Employers Promoting Sustainable Commuting: a Multilevel Count Data Analysis on Bicycle-Promoting Measures

Thomas Vanoutrive
Ghent University
Department of Geography
University of Antwerp
Department of Transport and Regional Economics
thomas.vanoutrive@ua.ac.be

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Samenvatting

Werkgevers promoten duurzame pendel: een multi-level analyse van fiets-ondersteunede maatregelen

Heel wat werkgevers nemen zeer diverse maatregelen om het pendelgedrag van hun werknemers duurzamer te maken. Daarbij lijkt het logisch te veronderstellen dat werkgevers die geconfronteerd worden met bereikbaarheidsproblemen, meer maatregelen nemen om carpoolen, fietsen en het openbaar vervoer te ondersteunen. In een multilevel model werd aan de hand van vooral ruimtelijke variabelen getracht te verklaren waarom fietsmaatregelen genomen worden op een werkplek. Dit model incorporeert naast de vestiging als basiseenheid ook de niveaus gemeente en werkgelegenheidsbassin. Gebruik makend van de driejaarlijkse enquête woon-werk-verkeer bij grote ondernemingen (sinds 2005) is er nu, naast de data uit de Belgische volkstellingen, ook meer informatie voorhanden over de werkgevers-kant van het pendelgebeuren. In het merendeel van het onderzoek over pendelgedrag ligt de focus voornamelijk op de karakteristieken van de individuele pendelaar. Het onderzoek over bedrijven en pendel blijft dikwijls beperkt tot een kwalitatieve analyse met case-studies en 'best practices'. Hier wordt getracht om daar een kwantitatieve analyse aan toe te voegen.
Uit onze analyse blijkt dat op vestigingen met meer werknemers en met meer parkeerplaatsen per werknemer meer maatregelen worden genomen om het fietsen te bevorderen. Dit laatste lijkt erop te wijzen dat werkgevers het voorzien van autoparkeerplaatsen als een last ervaren. Als werkgevers aangeven dat ze lijden onder congestie nemen ze ook meer maatregelen. In vestigingen waar onveilig verkeer op de fietsroutes naar de werkplek werd gesignaleerd, worden ook meer maatregelen genomen om het fietsen te promoten. Het verbeteren van de infrastructuur is een voorbeeld van dergelijke maatregel. Hierbij is een diepgaandere analyse nodig om na te gaan of deze variabele op zich verantwoordelijk is voor het resultaat of dat er een (verborgen) variabele bestaat. In meer heuvelachtige gebieden in België wordt de fiets minder gepromoot. In gemeenten die beter bediend worden door openbaar vervoer, wordt meer ingezet op openbaar vervoer dan op fietsgebruik. Verder onderzoek zal echter ook moeten focussen op (bedrijfs)economische variabelen en op alternatieven. Daarnaast zullen meer geavanceerde bereikbaarheidsindicatoren geïncorporeerd worden in een model.

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1. Introduction: the failure of sustainable commuting measures and why the future is maybe to the employers

"The future was better in the past", is the theme of the 2008 CVS. Commuting and measures to influence commuting are not new, as a consequence it is useful to look back and forward to measures which try to influence commuting. There exists a wide range of measures taken by employers which influence the commuting behaviour of employees (see Abbes-Orabi and De Wolf 2007). This ranges from the setting-up of a carpool database or introducing a fee to employees who cycle to work, to alternative work hours or telework and organising an own bus service. In the present paper the focus is on measures that promote bicycle-use.

1.1. Travel Demand Management

Travel demand management (TDM) is an alternative to the traditional transport policy approach which focuses on solving traffic problems on the supply side (building new infrastructure). The latter became less popular for financial (limited budget for infrastructure), environmental (air pollution, noise,…) and political (protest of inhabitants) reasons. In general, TDM strategies try to optimise traffic using the existing transportation infrastructure. Commuters frequently are the focus of TDM actions because of their regular, predictable driving patterns, the possibilities of employer partnerships and the opportunities for ride-sharing programs.

Governments strive for a more sustainable commuting and want to reduce the number of SOV's (Single Occupant Vehicles) for different reasons. There are the environmental problems like air pollution but also the financial losses caused by congestion due to waiting time. Both in the USA and Western Europe, one of the government strategies is to activate the private sector to take measures that promote a more sustainable commuting. Employers are not only confronted with the government regulations and recommendations but also with recruiting problems due to accessibility problems, including parking problems (Ferguson 2000).

