregional trade theory shows that a positive impact of a decrease of interregional transport **costs** on employment in a particular region is not guaranteed. A reduction of these **costs** leads to an increase of interregional competition. Local and regional production **may** be replaced by **imports** from **competitive** regions. The induced specialisation **process may** prove to be disadvantageous for employment in low **productivity** regions.

3 Empirical approaches

In this paragraph a concise summary is presented of approaches which are in common use in empirical research to **trace** the impact of new **infrastructure** on spatial patterns of **economic** activities. A diagram overview of approaches is given in Figure 2. The approaches applied later on in the empirical part of this article are printed in a bold way.

In Figure 2 a twofold subdivision is used. First, there is a subdivision between models and non-model approaches. **Second**, there is a subdivision based on the spatial **level** of aggregation of the data input. In order to emphasize the variety among these approaches we give below some **short**

	Models	Other approaches
Aggregate data	<ul style="list-style-type: none"> - transport land use models - production function models - location models - interregional trade models - general equilibrium models 	<ul style="list-style-type: none"> - quasi experimental
Disaggregate data	<ul style="list-style-type: none"> - stated preference models - revealed preference models 	<ul style="list-style-type: none"> - quasi experimental - entrepreneur survey - expert judgement - calculation of the impact of infrastructure on transport costs

Figure 2 Examples of research methods used to study **economic** impacts of transport infrastructure investments

comments on their particular features. For a broader review refer to **Vickerman (1991)**, **Bruinsma (1994)** and **Rietveld (1994)**.

Models based on aggregate data

This type of models is mainly used by transport engineers, urban planners and economists.

Integrated transport-land use models for example have mainly been **developed** by urban planners and transport engineers. These models **can** be considered as an extension of the well known urban transport models **where** a feedback is formulated from the transport system on employment and population growth in the various zones. An overview of those models is presented in **Webster et al. (1988)**.

Another example is the production function approach, which has become **very** popular among economists **after** the work of **Aschauer (1989)**. In the production function approach the **level** of production depends on the classic private production **factors** - **capital** and labour - supplemented with a (transport) **infrastructure** variable. Production functions are applied to estimate the impact of an improvement of a **certain** type of transport **infrastructure** on the

productivity of labour and **capital** (see Biehl (1986) for an example at the European level).

Improvement of transport infrastructure in a region **may** lead to an increase in the productivity of private production factors as described above. This **may** lead to an expansion and/or relocation of those production factors in and between regions. This effect is analyzed by location models. In those models the impact of transport infrastructure is analyzed together with other factors that **may** influence the location of firms like the **price** of labour, investment subsidies, **sectoral structure**, accessibility of **markets** etcetera. The **main** target in a location model is to explain the **changes** in private investments **and/or** employment by those location factors (see for **instance** Evers et al. 1987).

Models based on disaggregate data

Revealed and stated **preference** approaches are most common for studying the impact of transport infrastructure on spatial patterns of **economic activities** with models using data on a disaggregate level. These approaches **may** be applied at different spatial levels.

Both approaches are based on individual utility functions. In the case of revealed **preference** models the utility function is estimated with data concerning choice behaviour in actual situations. In case of stated **preference** models the data concern preferred behaviour of respondents **who** made a choice in a laboratory situation.

Both methods have their strengths and their weaknesses as **documented** in the literature (Kroes and Sheldon 1988). Revealed and stated **preference** models have to be seen as complementary instead of opposite, since they **provide** complementary information and avoid the weaknesses of the other.

Other approaches based on aggregate data

The quasi-experimental approach is an example of a non-model approach based on aggregate data. In this approach the development in a region is

analyzed **after** an improvement of the infrastructure. This development is compared with the development in the region before the improvement **and/or** with a group of reference regions. The choice of appropriate reference regions is **vital** for the quality of this approach (Isserman 1990).

Other approaches based on disaggregate data

One of the non-model approaches that is commonly used among **geographers** concerns surveys among entrepreneurs. Those surveys **may** be **postal** questionnaires, telephone or face to face interviews. These surveys allow one to **receive** information from entrepreneurs about various **subjective** elements, including perceptions and expectations. These **aspects** are **certainly** relevant for this type of research but are usually ignored in model type studies.

This short survey of research approaches reveals that widely different methods are used to **address** the issue of transport infrastructure impacts on the **economy**. These methods differ among others in theoretical background, type of data used, spatial **level** of analysis and dependent variable (**productivity** versus **employment**). It is therefore not surprising that these approaches sometimes lead to **rather** different outcomes (see Offner 1992). Therefore it is recommended that in studies on this subject various approaches are used. An example of **such** a multi-method approach is presented in the next sections.

