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Abstract:

Two important ways to study the impact of infrastructure improvement on spatial economic development are various model approaches and entrepreneurial surveys. In this paper we concentrate on the second type: entrepreneurial surveys. The empirical results of three surveys are presented. Two surveys concern the impact of highway construction at the regional level, the third is oriented at the urban level. The questions of the three surveys overlapped each other to a large extent, so changes over time in the perception of the impact of transport infrastructure on the firm's well being can be measured. The surveys showed 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. There appears to be a reduction in the perceived impact of a transport infrastructure project over time.

1 Introduction

Transport infrastructure is a necessary condition for a well functioning economy. This statement will receive almost universal acceptance. Nevertheless, in many countries hot debates are going on about the desirability of transport infrastructure projects. The reason is that the above statement is of little help when assessments have to be made about particular infrastructure projects. In that case one wants to know what would be the difference between what happens when a particular project is implemented versus when the project is not implemented. For a review of the problems involved we refer to: Batten and Karlsson (1996) and Vickerman (1991).

To address this issue basically two ways can be followed. First, modelling approaches can be used, based on historical data to find out the difference between the policy-on and policy-off situation, or to identify the contribution of infrastructure to economic variables such as employment and productivity. The second approach is based on the views of entrepreneurs: they are invited to indicate to what extent in their opinion an infrastructure project in the past has had impact on firm performance. In addition to such an ex-post evaluation, entrepreneurs may also be invited to present their views in an ex-ante fashion, i.e. with respect to projects that have not yet been completed.

Both approaches • models and surveys • have their limitations and strong points. It is advisable therefore to consider them as complements rather than substitutes. In the present paper we will not go into a systematic comparison of both approaches (see for example OECD, 1995). In stead we will focus on approaches of the second type, i.e., entrepreneurial surveys.

In this paper the empirical results of three surveys are presented. Two surveys concern the impact of highway construction at the regional level, The first regional survey was held in 1989 and is focussed on three Dutch regions in different parts of the country. The second regional survey was held in 1994 and concerns the eastern part of the country. The third survey (held in 1992) was oriented at the urban level by analysing the impact of the construction of the Amsterdam orbital motorway. The questions of the three surveys overlapped each other to a large extent, so changes over time in the perception of the impact of transport infrastructure on the firms' well being can be measured.

Before presenting the results of these surveys, some comments on the methodological implications of survey analysis are addressed in the next section.

2. Methodological considerations

A number of difficulties and limitations appear to arise in using regional entrepreneurial surveys to measure the impact of infrastructure construction on spatial economic development:

First, it is hard to make a distinction between distributive and generative effects. Are the effects of infrastructure investments, as perceived by the entrepreneurs only the consequence of a spatial shift in employment from the surrounding areas or is there more than a spatial redistribution (i.e., growth at an aggregate level). Most employers tend to be unaware of such aspects.

Second, it is difficult for employers to distinguish the influence of a change in the infrastructure from the influence of changes in the total regional economic production structure and environment.

Third, entrepreneurs may have the tendency to overrate the potential benefits of infrastructure projects in the hope that the research results will convince policy makers that these projects should indeed be carried out.

Finally, an obvious limitation of entrepreneurial surveys is that certain household effects are not taken into account. For example, households may experience benefits from better transport infrastructure that do not have clear impacts on economic activity, such as less time needed for social visits.

Is it possible to deal with these problems in an appropriate way? We will argue that indeed some of these problems can be solved by an appropriate questionnaire design and sampling strategy, however some of the problems remain (see also Leitham, 1996).

The first problem (generative versus distributive effects) can in principle be overcome by a broad sampling strategy so that not only entrepreneurs are interviewed that are located in the areas where positive effects occur, but also in areas where negative effects take place. The problem is, however, that the negative effects are most probably spread in a wide area and that they are small in the sense that the individual entrepreneur does not clearly notice it, even though at a collective level the negative

effects may be non-negligible. Thus, a tendency may be expected that negative effects are underestimated with entrepreneurial surveys.