The variety of (possible) measures is large (see Abbes-Orabi and De Wolf 2007) and there exists a lot of initiatives. But since there is still an evolution towards more private car use and the (modal shift) goals are not yet reached, there is still a long way to go. Research on individuals' commuter travel decision making is widely available, but fewer studies appear to have focused on the attempts by employers to impact the daily travel mode to work of their employees (Kingham et al. 2001; Rye 1999). That is why this paper wants to contribute to the research about the role employers play in the commuting behaviour of there employees. We focus in this paper on cycling but to set the tone, we first look to some other sustainable commuting measures.

1.2. Carpool

In a carpooling arrangement, two or more employees ride together to work in a personal or company-owned car. Carpools, like company buses and staggered work shifts were already widely used in the USA during World War II, mainly due to a limited car availability. But the literature and policy attention increased significantly due to the energy crisis of 1973, both

in the USA and Western Europe. And also in the light of the sustainability debate, ride sharing is seen as one of the solutions that will contribute to more sustainable commuting. (Hwang and Giuliano 1990)
Tsao and Lin (1999) find in the literature estimates that up to 68% of the peak-period automobile commuter trips could be candidates for carpooling (for the metropolitan area of Boston, following Kendall in 1975). Ridesharing looks attractive due to the reduced costs, the relative door-to-door directness and a comfort level most nearly like that of the single-occupant vehicle. (Hwang and Giuliano 1990, Comsis Corporation 1993, Kingham et al. 2001). But only 4,6 % of the employees working for large employers in Belgium make use of this attractive solution.

This number of 4,6 % questions the supposed attractiveness of carpooling. People view car sharing as unreliable as they are dependent on someone else. The pick-up/drop-off delay and extra travel and waiting time make carpooling less suitable for short distances. The lack of flexibility and the loss of privacy seem also important factors. The availability of potential carpool partners which share both the same origin and destination zone is limited, and is even more limited if carpooling between people with a different socio-economic background is excluded. In short, the economic advantage of carpool over driving alone is most of the times not strong enough to entice commuters to carpool. The monetary value of privacy and time is apparently relatively high in comparison with the saved out-of-pocket costs (Tsao and Lin 1999; Kingham et al. 2001). And at the end, carpooling still means that people are using an emission-producing private car with a limited number of passengers. Despite this, especially in the USA, 'Ridesharing traditionally has been the backbone of most TDM (Travel Demand Management) programs.' (Ferguson 2000 p.81).

1.3. Telework/Telecommuting

For broad concepts like telework and telecommuting numerous definitions exist (Mokhtarian 1991), but in general telecommuting can be seen as a subset of teleworking whereby telework includes all work-related substitutions of telecommunications for travel, whereas telecommuting concerns the impacts on daily commuting to and from work (Helminen and Ristimäki 2007). The introduction in the literature of the concept of telework is often situated in the early 1970s ('electronically mediated distance working') but it is in the second half of the nineties that there was a real peak in research and public interest in the topic of telework (Bergum 2007). The development and implementation of information and communication technologies (ICT) leads to more flexible ways of organising working practices (Helminen and Ristimäki 2007; Collins 2005). The number of trips decreases because for a lot of information exchange ICT can be used.

After the 1990s peak, public attention on telework diminishes and the travel reducing potential of telework was questioned. Bergum (2007) argues that there are different reasons for this decline in attention. First there is the diffusion hypotheses, the phenomena of telework is widespread and has become so common that there is less special attention for this topic. The second explanation is modification. This means that the original concepts are applied in practice and that its concepts are mixed and established. Then there is also the

failure hypotheses, the forecasts of the travel reduction potential of telework are overestimated. For all these hypotheses some evidence can be found and the effect of telework on transport remains unclear. Teleworking may not replace travel at all according to among others Mokhtarian (already in 1991). It is observed that as people work some days at home in a week, they can agree with longer commute distances, which encourage urban sprawl. Or employees telework some hours each day and go to work outside the peak hours. However ”the rise of telecommunication demand has been paralleled by a corresponding increase in travel demand at all geographical scales”, so there is no substitution relationship between communication and transport (Miller 2004 p.286).