4 A case study: the construction of the AI highway

4.1 The AI transport corridor

The highway network in the Netherlands has mainly been constructed in the last thirty years. During the same period a strong increase of the mobility **level** and the traffic intensity on the network occurred. Nowadays the Netherlands are **covered** by a highway network, which is in Europe only

exceeded by the Belgian network in density.

In **such** an extensive network a new link **will** usually only have limited impact for the network in total, so that the expected spatial **economic** impacts will be **small**. An exception of this **may** be transnational links. Using a European perspective **Bruinsma** en Rietveld (1994) showed for example that **such** links are relatively scarce in most networks. An example in the Netherlands of a transnational corridor that was created only recently is the A1 highway. This highway connects the relatively badly **accessible** eastern part of the country with the national and international road network. The A1 highway runs from Amsterdam, via Amersfoort, Apeldoorn, Hengelo and Oldenzaal to the German border (Figure 3). It is one of the most important east-west axes in the Dutch road network and **provides also** a **main** connection to the German road network. In Germany this highway runs as E8 to Berlin and **Poland**. It is **also** one of the **main** routes towards the Scandinavian countries.

The construction of the A1 from Amsterdam up to Twente took place between 1970 and 1975. Then the construction stopped to a large extent: the **section** up to Hengelo was opened in 1979, the remaining sections up to the German border were constructed in **small** sections between 1985 and 1992. **Almost all** these sections have been constructed as entirely new links, only the **section** Oldenzaal-German border is an upgrading of the existing road .

4.2 The research area

The A1 highway **crosses** three **Corop** regions between Apeldoorn and the German border: the Veluwe, Southwest-Overijssel and Twente (Figure 3). The **Corop** region is a statistical unit between the **level** of **provinces** and municipalities. To analyze the impacts of the highway construction it is important to know something about the **economic** development of the area. The analysis will be limited to the period 1970-1990, because the A1 construction took place in this period.

After 1970 a recession occurred in the Western world and **also** in the

Legend

AI Regions:

- A = Veluwe
- B = Northeast Overijssel
- C = Twente

AI Cities

- 1 = Amsterdam
- 2 = Amersfoort
- 3 = Apeldoorn
- 4 = Hengelo
- 5 = Oldenzaal

Reference Regions

- a = Achterhoek
- b = Agglomeration Arnhem/Nijmegen
- c = Northeast Brabant
- d = Southeast Brabant
- e = Middle Limburg