The second problem is a difficult one. Respondents must understand that they should not respond in a 'before versus after' fashion ('is your business more successful after the accessibility improvement than before'). The reason is that other conditions may have changed as well. As long the relevant other conditions have changed in a random way for the respondents, there no serious problem of a bias. However, some of the other conditions will most probably not be random (general economic development in a region or country), and therefore a bias may occur. The proper way of asking the questions is in terms of ('with

versus without'). A way to stimulate proper responses is a two step approach: 1. respondents are asked which factors played a role in the development of their business, and 2. they are asked to indicate how the development would have been if the other factors had not been present. This remains a difficult question, but sources of bias have been reduced in this way. Thus we finally arrive at three relevant levels (see Figure 1): the 'before' level, the 'after' level, and the 'adjusted after' level. It is the difference between the former and the latter that we are looking for. In figure 1 we show two cases, with an equal positive infrastructure effect, but where the actual developments ('before versus after') are quite different.

The third problem is sometimes difficult to avoid. The questionnaire and the accompanying explanation should not hint at a possible importance of the outcome of the survey for a particular policy decision. In addition, the questionnaire must be balanced in the sense that attention should not **only** be given to infrastructure aspects, but also the whole range of other relevant factors for the firms should be mentioned.

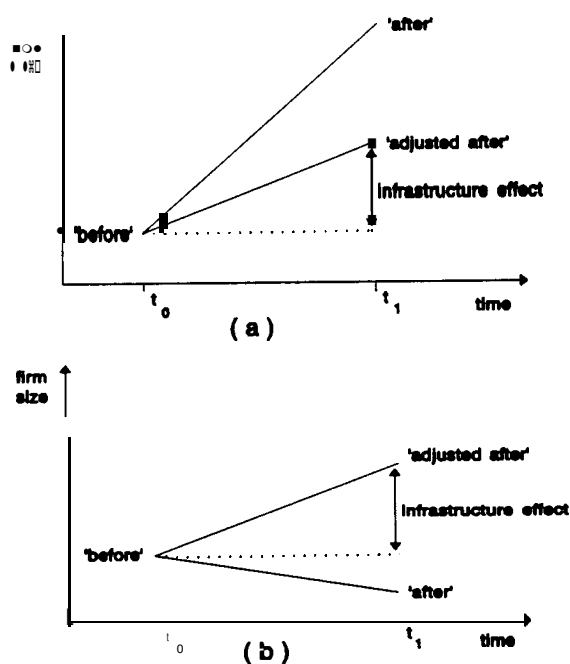


Figure 1 Two cases of 'before versus after' comparisons in impact analysis

The pertaining problem is most serious in ex-ante studies; in ex-post studies (as in the present paper) the incentives to give misleading responses are clearly smaller.

The last limitation is obvious: entrepreneurial surveys cannot provide the full picture of relevant effects. If one wants to provide a more complete picture also households should be interviewed to provide information about the effects of infrastructure on for example travel behaviour, and locational choices in the housing and labour market.

A final point that deserves our attention here is that infrastructure does not only have objective effects (e.g. via transport costs) but that also subjective effects (e.g. status considerations) are important. Such status effects are usually difficult to touch in modelling approaches, but in the context of entrepreneurial surveys they can be accommodated.

3. The surveys: an introduction

3.1 The 1989 survey

The survey of 1989 concerns an infrastructure impact study in the Netherlands, with particular consideration of the assessment of its economic importance in terms of investment volumes and employment effects (direct, indirect and spinn-offs). This study was undertaken to provide a more solid empirical basis for determining wether public infrastructure investments significantly



Figure 2 The research areas of the three surveys

contribute to the improvement of the employment situation in the Netherlands (see Bruinsma et al, 1992). So, the general setting of the research project was rather broad. In three regions in different parts of the Netherlands (Leyden in the western, southeast North-Brabant in the southern, and Twente in the eastern part) a postal questionnaire, focussing on the influence of new infrastructure on the number of employees, was sent out to basic sector firms with at least 50 employees (see Figure 2). In this paper we focus on the results achieved for Twente because this region was also the target of the 1994 survey.

In the last week of May 1989 255 questionnaires have been sent to firms in Twente. The net response was 93 questionnaires (36.5%), which are representative for the target population according to location, **sectoral** composition and size (for a more detailed analysis we refer to Bruinsma, 1990).