1.4. Sustainable Commuting Measures – a Tendency to Fail?

An overview of different sustainable commuting measures is given in Abbes-Orabi and De Wolf (2007). The same situation as with carpool and telework occurs for e.g. flexible work times. It is not clear if this has a positive impact on carpooling due to the possibility to accordate the work schedules of the carpoolpartners or a negative effect because there is a large variety in the start- and end-time of employees. Also other measures like company cars can diminish the positive effects of green commuting measures. And what to think about the tendency that commuting is seen as a time away form pressures of home and work, as relaxing time (anti-activity) or as ‘productive travel time’ (Lyons and Chatterjee 2008)?

It seems that there is academic evidence that almost all green commuting measures tend to fail. But maybe this is not only a transport problem. Bergum (2007) compared on the basis of his questionnaire on telework the opinion of researchers/academics with the opinion of consultants/practitioners. “the scientists referred to many failures, while the practitioners mentioned success stories”, “The failure hypothesis was especially supported by social scientists” while “consultants tend to be pro-telework”.
Several interpretations for the support of social scientist for the failure-hypotheses are possible, Bergum (2007) suggest among other things that “consultants have mostly been involved in successful business cases, or do no want to or are not allowed to talk about failures” while “social scientists have mostly been involved in home based telework and neighbourhood work centrals, which have been the least successful types of telework.” But as Jessop (2002) demonstrates in his thorough analysis on failure, the ‘pessimism of the intellect’ is a widespread phenomena and as a result, not limited to transport research.

Of course not all measures fail, and between failure and succes is always a large zone. But it seems that there is a need for a better understanding not only of the green commuting measures itself but also of why they are implemented. Bicycling-promoting measures are the subject of this paper, but it is obvious that a closer look at measures that promote carpool, public transit,… is necessary in the future.

2. Measures taken by employers to promote a more sustainable commute

Increasingly companies throughout Europe are implementing green commuter plans (GCP), also called ‘site-based mobility management’, ‘green transport plans’, ‘employer (based)

transport plans',… which try to reduce transportation problems of a company and influence the commuting behaviour of employees. It is supposed that it are in the first place employers confronted with concrete accessibility problems which take measures (Enoch and Potter 2003; Rye 1999; Ligtermoet 1998). But it cannot be ignored that incentives towards employees are also seen as a possibility to increase the net wage and these measures could also be part of corporate sustainability strategies.
Employers confronted with concrete accessibility problems are supposed to be the first to invest in green commuting measures. Geurs and Ritsema van Eck (2001 p. 27-45) define accessibility as "The extent to which the land-use transport system enables (groups of) individuals or goods to reach activities or destinations by means of a (combination of) transport mode(s)". An important difference exists between 'infrastructure-based accessibility' (the performance of transport infrastructure) of which congestion level is a typical measure and 'activity-based accessibility' which is the range of available opportunities with respect to their distribution in space. Levinson (1998) stresses that both the home and work ends of trips are relevant to explain travel behaviour but the latter seems to be the most important.
Next to accessibility, density gets quite a lot of attention in commuting literature (Chen et al. 2008). Research has shown that employment density at the workplace is strongly associated with a slightly lower likelihood of car commuting and reduced personal commercial vehicle miles travelled. But is not clear if density on itself or related characteristics (higher parking costs, increased road congestion, and better public transport service) are the cause. (Chatman 2003; Bhat and Guo 2006; Chen et al. 2008)

3. The Promotion of the Bicycle by Employers

According to Parkin et al. (2007), Rodriguez and Joo (2004) and Comsis Corporation (1993), the decision of an individual to cycle depends on car ownership, journey distance, journey purpose, bicycle ownership, class, age and concerns for health and the environment. Next to these, residential density, climate (rainfall), topography and factors related to the transport environment (traffic risk, qualities of cycling routes,...) influence the decision to cycle. According to design guidances for cycling infrastructure, this infrastructure must be coherent/comprehensive, direct (avoiding detours), attractive, safe and comfortable. For factors like the risk of cycling, the perception is often more important than the actual levels of risk. Relevant variables for the infrastructure-based accessibility by bicycle are the hilliness, traffic risk and the quality of the cycling routes. The activity-based accessibility is limited by the smaller range of a bike in comparison with public transport and private car use.
When investigating measures taken by employers to promote one mode (e.g. bicycle) the accessibility characteristics of the alternatives are important as measures are often seen as a stimulus to use an alternative to the 'Single Occupant Vehicle'-use. Important alternatives are the private car and public transport.
A shortage of parking space is seen as one of the most important problems related to car accessibility that leads to measures taken by employers. (Naess and Sandberg 1996; Banister and Gallent 1999; Potter et al. 1999; Ferguson 2000). Congestion is another important infrastructure-based accessibility problem.