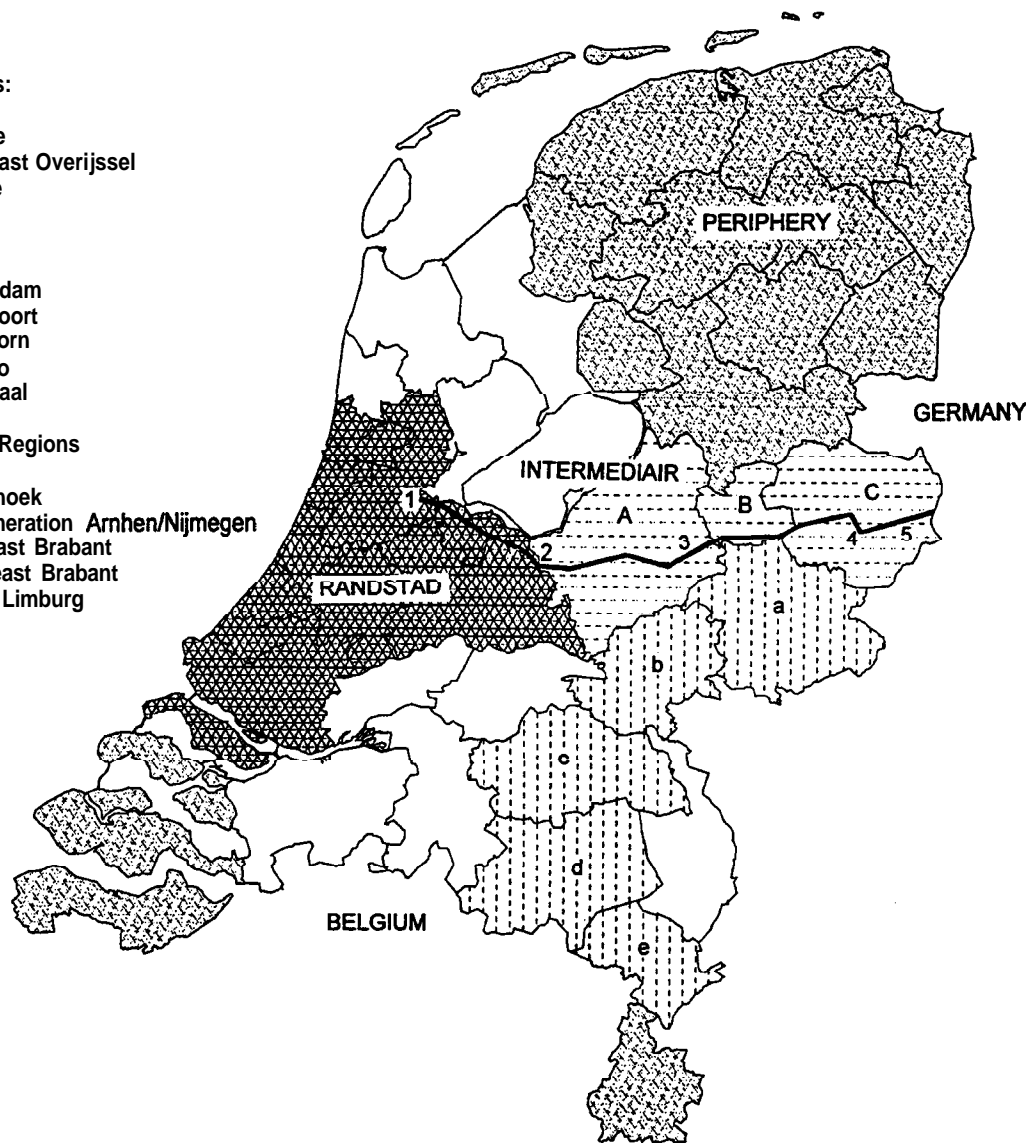


Figure 3 Research area

Netherlands. In the **second** half of the 1980's **however**, a strong recovery manifested itself. In the observed period **also** structural **changes** took place in the **sectoral structure** of the economy. During the period considered, the share in employment of the industry sector in the Dutch economy decreased from 42 until 29 %, while the share of the services sectors increased from 42 until more than 54 %.

In spatial terms a deconcentration **process** took place. The **economic**

development of the Randstad area (see Figure 3) was slightly below the national **average**. The so-called intermediary zone developed favourably, while the peripheral zone experienced a less positive development. The intermediary zone is defined by the area between the **central** Randstad regions and the peripheral regions in the Netherlands (Figure 3). The research area **chosen** is located in the intermediary zone which **experi-**enced - with maybe the Twente region as an exception - a relatively **favour-**able **economic** development.

In order to correct for **sectoral** composition **effects** in the growth of **employ-**ment one might use shift-share analysis (Armstrong and Taylor, 1993). A differential **shift** in a region of for example 10 % **means** that - **after** correction for the **sectoral** structure - the employment growth is 10 % **higher** than the national **average**. In this way the growth **rate** is **corrected** for advantages and disadvantages which **may** occur because of the initial **sectoral** structure. The differential shifts of the AI-regions are presented in Table 1.

It appears that the Veluwe had the most favourable **economic** development, while the differential **shifts** of Twente appear to be less favourable. The high shifts in the Veluwe are mainly explained by the rapid growth of service sector in this region, **where** in the period 1970-1975 especially defence employment grew rapidly. The **economy** of Southwest-Overijssel on the other hand has a high share of the industry sector, while the service sector is relatively small. In the analyzed period one **can** clearly observe a **conver-**gence of the regional production structure in these two regions towards the national **average**. This does not hold true for Twente to the same extent.

Table 1 Differential shift of employment in the AI-regions (corrected by sectoral structure)

	'70-'75	'75-'80	'80-'85	'85-'90
Veluwe	0.10	-0.00	0.02	0.05
Southwest-Overijssel	0.01	0.02	-0.02	0.08
Twente	0.03	0.02	-0.02	0.02

This region has traditionally been oriented on the industry (mainly **metal** and textile). The employment in the textile industry decreased rapidly because of **many** reorganizations. **When** the **figures** are **corrected** for the **sectoral** structure **however, also** Twente appears to have a positive differential shift in most periods.

5 Analysis at the regional level

At the **Corop level** two research methods have been applied. In the first place a reference region method (quasi experimental approach) has been used. In this method the employment growth in AI regions has been compared with that of reference regions. These are comparable with the AI regions in terms of **economic** structure and location, but in these regions **little** or no construction of **main road infrastructure** took place. Next, a regional labour market model has been constructed in which accessibility • via the **main road network** • is one of the **main** variables.