3.2 The 1994 survey

The second regional survey which was held in 1994 is specifically focused on the impact of the construction of the A1 highway, located in the eastern part of the Netherlands, on spatial economic development (see Bruinsma et al, 1997). The A1 is one of the most important east-west axes in the Dutch road network and provides the main connection from Amsterdam to the German road network. The final sections in Twente towards the German border were constructed- in the period 1985-1992. Where possible the results are presented for Twente only, to allow us to compare the findings with the results of the 1989 survey (see Figure 2).

In the last week of April 1994 1.845 questionnaires have been sent to firms 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., 1995).

3.3 The 1992 survey

The 1992 survey differs from the other two surveys by its urban orientation: the orbital motorway of Amsterdam (see Figure 2). In March 1992 a questionnaire was sent to 516 entrepreneurs • with a labour force of at least 10 persons • divided over three

types of zones of the Amsterdam agglomeration (see Bruinsma et al., 1996). The first zone consists of areas which are located near parts of the orbital motorway which already existed before the completion. The second zone consists of areas which became accessible after the opening of the new and final segments of the orbital motorway in 1990. The third zone consists of areas which are located rather at a distance from the orbital motorway (either the inner city or the remote suburbs). The first zone is further on named the **old accessible zone**, the second zone the new **accessible zone** and the third zone **the remote zone**.

The questionnaire was sent to entrepreneurs in four economic sectors: industry, distribution, services and the office sector. The first two sectors have a strong orientation on the transport of goods, the latter on business and commuting traffic.

The net response of 25 % was evenly spread across zones and sectors. In an over-surveyed area like the Amsterdam region the net response rate of 25 % is relatively high. In the old accessible and remote zone the office sector is the dominant sector with shares of 74 and 59 % respectively. In the new accessible zone the industry sector (41 %) and distribution sector (30 %) are the main economic sectors. These shares are close to the overall **sectoral** composition in those zones (for a more detailed analysis we refer to Bruinsma et al., 1993).

A feature shared by the three questionnaires is that they have an **ex-post** character: the questions concern the perceived impacts of changes in infrastructure already realized before the time of the interview.

4. General results of the 1989 survey

In general, it is plausible to assume that infrastructural improvements should result in a rather large improvement of the regional infrastructure complex (the synergy of all individual infrastructure components), before we may observe a spin-off effect that is sufficiently significant to be measured. The survey therefore focussed on such infrastructural projects, like, for instance, motorways, railways and regional airports.

The employment spin-off effects of the railroad and regional airports appeared to be marginal due to the fact that those infrastructure elements are not in common use for any of the economic sectors. The perceived employment effects of highways appear to

be substantial (Table 1).

In Leyden (located in the centre of the Randstad area in the western part of the country), for instance, 27 per cent of the entrepreneurs indicated a positive employment development as a consequence of the improvement of the highways. In Brabant (in the southern part of the country) 11 per cent and Twente (in the eastern part) 22 per cent of the enterprises gained employment for this reason.

In another question the employers were asked on their opinion about how the firm would have acted if the new infrastructure had not been realized. The results, which are presented in Table 2, are quite consistent with the figures shown above. In this respect Leyden appears to score with 17 per cent a little lower than would be expected, and Twente somewhat higher with 26 per cent.

In both Leyden and Twente a relatively high percentage of firms indicated that their **firm** size would have been smaller without the new infrastructure. The effect on the investment level of firms appears to be substantial. Nearly 40 per cent of the firms in Leyden, 30 per cent of the firms in Twente and 20 per cent of the firms in Brabant expected lower company investments, if the infrastructure had not been realized. About

Table 1 Perceived impact of the construction of highway infrastructure on employment growth

	Leyden	Brabant	Twente
positive	27	11	22
neutral	64	74	65
negative	0	0	2
no opinion	9	15	11

Table 2 Effects if the infrastructure had not been realized

	Leyden	Brabant	Twente
company size smaller	10	2	17
investments smaller	37	21	30
company not relocated	17	21	22
less employment	17	8	26

15 per cent of the relocated firms would not have been relocated.

The overall view from these figures is that the impact of new infrastructure in these regions on company behaviour is rather large, especially in the cases of Leyden and Twente.

Given the properties of the various regions, what general inferences can be drawn from this case study on the Netherlands? The following factors were found to have a positive influence on the strength of the employment effects.