The question is to which extent the promotion of bicycle-use by an employer is related to the accessibility of a site and to some other variables.

4. A multilevel count data model

4.1. Multilevel Analysis

Multilevel analysis (MLA) reckons with the fact that, especially in socio-economic research, observations are often grouped. In multilevel research this hierarchical structure is explicitly part of the research design. Single-level research supposes that data on the individual level are independent, which is seldom the case. (Maas and Hox 2004; Schwanen et al. 2004; Rasbash et al. 2005)
A simple (intercept-only) multi-level regression analysis with two levels can be formalised as follows:

$$y_{ij} = \beta_{0j} + \beta_1 x_{ij} + e_{ij} \quad (1)$$

$$\beta_{0j} = \beta_0 + u_{0j} \quad (2)$$ where i is the individual and j the second level

This model allows that different level 2-units have different intercepts (and this is therefore called random intercept model). The u_{0j} –terms are the level 2 random effects or the level 2 residuals. This basic model can be extended by adding more levels.
Multi-level modelling not only has the advantage of getting a better understanding and more clear interpretation of the effects of higher levels but ignoring clustering also generally causes underestimated standard errors of regression coefficients (Maas and Hox 2004; Schwanen et al. 2004; Rasbash et al. 2005). The main disadvantages is that models become more complex. As a consequence, diagnostics can be more complicated.

The number of measures taken by firms is the response variable of interest and can best be expressed as count data. This kind of data occurs often in health research but also in ecological, transport and social research. Typical for count data is that negative numbers do not occur and it are integer values. Negative binomial and Poisson regression models are typically used to analyse this kind of data, in stead of supposing a normal distribution. Here a Poisson distribution will be used (Rasbash et al. 2005 p.154-161; Twisk 2006 p.52-57).

4.2. The Database Home-to-Work-Traffic

Census data are already for decades a main source for commuting research (see e.g. Dickinson 1957), although more and more attention goes now to commuting diaries. Through a Belgian law of 2003 a new important source of data is available about home-to-work displacements of employees. This new statistic is based on a three-yearly questionnaire to companies with at least 100 employees. The first questionnaire dates from 2005. The main difference with census data is that the questionnaire home-to-work-travel is filled in by employers.

The goal of this new regulations is twofold. On the one hand, the government wants to collect information about the home- to-work-travel to underpin their policy; on the other hand, there is the obligation to discuss the questionnaire in the works council. The objective of the latter is the creation of a debate among the social partners which can lead towards a company mobility plan, or at least measures that support a more sustainable commute. In reality discussions about home-to-work travel are seldom important issues in the collective bargaining process.

4.3. The Variables

Explanatory Variable

The explanatory variable is the number of pro-bicycle measures taken by an employer on a site. In the questionnaire employers could indicate 15 different bicycle measures. The frequencies are given in Table 1.

pro-bicycle measure	**% worksites**
additional cycling fee	42,76
covered bicycle storage	34,85
secured bicycle storage	28,74
showers	24,12
room to change clothes	23,35
bicycles available for work trips	9,20
other	7,29
additional fee for work trips	7,18
bicycle repair facilities	3,06
improvement of infrastructure	2,90
information on cycling routes	2,88
rain clothes	1,61
bicycle maintance	1,27
bicycles available for home-to-work travel	0,84
bicycles available at the railway station	0,64

Table 1: Frequency of the pro-bicycle measures on worksites (source: questionnaire home-to-work-travel; n = 7460)

Independent Variables

The number of employees is relevant as it is supposed that on larger sites, more measures will be taken (E*mployees*). The number of car parking places is divided by the number of employees on the site to create a parking index (*ParkingIndex*). The maximum is set on 1 because in this way there will be no bias caused by large customer parking zones near shops for example.

As yet, there exists no central dataset with the availability of cycling paths in Belgium. This variable is related to the safety of roads for cyclists. And, as the perception of safety and quality, is the most important, data based on questionnaires are useful. The Database home-to-work-traffic can be used as 'dangerous traffic on the cycling routes towards and from the work site' could be pointed as an issue of mobility problems related to cycling (*BicyTraf*). Also the sense of insecurity is taken into account (*BicySens*). 'Congestion' could

be indicated as a car-mobility problem in the questionnaire and is used as a binary variable (*Congestion*).
The accessibility of public transport is not only a function of the availability of public transport stops in the neighbourhood of the work site but also of the frequency. However in this analysis only binary variables based on the questionnaire are used (*Train1km* and *BTM500m*).