5.1 The reference region method

The first approach at the regional **Corop level** is the reference region method. First the development of regional employment will be compared with that in the remainder of the intermediary zone (see Figure 3). Next the distinct regions will be compared with **specific** reference regions, which are **also** located within this zone (for a more detailed analysis we refer to **Bruinsma et al. 1995a**).

In Table 2 a comparison is made between the differential shift in the three AI regions and the remainder of the intermediary zone and the distinct reference regions.

When we **compare** the differential shifts in the periods of opening of the AI, we **find** that in the Veluwe the shift is **much higher** than in the intermediary zone. At **first** sight this seems to be the **result** of the AI construction. **When**

Table 2 Differential shift in the **intermediary** zone, the AI regions and the reference regions (corrected by **sectoral** structure)

	'70-'75	'75-'80	'80-'85	'85-'90
Intermediary zone	0.05	0.01	0.02	0.04
Veluwe <i>reference region: Achterhoek</i>	0.10 0.05	-0.00 0.05	0.02 -0.04	0.05 0.07
Southwest-Overijssel <i>reference region: NE-North-Brabant Middle-Limburg</i>	0.01 0.70 0.11	0.02 0.03 0.09	-0.02 0.05 0.02	0.08 0.10 0.06
Twente <i>reference region: Aggl. Arnhem/Nijmegen SE-North-Brabant</i>	0.03 -0.00 0.03	0.02 -0.02 -0.00	-0.02 -0.03 0.02	0.02 0.01 0.06

periods in which the AI is constructed are **printed fat**

the **sectoral** structure is investigated **however**, it appears that the high differential **shift** is mainly **caused** by growth of the government sector, in the form of a growth of defence employment. It is not likely that this employment has been attracted by the construction of the AI.

When we inspect the other periods during which construction took place, we observe that the differential shift in Twente is somewhat **higher** in the period 1975-1980. In the other relevant periods the shift is **lower** than in the intermediary zone, **however**. **Also** an investigation of lagged **effects** does not lead to clear results on an impact of highway construction on regional employment growth. So it is concluded that a positive influence of the construction of the AI on the shift cannot be proven by using the remainder of the intermediary zone as reference region.

Although it is certainly relevant to **compare** the development of the AI regions with that in the intermediary zone, it is clear that the intermediary zone is not an entirely satisfactory reference region. The reason is that in the periods concerned, **also** other highway construction **projects** took place in the intermediary zone. Therefore a more detailed analysis with reference regions which did not experience extensive highway construction projects

during the periods concerned has been **carried out** too (Table 2, Figure 3). It appears that in 8 cases an AI region has a **higher** differential shift than the reference region during a period of AI construction. In one case the shifts were equal, while the shift is lower in 11 cases. About the same figures are found **when** a one period lag is assumed.

It **may** be clear that the results in this approach **depend** strongly on the reference regions chosen. It appears **however**, that **also when** other relevant reference regions are chosen, the conclusion remains about the same. A problem is that this approach is **rather crude**, because no other **specific** features of the regions are taken into account, as is the case with the model approach. Clearly, in a relatively **small** country with only 40 statistical **Corop** regions, one cannot select reference regions in **such** a way that they satisfy **all** requirements for a quasi-experimental method (cf. Isserman 1990). Therefore, a multivariate approach is recommended as a complement to the reference region method. This is the subject of the next **section**.

5.2 The regional labour market model

A **second** approach at the regional **Corop level** is **to** use a regional labour market model. In the **final** estimation of the regional labour market model at the **Corop level** the differential shift in employment of a region during a **five** year period is explained by:

- acc** the relative change in domestic accessibility
- int** the relative change in international accessibility
- unemp** the relative change in short term unemployment
- educ** the relative change in the **level** of education
- urb** the **level** of urbanization
- pol** the regional policy variable (a dummy)

The results of these estimations are presented in Table 3; the coefficients which are significant at a 5 % **level** are marked with an asterisk.

It appears that **the** change in domestic accessibility had a significantly negative impact on the employment in the period 1970-1975, while in the period **1985-**

Table 3 Results regression **analysis** for the differential shift in employment

	1970-1975 coefficient	1975-1980 coefficient	1980-1985 coefficient	1985-1990 coefficient
acc	-0.94'	0.74	0.22	2.12'
int	0.08	0.20	1.47	-0.67
unemp	-0.01	0.22'	0.05'	0.15
educ	-0.54'	-0.09	0.03	-0.07
urb	-0.65'	-0.15	-0.19'	-0.28'
pol	-0.10'	-0.04	-0.06'	-0.07'
constant	0.51'	-0.02	0.02	0.00
R²	0.52	0.59	0.50	0.26

1990 **this** impact was positive. In the other periods no significant impact is found. The international accessibility - made operational by **the** accessibility to the **main** German and Belgian cities - does not have a significant impact on regional employment. **Thus**, a **clear** impact of a change in accessibility on the shift in regional employment **cannot** be proven.