First, the region must possess a clear economic potential. On the labour market there should not only be a reserve quantity of labour, but it is also necessary that it contains a good quality of labour. There has to be also a good entrepreneurial spirit, while the political climate has to be in favour of economic development.

Second, the new realised infrastructure has to serve the needs of major economic sectors. As a consequence, spin-off effects can be expected by an expansion of: road infrastructure, telecommunication networks, energy and water supply infrastructures. Energy and water supply infrastructures are basic infrastructure elements and normally already available, without any capacity constraint. It is not reasonable to assume that increasing investments in those networks will lead to substantial spin-off effects, unless these networks were absent. However, the construction of highways may result in substantial structural employment effects. Through those expansions, the whole **infra-**structure complex of the region may be upgraded.

Substantial employment effects were found in two situations. Employment effects appear to emerge when an essential but missing link in the infrastructure **network** was constructed or when the new investments led to a capacity increase in a clearly congested network.

5. General results of the 1994 survey

The results presented in this section concern the survey of 1994. However, where possible, a comparison with the results of the 1989 survey is made. Because of this comparison the above presentation of the results of the 1989 survey was rather limited. More attention is paid to the presentation of the results of the 1994 survey and the differences and similarities with the findings of the 1989 survey. It will appear that the

perception of the impact of the construction of the A1 highway in Twente on the performance of firms located in the surrounding of this transport corridor has decreased over this five year period.

5.1 Infrastructure and firm development

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 3). In the 1989 research project similar results were found for the Twente region. Other factors that are often mentioned as ‘very’ important are: availability of employees, accessibility by A1, 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

Table 3 Perceived impact of (location) factors on employment growth (in %)

	very important	most important	second most important
internal company considerations	24.0	19.6	22.8
market perspectives	53.3	65.0	18.8
education employees	6.6	1.8	4.8
availability employees	12.7	2.4	13.2
telecommunication	8.8	0.2	1.1
accessibility by A1	12.9	0.7	2.2
accessibility by road	10.9	1.3	5.9
public traffic	3.5	0	0
parking possibilities	10.1	0	0.3
government	6.3	0.2	1.4
image region	8.1	0.2	2.2
expansion possibilities of buildings	25.6	6.2	13.5
representativeness location	16.6	0.7	2.2
price location	14.2	0.2	1.7
subsidies	7.6	0.4	2.0
residential environment	7.5	0.2	2.2
private factors	8.3	0.9	5.6

infrastructure related factors (accessibility by road, accessibility by A1) are only considered as 'most' or 'second most' important in a small number of cases (this also holds 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 often identified as 'most' or 'second most' important. Other factors are apparently more decisive when one wants to explain employment growth of individual firms.

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 A1 highway. 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 poor 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 expansion capacity, the representativeness and to a lesser extent the price and the accessibility of the new location. An interesting conclusion is that road accessibility ▪ and especially accessibility of the A1 highway ▪ is more important as a pull factor than as a push factor in the location behaviour of firms. Only after entrepreneurs have decided to relocate do they start to attach a role of some importance to road accessibility.

Of the 510 firms surveyed, 100 started between 1980-1994, while 182 relocated during that period. It is striking 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 is higher in the zone until 7.5 kilometres of an access compared with zones further away (see Table 4). In addition, a high rate of relocation is found for firms within the 7.5 kilometres zone (36.8 %) compared with those in the longer distance zone (19.9 %). This difference cannot simply be explained by the larger presence of new

Table 4 Distance to a highway ramp and the rate of birth and relocation of firms

distance highway access	no. of existing firms before 1994 1980		birth between 1980- 1994 abs. % ¹⁾		relocation of firms			
					number of relocated firms		of which birth between 1980-1994	
					abs.	% ²⁾	abs.	% ³⁾
< 7.5 km.	359	277	82	29.6	93	36.8	39	29.5
> 7.5 km.	151	133	18	13.5	23	19.9	7	23.3

1) the percentage concerns the firms existing before 1980

2) the percentage concerns the firms in 1994

3) the percentage concerns the share in relocating firms

firms in the 7.5 kilometres zone (new firms relocate more frequently). As shown in Table 4 the composition of relocating firms (in terms of already existing before 1980 and started up between 1980 and 1994) is not that different for both zones (80.5 and 76.7 % versus 29.5 and 23.3 %). Apparently, also firms already existing before 1980 are relocating more frequently in the 7.5 kilometres zone. A possible explanation is that in this **rather urbanized** zone opportunities for expansion at the same site are limited, so that expanding firms are forced to relocate.