Next to variables linked to the work site, also some variables at the municipality level are used. Vandenbulcke et al. (2008) calculated for each Belgian municipality the average slope on the street network. This data will be used as a measure for hilliness (*Slope*). The activity-based accessibility will partly be covered by the population density (*PopDens*). It is assumed that in more denser areas, more inhabitants can reach a worksite in a given time period. But this parameter is also a proxy for different other phenomena. For the activity-based accessibility by car, the number of people that can reach a municipality in a certain period of time, is based on Vandenbulcke et al. 2007 (*PotPop*). Job density at the work end of the commute trip (*JobsPop*) seems to be the most important density variable (Chen et al. 2008). Here the number of jobs in large companies is divided by the number of inhabitants between 20 and 64 years old.

Dependent variable	**description**	**source**	**binary or not**	**min**	**max**
BicyMeas	number of pro-bicycle measures	Database home to work travel (2005)		0	11
Independent variables					
Employees	number of employees on the work site	Database home to work travel (2005)		30	6552
ParkingIndex	the number of parking places divided by the number of employees	Database home to work travel (2005)		0	1
Train1km	railway station at less than 1km	Database home to work travel (2005)	binary	0	1
MTB500m	metro/tram/bus-stop within 500m	Database home to work travel (2005)	binary	0	1
Congestion	Congestion	Database home to work travel (2005)	binary	0	1
BicyTraf	Dangerous traffic on cycling roads towards the site	Database home to work travel (2005)	binary	0	1
BicySens	High sense of insecurity in the surroundings	Database home to work travel (2005)	binary	0	1
Slope	Average slope on the roads in the municipality	Vandenbulcke et al. 2008		0,68	10,29
PotPop	Accessibility by car: potential number of people that can reach the municipality by car (in millions; municipality)	Vandenbulcke et al. 2007		0,389	1,664
JobsPop	Job density: number of jobs/number of people age 20-64 (municipality)	Database home to work travel (2005), Ecodata - FPS Economy - Directorate-general Statistics Belgium		0,004	1,338
PopDens	Population Density (inhabitants/km²; municipality)	FPS Economy - Directorate-general Statistics Belgium		23,4	21038,2

Table 2: Description of the variables used in the model (all variables are on work site level, except those were 'municipality' is mentioned; n = 7460)

Levels

The choice of the right levels is essential in multi-level modeling. This is related to the choice for an appropriate aggregation level. Arauzo-Carod (2008) shows that the use of different spatial units can create significant different effects and even opposite signs in the results. Generally, a distinction is made between administrative divisions (municipalities, provinces,...) and functional divisions (Travel-To-Work-Areas,…). Functional divisions are preferred because they are delimited on the basis of real-world phenomena.
For Belgium 47 employment basins (bassins d'emploi) are delimited on the basis of commute data of the 1991 census. In an employment basin the (relative) majority of employees has both their home and work location within that basin. These are not closed labour markets but it is nonetheless a (multi)functional division that tells something about labour market characteristics (De Wasseige et al. 2000).
Municipalities are in the first place administrative units. Parking policy is mainly a competence of the municipality level and also in the development of industrial zonings, town and country planning,… the municipality execute some tasks. Next to this, there is the advantage that a lot of data are available on this level.

5. Results and Discussion

5.1. Results

The results of the model can be found in Table 3. On the labour basin level (level 3) the standard error is larger than the variance. That does not alter the fact that a closer look at the residuals on this level can be meaningful. The lowest residual is found for the Brussels Labour Basin and the highest for the Antwerp Labour Basin. The variance on municipality-level is significant.
As for the Poisson model the logarithm is used, the inverse of the logarithm is given to interpret the results. More employees on a site is associated with more pro-bicycle measures. One employee more, means 1,00013 times more measures and 1000 employees more are associated with 1,14 times more measures (exp(0,000134 * 1000)).
The more parking there is in proportion to the number of employees, the more measures are taken. This finding is not in line with the hypothesis that when there are more accessibility-related problems, like a parking shortage, employers take more measures. The presence of a railway station in a range of 1 km around the work site influences the number of measures in a negative way. For other public transport stops (500m) the standard error seems too large to draw sound conclusions[1]. The variable for congestion has the expected sign. If employers indicate that they suffer from congestion, 1,07 times more pro-bicycle measures are taken. When employers indicated dangerous traffic for bicycles, more measures are taken and less when they indicate problems with the sense of insecurity (social, not traffic). In municipalities with larger average slopes (hilliness), less measures to promote cycling are taken and the accessibility by car is associated with the number of measures in a positive way. If the population density is higher, less measures are taken. The result for job density differs little from zero.