Of the other variables the change in unemployment **rate** has a positive sign in two five-year periods: employment growth is **higher** in regions with a large increase in labour surplus. The level of education does not have the expected impact. **The** urbanization density has a significantly negative sign in three periods, which **means** that the **urban-rural** manufacturing shift (see Keeble et al. 1983) has a stronger influence **than** agglomeration advantages. The regional policy has a negative significant sign in three periods, which **may mean**, that the substitution effect of **capital** subsidies on employment is larger than the output effect. Another possible interpretation is that the regions receiving government support are regions with structural weaknesses, not incorporated by the other variables. Government **policies** are not strong enough to **overcome** these structural weaknesses and as a **consequence** a negative sign is found for **the** policy **variable**.

A sector **where** a significant impact of a change in accessibility on employment

growth **may be** expected is **the transport and communication sector**. Regression results for this sector are reported in **Bruinsma et al. (1995a)**; it appears that the domestic accessibility has a significant positive **influence** on the employment in this sector in the three periods between 1975 and 1990. The same **accounts** for **the** international accessibility in **the** periods 1970-1975 and 1985-1990. So it **may** be concluded that the change in accessibility has a positive impact on the **development** of employment in the transport sector. The other variables give about **the** same results as the model for the total employment.

As far as the other **economic** sectors are concerned the domestic as well as the international accessibility do only have in a small number of cases a significant influence on employment growth. In **an** alternative **specification** we tested whether the accessibility variable has a different impact for importing and exporting sectors, but this did not yield better results for the individual sector estimates. The conclusion is that the transport and communication sector is the only one **where** a consistent impact of highway construction during several periods **can** be demonstrated at the **Corop** level.

5.3 Conclusions

By using **the** reference region approach and the regional labour market model we could demonstrate a significant impact of highway construction on **employment** growth in the transport sector. For the other sectors and for aggregate employment growth **no** significant results were obtained.

A reason for this negative **result may** be that the density of **the** network is **already** relatively high. In the case of the A1 **however this** argument does not apply. In the **first place** the highway is entirely new **and** not **an** upgrading of **an** existing road. **Second**, there is **no** alternative connection at the highway level available **from** and to the regions connected by the A1; in addition the **completion** of the A1 implies a high quality connection to the German road network. All other highways are located **rather** far from the research area.

A possible explanation of these results is that the spatial **scale** level of **Corop** regions **may** be too high for our purpose. It is not impossible that at lower

spatial levels **such** impacts **may** be found. This **will** be **discussed** in the remainder of this article.

6. A survey among entrepreneurs

In **the** last week of April 1994 1.845 questionnaires have been sent to **firms** in the **provinces** of Overijssel and Gelderland **with** at least 10 employees. Only **firms** in sectors with a predominantly non-local orientation of **demand** have been included. The net response is 510 questionnaires (**27.6%**), which are **representative** for the target population according to location, **sectoral** composition **and size** (for a more detailed analysis we refer to **Bruinsma** et al. 1995b).

It **may** be argued that **infrastructure** does not only have objective effects (e.g., via transport **costs**), but that **also** subjective effects (e.g. status considerations) are important. Some of the answers of respondents on the **importance** of **infrastructure** **will** reflect **both** objective and subjective effects. In order to avoid the risk that respondents would perceive the questionnaire only from **an infrastructure** perspective, which might lead to biased **results**, in the questionnaire ample attention was paid to the broader context in which **firms operate**, as **well** as to **firm internal factors**.

6.1 Infrastructure and firm development

Development of employment

The employment growth of the **firms** which responded was 52 % in the period 1980-1994, which is a **very** high growth **rate**. This **can** be explained by **the fact** that the **companies selected** have survived the recession period, or are starters in this period; so no questionnaires have been sent to **companies** which became a bankrupt, and to **companies** of which the number of employees **fell under** 10 employees. The industry sector, which **accounts** for most employment (48 %), grew relatively slowly (**27 %**) **during** the period considered.

Most employment in the **study** area (65 %) appears to be located within 5

kilometres of **an access** of a highway. **Also** the **main** population **centres** and largest **firms** are **found** in this area, so this is not a striking finding.