When the relocated **firms** are analyzed more in detail, it appears that 42 % stay in the same four digit postal code area, while 75 % stay in the same city or village. When the change in distance to a highway is measured 41 % of the **firms** appear 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 have been constructed in the course of time.

In the 1989 survey we did not find such a decrease in distance to a highway entry or exit after a relocation of the firm. This can be explained by changes in the spatial policy of the Dutch government. Physical planning in The Netherlands is **characterized** by strict zoning regimes. In the eighties the policy was to expand near existing industrial sites at the outskirts of cities. The surrounding of the A1 highway

should remain a green zone. By the turn of the decennium this policy has changed. Large industrial sites were developed near highway ramps. As stated above the relocation decision of most firms is caused by a lack of expansion possibilities at the old location. Those firms can only relocate to locations where there is enough supply of space. So from 1988 onwards firms were forced to locate near a highway ramp, simply because hardly any other location was offered.

5.2 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 the perceived values given by entrepreneurs to the impacts of the AI construction on specific elements of the firm's performance are discussed.

It appears that especially road infrastructure is valued often as 'most important' (Table 5). Telecommunication is found to be most important 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

Table 5 The importance of infrastructure (in %)

	very') most second			increased 1990-1994
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) More than one infrastructure component can be mentioned as 'very important'.

Table 6 Impacts on firms of the A1 construction

	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

infrastructure components during the past period are rather similar to the present importance, although certain shifts can be observed. Roads remain dominant but, telecommunication and airports are 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. It appears that there are no significant differences between the valuations according to distance to highways. This also holds true for the valuation of highways: entrepreneurs with firms located further from the A1 did not value road infrastructure lower than entrepreneurs with firms nearby.

In the questionnaire the entrepreneurs were asked to consider the hypothetical case of the A1 highway *not* having been constructed. The impacts of the construction of the A1 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 A1 these findings are rather disappointing. The impact of the construction appears to be smaller when the company is located further away from the A1. 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 7 Expected impacts on firms if the A1 was not constructed

	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. For the service ■ and to a lesser extent the industry sector ■ relatively small impacts are obtained.

On the question of 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 (see Table 7). These answers are mainly given by entrepreneurs located at less than 7.5 kilometres from a highway access.

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. General results of the 1992 survey

The third survey focussed on the Amsterdam orbital motorway which was constructed in several phases, partly using existing motorways. Major parts were already completed in the 1970's and 1980's (the segments in the southern and western part of Amsterdam). In September 1990 the last segment in the northeastern part of Amsterdam was completed.

Although the spatial demension is slightly smaller than the regional surveys discussed above, we foresee no difficulties in comparing the results of these studies,

since identical questions are used in the questionnaire.

6.1 The effects of the opening of the orbital motorway

Most companies stated that the opening of the orbital motorway relieved the traffic problems for their company (Table 8). A clear majority noticed a reduction in

Table 8 Effects of the orbital motorway (in %)

A. Zonal	<u>All respondents</u>			<u>New accessible</u>		
	Impr.	Neutr.	Worsen.	Impr.	Neutr.	Worsen.
accessibility	80	19	2	91	10	0
travel time	76	14	10	76	12	12
annoyance in traffic	75	20	5	74	19	7
inflow/outflow of goods	43	50	7	64	28	8
costs per unit product	19	78	3	23	71	6
turnover	12	87	1	15	85	0

	<u>Old accessible</u>			<u>Remote</u>		
	Impr.	Neutr.	Worsen.	Impr.	Neutr.	Worsen.
accessibility	74	24	2	72	24	3
travel time	71	21	7	83	7	10
annoyance in traffic	78	20	3	72	21	7
inflow/outflow of goods	24	74	3	35	52	13
costs per unit product	9	89	3	28	72	0
turnover	16	82	3	4	96	0