[1] Although the standard error cannot interpreted as by a single-level regression where a normal distribution is assumed, it still is an indicator (Twisk 2006).

level		**estimate**	**s.error**
3	Cons	0.001395	0.001899
2	Cons	0.03188	0.005495
1	Poisson distribution		
Variable	**estimate**	**s.error**	**Exp (estimate)**
Cons	0.42	0.097	1,52
Employees	0.0001329	2.042e-005	1,000133
ParkingIndex	0.1723	0.0249	1,188034
Train1km	-0.02416	0.01882	0,97613
MTB500m	0.0003115	0.02488	1,000312
Congestion	0.06757	0.0208	1,069905
BicyTraf	0.1785	0.01912	1,195423
BicySens	-0.04725	0.03649	0,953849
Slope	-0.04858	0.01124	0,952581
PotPop	0.1219	0.08383	1,129641
JobsPop	0.06913	0.08065	1,071576
PopDens	-1.233e-005	6.58e-006	0,987746

Table 3: results of the model
(the software used is MLwiN, see Rasbash et al. (2005))

5.2. Discussion

As expected, sites with more employees and sites in congested areas are associated with more measures and in municipalities with steep slopes, less measures to promote cycling are taken.
When there are public transport stops in the neighbourhood, employers will less invest in promoting the bicycle but more in public transport-measures. The average number of measures to promote public transport is 0,57 when there is a train station at less than 1km (in stead of 0,52 if not) and 0,56 when there is a metro, tram or bus stop at less than 500m (in stead of 0,42 if not).
In neighbourhoods indicated as (socially) unsafe, the bicycle is less promoted, and also less used (6,58% cycling employees vs. 9,33%). But when the traffic on the roads is dangerous more measures are taken. As the number of cycling employees is lower at worksites where there is dangerous traffic (7,80% vs. 9,33%) the hypotheses that employers with more cycling employees are more willing to indicate this problem in the questionnaire, does not hold. The fact that some measures like 'improvement of infrastructure', try to increase the safety, can be an explanation.
One possible explanation for the positive relation between the number of parking places per employee and the number of pro-bicycle measures is that when an employer has to spent more money and space on parking he/she will try to reduce the amount of parking needed by e.g. promoting bicycle-use. In the questionnaire the average parking index of employers

who indicated 'high parking costs for the employer' is slightly higher (0,504) than for employers who did not indicate this (0,491).
Sites with a higher activity-based accessibility by car (potential population that can reach a municipality by car in a certain period of time) take more measures. This can be interpreted with care because this is associated with some other variables. More accessible municipalities are located in the centre of Belgium, in areas with more economic activity. Density is also a variable that can act as a proxy for other variables like travel time and travel cost, job accessibility and access to public transport stations. A higher population density means less pro-bicycling measures but it was supposed that these are areas with a higher potential for cycle. There is perhaps less resistance to overcome, so less reason to invest in pro-cycling measures or in these areas employers invest more in public transport. And we may not forget that travel plans often just tend to tackle the symptoms (provide cycle facilities) but fail to tackle the underlying problems like distance (Dickinson et al. 2003).

The previous analysis only takes into account more spatial variables like accessibility and density. The BELFirst database is used to add information about the economic sector. A quick look at Table 4 shows that the average number of pro-bicycle measures differs between the different economic sectors, of which the NACEBel-codes gives an indication. Companies can also be classified on the basis of the (main) parity committee to which they belong. This was possible for 2886 sites. The average number of pro-bicycle measures for worksites belonging to more manual labour oriented parity committees is 1,90 while it is 1,80 for more headwork oriented companies. For the third category of parity committees ('employees in general and their employers') the average is the lowest (1,71). So it is supposed that incorporating some economic variables can enrich the analysis.