Market perspectives **and** internal company considerations appear to be the **main** factors **influencing** employment growth (Table 4). In a previous research project in 1989 (**Bruinsma** et al. 1992) similar results were **found** for the Twente region. Other factors that are **often** mentioned as **'very'** important are: availability of employees, accessibility by AI, accessibility by road, parking possibilities, expansion possibilities of buildings, representativeness of the location and the price of the location. A **closer** look at these factors reveals that **infrastructure** related factors (accessibility by road, accessibility by AI) are only considered as **'most'** or **'second most'** important in a small **number** of cases (this **also holds**

Table 4 Perceived impact of (location) factors on employment growth and **locational** decisions (in %)

	<u>growth employees</u>			<u>decision to relocate the firm</u>				
	1	2	3	1	<u>push factors</u>		<u>pull factors</u>	
					2	3	2	3
internal company considerations	24,0	19,6	22,8	24,8	9,2	7,4	7,4	2,5
market perspectives	53,3	65,0	18,8	27,0	2,0	9,6	3,4	3,3
education employees	6,6	1,8	4,8	0,9	0	0	0	0
availability employees	12,7	2,4	13,2	4,7	0	1,1	0	0,8
telecommunication	8,8	0,2	1,1	5,7	0	2,1	0	0,8
accessibility by AI	12,9	0,7	2,2	17,8	2,0	1,1	8,1	3,3
accessibility by road	10,9	1,3	5,9	21,6	7,8	12,8	13,4	9,9
public traffic	3,5	0	0	5,6	0	0	0	0,8
parking possibilities	10,1	0	0,3	16,2	0,7	9,6	1,3	1,7
government	6,3	0,2	1,4	4,6	0,7	2,1	0,7	0
image region	8,1	0,2	2,2	17,9	0	0	0,7	4,1
expansion possibilities of buildmgs	25,6	6,2	13,5	54,3	61,4	16,0	45,0	19,0
representativeness location	16,6	0,7	2,2	46,6	4,6	25,5	8,7	31,4
price location	14,2	0,2	1,7	26,0	1,3	3,2	5,4	13,6
subsidies	7,6	0,4	2,0	15,5	0	0	2,7	5,0
residential environment	7,5	0,2	2,2	14,4	7,8	6,4	2,7	0,8
private factors	8,3	0,9	5,6	10,1	2,6	3,2	0	2,5

1 = percentage of entrepreneurs that value the factor **'very'** important

2 = percentage of entrepreneurs that value the factor **'most'** important

3 = percentage of entrepreneurs that value the factor **'second most'** important

true for the price, and the representativeness of the location). Thus, although infrastructure is **often very** important in the eyes of the entrepreneurs, it is not so **often** 'most' or '**second** most' important. Other factors are apparently more **decisive when** one wants to explain employment growth of individual **firms**.

New and relocated firms

Of the 510 **firms** surveyed, 100 started between 1980-1994, while 182 relocated during that period. Striking is that of the 100 newly started **firms** no less than 46 have relocated at least **once** in this period; obviously young (successful) **firms** are more mobile than other firms.

The service sector appears to be most dynamic; the percentage of starters as **well** as relocations is the highest for this sector. The industry sector on **the other** hand is least dynamic.

When the distance to a highway is analyzed, it appears that the **rate** of birth of new **firms**, and the **rate** of relocation of **firms** are **higher** in the zone until 7.5 kilometres of an **access** compared with zones further away . **When the** relocated **firms** are analyzed more in detail, it appears that 42 % stays in the same four digit **postal** code area, while 75 % stays in the same city or **village**. **When** the change in distance to a highway is measured 41 % of the **firms** appears to relocate towards a highway, while 16 % of the **firms** relocate to a **site** at a larger distance. The **average** relative change in distance to an **access** due to a **relocation** is a decrease of 28 %. Thus relocations of **firms** lead on **average** to shorter distances to highways. Another obvious reason why **average** distance to highways decreases is that new highways are constructed in the course of **time**.

As **also** shown in the 1989 **study**, market perspectives and internal company considerations are not the **main** factors for a relocation decision; these are only found as next important factors, together with the price of buildings and location, the accessibility by road infrastructure in general and - to a lesser extent - the AI (Table 4). The most important factors appear to be the expansion **possibilities** of buildings and the representativeness of the location.

When a distinction is made between push and pull factors it appears that the

most important push factors are the bad quality and expansion possibilities of buildings and to a lesser extent the bad accessibility by road, the residential environment and a shortage of parking lots. On the other hand, the most important pull factors are the expansion capacity, the representativeness and to a lesser extent the price and the accessibility of the new location. An interesting conclusion that can be drawn from Table 4 is that road accessibility - and especially accessibility of the A1 highway - is more important as a pull factor than as a push factor in location behaviour of firms. Only after entrepreneurs have decided to relocate, they start to attach a role of some importance to road accessibility.