B. Sectoral	<u>Industry</u>			<u>Distribution</u>		
	Impr.	Neutr.	Worsen.	Impr.	Neutr.	Worsen.
accessibility	80	20	0	84	16	0
travel time	80	12	8	80	10	10
annoyance in traffic	73	23	4	74	11	16
inflow/outflow of goods	50	38	13	65	18	18
costs per unit product	32	68	0	31	63	6
turnover	10	86	5	18	82	0

	<u>Offices</u>			<u>Services</u>		
	Impr.	Neutr.	Worsen.	Impr.	Neutr.	Worsen.
accessibility	75	22	4	87	13	0
travel time	76	18	6	64	14	21
annoyance in traffic	79	21	0	75	17	8
inflow/outflow of goods	24	74	2	60	40	0
costs per unit product	9	86	5	9	91	0
turnover	9	91	0	27	73	0

travel time, a better accessibility and/or a decrease in annoyance participating the traffic. Although the effect reported by the majority is neutral, still a substantial percentage of companies noticed a rise in turnover, a decrease in the costs per unit product and/or improved punctuality in the delivery of goods.

At the zonal level (8A) only a few differences on this general pattern occur. The major contrasts are between the new and the old accessible zone. For instance, in the new accessible zone 64 % of the companies noticed a rise in the punctuality in the delivery of goods, whereas in the old accessible zone 74 % noticed no difference at all. These differences are caused by the **sectoral** composition of the areas: the industry and distribution sector are overrepresented in the new accessible zone, the office sector in the old accessible zone.

At the **sectoral** level (8B) it is important to note that a relatively high percentage of companies in the industry and distribution sector experienced a decrease in the costs per unit product. Those sectors are • more than the other sectors • used to work in terms of costs per unit product and actually could notice changes in the costs structure of their products. Relatively many companies in those sectors also noticed an improvement in the punctuality of the delivery of goods. On the other hand a relatively high number of companies experienced a decrease in punctuality. The fact that the office sector is not used to work with physical products, leads to very neutral scores for changes in costs per unit product and in the delivery of goods.

The developments in the service sector are interesting. The relatively high score for the rise in turnover could point to a better accessibility what could have resulted in a rise in the number of customers. Second, the strong reduction in travel time has led to an expansion of the market area. So not only the accessibility has improved but also the reach. And third, the rise in punctuality in the delivery of goods has led to more efficient operations.

6.2 Expected consequences if the orbital motorway had not been completed

In Table 9 the results are given of questions about the effects which would have occurred in case the orbital motorway had not been completed.

As shown, this would especially have had effects on the investments of the companies. About 10 % stated that they would have invested less. A minor number of

Table 9 Expected effects if the orbital motorway had not been completed¹

A. Zonal	Total	New accessible	Old accessible	Remote
firm closed	1		1	
firm smaller	4	1	1	2
firm relocated	7	2	3	2
less invested	11	8	2	1
less personnel	6	4	0	2
Total	130	45	44	41

B. Sectoral	Total	Industry	Distribution	Offices	Services
firm closed	1			1	
firm smaller	4		1	3	
firm relocated	7		1	6	
less invested	11	2	4	4	1
less personnel	6	-	2	3	1
Total	126	26	22	60	18

1 * since no entrepreneur mentioned an enlargement of the firm, or expected that their investment or employment figures would have been higher as the orbital motorway was not constructed, these factors are not included in the Table.

* four observations have been deleted in part B because the sector is unknown.

* In some cases a firm may have indicated more than 1 option.

companies expected to have less personnel or stated that they would have moved to another location. These negative effects would have been felt mostly in the new accessible zone and in the office or distribution sector.

7. Integration of the results achieved by entrepreneurial surveys

The survey approach makes it possible to carry out an analysis at the level of individual firms and investigate spatial effects within regions. In the A1 highway studies it appears that transport infrastructure might attract firms. There is a tendency of firms who are relocating to move to a location nearer to the highway. In addition a positive

relation between the growth of companies and the distance to the A1 is found. Zones at a distance up to 7.5 kilometres of the A1 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.

The rather uniform questionnaire used in the three surveys discussed allows us to compare some results of these studies (see Table 10). The results for Twente are given for the years 1989 and 1994. The results of 1994 are selected from the data of the A1 transport corridor study which was held for the eastern part of the country.