NACEBel 2003	**average number of pro-bicycle measures**
Transport, warehousing and communication	1,04
Real estate, renting and producer services	1,50
Electricity, gas and water	1,58
Wholesale and retail; repair of motor vehicles and consumer goods	1,67
Hotels and restaurants	1,69
Other community, social and personal services	1,70
Health and social services	1,81
Manufacturing	1,99
Agriculture, hunting, forestry and fishing	2,08
Construction	2,14
Education	2,18
Mining and quarrying	2,25
Finance	2,62
Public administration and defence; social security insurance	2,94

Table 4: average number of pro-bicycle measures per economic sector (n = 4015)

6. Conclusion

Employers take different kind of measures to promote more sustainable commuting of their employees. It is supposed that if they are confronted with more accessibility problems, they will take more measures. Via a multi-level model is tried to explain the number of pro-bicycle measures on the hand of spatial variables (mainly accessibility and density). This multi-level model allows that data on municipality level are incorporated not just by giving the same value to each observation within the same municipality, but in a way that there is no violation of the assumption that data are independent from each other. The differences between municipalities are significant but there could, however, not be found a significant difference between labour basins.

As expected on sites with more employees more measures are taken and less on work sites in more hilly municipalities. In the neighbourhood of public transport stops employers stake more on public transport-measures and less on promoting the bicycle. Population density, associated with less public transport stops, has also a negative effect on the number of measures. The accessibility by car however, is positively related to promoting cycling. If employers indicate that they suffer from congestion, they will take more cycling measures. Unsafe traffic on the roads is also associated with more measures to promote cycling. One possible explanation is that the aim of some cycling promoting measures is to increase safety. It seems that employers with more parking space than average try to promote the bicycle presumably to reduce the parking cost. In general it is also probable that there is not yet a rational, well-founded sustainable commuting policy in every company. As a result, the outcome of the analysis can contain some contradictory elements.

More economic variables can be incorporated in the model and some dummy variables could be replaced by more quantitative accessibility indicators. The future research will also investigate the effectiveness of the measures taken to promote cycling. The research about the role of the employers in the commuting behaviour of the employees is most of the time limited to case studies. These are useful but the research can now take advantage of the Belgian questionnaire home-to-work travel. Although, when analysing the received results, one should recognise that the basic data coming out of the home-to-work travel questionnaire are the result of the first questionnaire of this kind in Belgium.

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8. References

-Abbes-Orabi F., De Wolf N. (2007) "Assessing and Developing Initiatives of Companies to control and reduce Commuter Traffic (ADICCT). A literature review". Proceedings of Colloqium Vervoersplanologisch Speurwerk (CVS) De Xpert-factor. Antwerpen, 22-23 November, 137-153.
-Arauzo-Carod, J.-M. (2008) Industrial location at a local level: comments on the territorial level of the analysis. Tijdschrift voor Economische en Sociale Geografie, Vol. 99, No. 2, pp. 193–208.
-Banister, C., Gallent, N. (1999) Sustainable commuting: A contradiction in terms?. Regional Studies. 33 (3), 274-280.
-Bergum, S. (2007) What has happened to telework? Failure,Diffusion or Modification? The Journal of E-working, Vol 1, February 2007, Pages 13-44.
-Bhat, C.R. and Guo, J.Y. (2006), An Innovative Methodological Framework to Analyze the Impact of Built Environment Characteristics on Activity-Travel Choices, Innovations in Travel Demand Modelling Conference, Transportation Research Board, Austin, Texas, May.
-Chatman, D.G. (2003) The Influence of Workplace Land Use and Commute Mode Choice on Mileage Travelled for Personal Commercial Purposes, 82nd Transportation Research Board Annual Meeting, 12-16 January, Washington D.C.
- Chen, C., H. Gong, and R. Paaswell. (2008) Role of the build environment on mode choice decisions: Additional evidence on the impact of density. Transportation 35(3):285-299
-Collins, M. (2005) The (not so simple) case for teleworking: a study at Lloyd's of London. New Technology, Work and Employment. 20 (2), 115-132.
-Comsis Corporation (1993) A guidance manual for implementing effective employer-based travel demand management programs. The Institute of Transportation Engineers, Washington.
-De Wasseige Y., M. Laffut, C. Ruyters and P. Schleiper (2000) Bassins d'emploi et régions fonctionnelles, Méthodologie et définition des bassins d'emploi belges. Discussion Papers, Ministère de la Région wallonne
-Dickinson, J.E., Kingham, S., Copsey, S. and Pearlman Hougie, D.J. (2003) Employer travel plans, cycling and gender: will travel plan measures improve the outlook for cycling to work in the UK? Transportation Research D. 8 (1), 53-67.
-Dickinson, R. (1957) The geography of commuting: the Netherlands and Belgium. Geographical Review. 47: 521-38
-Enoch M. and Potter S. (2003) Encouraging the commercial sector to help employees to change their travel behaviour. Transport Policy, Volume 10, Number 1, January 2003 , pp. 51-58(8)
-Ferguson, E. (2000) Travel Demand Management and Public Policy. Ashgate, Aldershot, UK.
-Geurs, K.T. and Ritsema van Eck, J.R. (2001) Accessibility Measures: Review and Applications. RIVM Report 408505 006, National Institute of Public Health and Environment, Bilthoven.
-Helminen, V. and Ristimäki, M. (2007) Relationships between commuting distance, frequency and telework in Finland. Journal of Transport Geography. 15 (5), 331-342.
-Hwang, K. and Giuliano, G. (1990) The determinants of ridesharing: literature review. , Working paper, UCTC n° 38.
-Jessop, B. (2002) Governance and Metagovernance: On Reflexivity, Requisite Variety, and Requisite Irony. Published by the department of Sociology, Lancaster University, Lancaster LA1 4YN, UK.
-Kingham, S., Dickinson, J. and Copsey, S. (2001) Travelling to work: will people move out of their cars?. Transport Policy. 8, 151-160.
-Levinson, D. M. (1998) Accessibility and the Journey to Work. Journal of transport geography, 6(1), 11 - 215