6.2 Infrastructure components

In this section the importance of various infrastructure components will be discussed. First an analysis is presented of the infrastructure elements which are considered to be the most important by entrepreneurs. Next entrepreneurial perceptions on infrastructure bottlenecks are discussed. Finally the values given by entrepreneurs to the impacts of the A1 construction on specific elements of the firms performance are discussed.

The impact of infrastructure in general

It appears that especially road infrastructure is valued often as 'most important' (Table 5). Telecommunication is found next, while public utilities are valued a little lower. It may be clear that all these elements are intensively used by all firms, while airports and railways are used much less; these are valued much lower, accordingly. As shown in the last column of Table 5 the changes in importance of infrastructure components during the past period are rather similar to the present importance, although certain shifts can be observed. Roads remain dominant but especially telecommunication and airports are relatively often mentioned as infrastructure components of increasing importance.

We also investigated to what extent the present location of firms has an impact on the valuation of the importance of infrastructure (Bruinsma et al., 1995b). It appears that there are no significant differences between the valuations accord-

Table 5 The importance of infrastructure (in %)

	1	2	3	4
roads	76,2	79,4	9,1	66,4
rail roads	2,3	0,7	11,6	7,3
waterways	2,6	1,3	4,0	3,8
airports	5,2	0,4	4,5	17,0
telecommunication	39,3	3,6	29,5	62,1
public utilities	27,3	4,7	18,2	24,2
terminals	4,3	0,4	4,8	8,9
no opinion		9,4	18,2	
total		100	100	

1 = % entrepreneurs that value the infrastructure component 'very' important

2 = % entrepreneurs that **value** the **infrastructure** component 'most' important

3 = % entrepreneurs that value the infrastructure component 'second most' important

4 = % entrepreneurs that **noticed an** increased **importance** over the last **five** years

ing to distance to highways. This **also holds** true for the valuation of highways: entrepreneurs with **firms** located further from the AI did not value road **infrastructure** lower than entrepreneurs with **firms nearby**.

Bottlenecks in the infrastructure networks

Among the entrepreneurs 44 % **mention** that they suffer **from** bottlenecks in infrastructure networks, especially in road infrastructure and to a lesser extent in telecommunication. Concerning road infrastructure, bottlenecks at **all** spatial levels are mentioned. At the **national** level especially congestion - **mainly** in the western part of the Netherlands (the Randstad) - is experienced as a bottleneck. **Thus** congestion in the most highly urbanized part of the country does not only disturb **firms** located there, but **also firms** in the more peripheral **parts** of the country. Striking is **that** bottlenecks in the **international** road network are **only** mentioned in 1 % of the cases; in particular the connection with **the** German Ruhr area is mentioned. This **may** be considered - especially for a border region - **very** low. It is **an** indication that there is in this case no serious **mis-**match between supply and **demand** for infrastructure in border regions. A similar **result** was **found** by **Bruinsma** and Rietveld (1994) for a **much** broader set of

European border regions.

The **valuation** of the **importance** of infrastructure **components** does not only **depend** on the intensity of use, but **also** on bottlenecks experienced. This is the reason that road infrastructure and telecommunication figure prominently in Table 5. The low level of bottlenecks in services of public utilities is **an explanation** why these **receive** lower scores in this table.

Impact of the AI on the performance of fii

In the questionnaire the entrepreneurs were asked to consider the case that the AI highway would *not* have been constructed. The impacts of the construction of the AI highway on **firms** are described in Table 6.

The impact is especially found in increased accessibility and shorter travel **times** and to a lesser extent in **the** punctuality of goods supply . These results are not **very** striking since the research area is not suffering **from** serious congestion. Striking **however** is, that the least positive impact is found for **the size** of the international market area. For a transnational transport corridor like the AI these findings are **rather** disappointing. The impact of the construction appears to be smaller **when** the company is located further away from the AI. This **holds** true for the impact on sales as **well** as on accessibility . The impact on travel **time** is especially small **when** the **site** is located more than 7.5 **kilometres** away from the highway .