A first finding is that a relatively high percentage of entrepreneurs experience hindrance in the business use of the highway network. The percentage of firms stated to experience hindrance decreases with the degree of peripherality. A relatively high percentage of companies in the Amsterdam agglomeration experience hindrance compared with the peripheral located firms of Twente. This result is consistent with the

Table 10 Impact highway construction on firm performance

	Regions				orbital motor- way 1992	A1 transport corridor 1994
	Twente		Brab.	Leyd.		
	1989	1994	1989	1989		
<i>Hindrance use highway</i>	28	37	36	56	68	40
<i>Improvement by construction</i>						
accessibility	--	--	--	--	80	74
travel time	--	--	--	--	76	78
inflow/outflow of goods	--	--	--	--	43	54
costs per unit product	--	--	--	--	19	37
turnover	--	--	--	--	12	33
<i>Effect of non-construction</i>						
firm smaller	17	9	2	10	4	8
less invested	30	22	21	37	10	19
less personnel	26	20	8	17	6	17

actual congestion levels on the highway network in the Netherlands. Remarkable is that regardless the opening of the A1 transport corridor an increased percentage of **firms** in Twente experience hindrance in the use of the highway network in 1994 compared to 1989. The explanation is probably that entrepreneurs in Twente show a stronger orientation to the Randstad area after the opening of the A1 transport corridor and that in the Randstad itself congestion has increased. In Twente there is still hardly any congestion on the highway network.

There is a strong similarity in the results of the orbital motorway study and the transport corridor study considering the impact of **the** construction of the highway and the improvement of the accessibility and travel times. In Twente a higher percentage of firms than in Amsterdam experience an improvement in the delivery time of goods, a decrease in costs per unit product and an increase in turnover. These differences can partly be explained by the **sectoral** structure of both regions. In the Amsterdam region the service and office sector are dominant, whereas the industry and construction sector are dominant in Twente. The industry and construction sector have a much stronger orientation on goods than the office and service sector have.

A last comparison considers the expectations of the firms had the highway not been constructed. The entrepreneurs stated that in case of non-construction they expected a strong negative impact on the investment level and the number of employees of their firm. Depending on the region • and the highways constructed in those regions • about 10 till almost 40 percent of the **firms** expected to have invested less had the infrastructure not been constructed. In 1994 a considerably lower percentage of firms stated to expect negative impacts of non-construction in Twente compared to 1989. In 1989 the highway was new and the entrepreneurs had high expectations about the opportunities this new highway could offer their firms. In 1994 the firms are accustomed to the availability of the highway and their expectations are levelled to more realistic proportions. Nevertheless, it is important to note that entrepreneurs perceive the construction of a highway as a new opportunity to expand their activities (in investment level and number of employees). This is an indication that government public investments can be effective to provoke private investments. Moreover, it is an indication of the fact that entrepreneurial perceptions about the opportunities of the new infrastructure contribute to the impact of infrastructure on spatial economic development. It is hard to cover such

perceptions in model exercises, so qualitative approaches can enrich the information one needs to arrive at a balanced analysis. Moreover, where models often consider a regional level of spatial aggregation, a qualitative approach can be applied at a low level of spatial aggregation and produce useful information about distributive and generative effects.

8. 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. However, it is important to note that a decrease in the distance to a highway access is not a main reason to relocate a firm. The main reason to relocate is the unsuitability of the old location. Moreover, the choice of the new location depends on the supply of industrial sites. This might partly explain the decrease in the average distance to a highway access of the relocated firms.

Another indication for an impact of highway construction on economic development is found in the high percentage of entrepreneurs that stated that their companies' accessibility has improved and that the construction of highways led to a decrease in travel times.

Other relationships between transport infrastructure and the vitality of firms are less convincing. Although entrepreneurs indicate that infrastructure in general and the construction of highways 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 surveys showed 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. The impact of these

subjective reasons might be considerable. If an improvement of the perceived attractiveness of an area by the construction of a highway leads to an increase in private investments, then public investments could be used to provoke private investments when applied in a proper manner. Such perceptions are not necessarily stable however. For example, for the Twente region, 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 highway over time.

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