-Ligtermoet, M. (1998) Mobility Management in the Netherlands, Report to the Netherlands Ministry of Transport (The Hague: Netherlands Ministry of Transport).
-Lyons, G., Chatterjee, K. (2008) A human perspective on the daily commute: costs, benefits and trade-offs. Transport Reviews, 28(2), 181-198.
-Maas, C.J.M. and Hox, J.J. (2004) Robustness issues in multilevel regression analysis. Statistica Neerlandica, 58 (2): pp. 127–137.
-Miller, H., J., (2004) Tobler's First Law and Spatial Analysis. Annals of the Association of American Geographers, 94(2), 2004, pp. 284–289
-Mokhtarian, P. (1991) Defining telecommuting. Transportation Research Record. 1305, 273-281.
-Naess, P. and Sandberg, S.L. (1996) Workplace location, modal split and energy use for commuting trips. Urban Studies. 33, 557-580.
-Parkin, J., Ryley, T. and Jones, T. (2007) Barriers to cycling: an exploration of quantitative analyses. Chapter in Cycling and Society edited by Rosen, P., Horton, D. and Cox, P. Ashgate, Aldershot, UK.
-Potter, S., Rye, T. and Smith, M. (1999) Tax and green transport plans: a survey of UK experience. Transport Policy. 6 (4), 197-205.
-Rasbash, J., Steele, F., Browne, W.J. and Prosser, B. (2005) A user's guide to MLwiN version 2.0. University of Bristol
-Rodriguez, D.A. and Joo, J. (2004) The relationship between non-motorized mode choice and the local physical environment. Transportation Research D. 9 (2), 151-173.
-Rye, T. (1999) Employer attitudes to employer transport plans: a comparison of UK and Dutch experience. Transport Policy. 6 (3), 183-196.
-Schwanen, T., Dieleman, F. M., and Dijst, M. (2004) The impact of metropolitan structure on commute behavior in the Netherlands: A multilevel approach. Growth and Change, 35(3), 304–333.
-Tsao, H.-S. J., Lin, D.-J. (1999) Spatial and Temporal Factors in Estimating the Potential of Ride-sharing for Demand Reduction. California PATH Research Report, UCB-ITS-PRR-99-2
-Twisk, J. W. R. (2006). Applied Multilevel Analysis: A Practical Guide. Cambridge University Press
-Vandenbulcke, G., Steenberghen, T. and Thomas, I. (2007) Accessibility indicators to places and transports: Final Report. Belgian Science Policy and FPS Mobility and Transports, Brussels. Available from http://www.mobilit.fgov.be/fr/index.htm
-Vandenbulcke, G., Dujardin, C. and Thomas, I. (2008) Cycling to work: Modelling spatial variations within Belgium. 48th Congress of the European Regional Science Association, Liverpool, United Kingdom, 27-31 August 2008)