Table 6 Impacts of the AI construction on firms

	strong improvement	improvement	no impact	no opinion
accessibility	38.7	31.7	20.7	9.3
travel time	31.9	38.9	20.1	9.2
punctuality deliveries	13.2	33.0	38.8	15.0
sales	7.9	19.5	55.2	17.4
national market	9.8	19.6	54.4	16.2
export market	5.6	12.3	63.0	19.2
costs per unit	6.2	23.6	51.1	19.0

Table 7 Expected impacts if the AI was not constructed on firms

	agree	disagree	no opinion
company closed down	0.8	78.9	20.4
company size enlarged	0.5	74.4	24.7
company size smaller	6.9	66.0	27.2
investments enlarged	17.0	56.8	26.3
investments smaller	2.1	69.8	28.1
expansion employment	14.5	58.7	26.8
less employment	2.1	69.8	28.1

When a sectoral distinction is made, we find that for the transport and communication sector the most positive impacts are found, which is consistent with the findings in the regional labour market approach (section 5.2). For the service - and to a lesser extent the industry sector - relatively small impacts are obtained.

On the question how the situation would be if the highways would not have been constructed, some 10-20 % of the entrepreneurs indicates that this would have had a negative impact on employment and the level of investments. These answers are mainly given by entrepreneurs located at less than 7.5 kilometres from a highway access (see Table 7).

In comparison to the 1989 study a substantial smaller share of the entrepreneurs indicate negative impacts of the non-construction. It appears that the positive impacts of the construction which are reported by entrepreneurs just after the construction are less evident to entrepreneurs when they are interviewed some years later.

6.3 Conclusions

In the relation between transport infrastructure and economic development the perception of entrepreneurs about the importance of transport infrastructure is of major importance.

A high consensus exists among entrepreneurs about the **importance** of road infrastructure and to a lesser **extent** telecommunication and public utilities. This common feeling about **the importance** of road **infrastructure** is partly reflected by actual location behaviour. The **average** distance to a highway access is decreased by 28 % **after** the relocation of a **firm**. Other relationships between transport infrastructure and the vitality of **firms** are less convincing. Although entrepreneurs indicate that **infrastructure** in **general** and the construction of the A1 highway in particular are of a certain **importance** for the development of employment, they value market perspectives and internal company **considerations** clearly **higher**. In addition, there is no **clear** indication of a tendency of decreasing impacts with increasing distances to **an** access of a highway .

The questionnaire shows that **the** valuation of transport infrastructure by entrepreneurs is not only based on solid rational and **objective** reasons, like for **instance** transport **costs**. **Also subjective** reasons - like image **effects** - are involved. In 1994 the entrepreneurs indicate the impacts of the A1 construction to be considerably lower than in 1989. This **means** that there is a reduction in the perceived **importance** of the A1 over **time**.

7 **Concluding remarks**

In **this** study the impacts of highway construction on employment have been investigated with data at different spatial levels. At the highest level of spatial aggregation - the **Corop** level - it **appears** that only the transport and **communication** sector benefits from the increased national and international accessibility **caused** by the construction of the A1 highway. For this sector a priori the biggest impacts were to be expected. **When** the reference region method is applied, it appears that no convincing indications are **found** that the A1 construction had a positive impact on total regional employment.

It **may** be concluded therefore, that the impact of **constructing** highways on regional employment growth is not significant (**except** for the transport and communication sector). An explanation of this **result may** be that the spatial

level of analysis used is too high for **finding clear** spatial **economic** impacts. It is possible that spatial effects do exist, but that these **relate** to distribution effects within regions. Highway construction **may** for example lead to relocation of **firms** in a region to sites **near an** access point. In this case one does not observe **an** impact at the level of the region as a **whole**, but if data would be available at a lower spatial level one would really find relocation effects.

The survey approach **makes** it possible to carry **out an** analysis at the individual level and investigate spatial effects within regions. It appears that there is **indeed** a tendency of relocation of **firms** to move to a location **nearer** to **the** highway. In addition a positive relation between the growth of companies and the distance to the AI is found. Zones at a distance up to 7.5 kilometres of the AI have on **average higher** employment growth than zones at **longer** distances. A difficulty is that **all** major **urban areas** in the region are located within a distance of 7.5 kilometres from the highway, so that distance to highway and degree of **urbanization** are strongly correlated. The zone with a distance up to 7.5 kilometres to a highway is in **all respects** most **dynamic**: total employment growth, new **companies** and relocating companies.

Since the highway studied here is **an** international link in the highway network it is interesting to consider the international component of its impact. This appears to be surprisingly small. The entrepreneurs **indicate** that the **benefits** for **the** access to the national market are clearly **higher** than to the **international** market. **Also** in the study at the regional level, international accessibility plays a **much** smaller role **than** one might **expect**. This **result** is obviously relevant for **discussions** about Trans **European** Networks (TENS). It is probably no exception **when** the **importance** of the national **dimension** seems to dominate the **importance** of the international dimension of links in TENS.

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