The regionalization of labour markets by modelling commuting behaviour

Frank Cörvers and Maud Hensen

Research Centre for Education and the Labour Market Maastricht University, The Netherlands Telephone: +31-43-3883647 E-mail: m.hensen@roa.unimaas.nl

June 2003

Abstract

There hardly exists any country in which regional employment issues do not play an important role in policy making. The need for models to carry out policy analyses in this field of research is evident. In order to analyse regional labour markets administratively defined areas are usually taken as units of analysis. On the one hand, labour market policies targeted on these administratively defined areas may be less effective if the administrative boundaries do not follow functionally linked labour market areas. On the other hand, it may be very difficult for local planning authorities to set policy goals with regard to another subdivision of areas than the administrative subdivision. Therefore it is important for policy makers at the regional level to be aware of the functional interdependencies between regions, in particular when these regions are not functional regional labour markets. In our paper we subdivide functional regional labour markets by modelling the commuting behaviour of workers in the Netherlands. For a better understanding of regional labour markets and their dynamics, commuting behaviour of workers is analysed by using the distance travelled from home to work (see Isserman et al., 1986). The commuting decision depends on workers' background characteristics like age, sex, education, income or region-specific variables. By analysing

the impact of these determinants on commuting, we are able to compare the average commuter of a country, in our case the Netherlands, with the commuters at the municipality level. By taking a closer look at the commuters at the municipality level, we find municipalities in which commuters act significantly different from the average commuter. These differences in commuting behaviour at the municipality level give an impression of the relative labour market attractiveness of the municipalities and thereby of the ratio between labour demand and supply in regions. We use these differences in commuting behaviour to regionalize the labour market. Although many studies have analysed commuting behaviour, a regionalization of labour markets with respect to different groups of workers has rarely been made. In the paper commuting flows of different groups of workers are used to subdivide the national labour market into functional regional labour markets. Contrary to earlier research (for example Baumann et al. 1996), we prevent to use arbitrarily chosen cut-off points to regionalize the labour market. Instead, we model the commuting behaviour of individual workers and use statistical criteria to subdivide regional labour markets (Baumann et al. 1996). Moreover, we show that the resulting regionalization of the labour market strongly depends on the group of individual workers concerned in the analysis. For example, it is shown that workers travel on average 21,5 kilometres for the home-to-work journey and that this distance increases with the educational level of the commuters. Therefore the regional labour market for workers with a high level of education is relatively large. To perform our empirical analysis we use journey-to-work data from Statistics Netherlands (CBS, 2001).

1 Introduction

In analyzing regional labour markets administratively defined areas are usually taken as units of analysis. However, it has been recognized that areas defined by administrative boundaries do not provide insight into the functional relationship between these areas. Therefore, the need for models to carry out analyses in this field of research is evident. Before analysing and assessing regional economic development, competitiveness, job opportunities and territorial disparities, it is of great importance to carefully define functional regions. The dominant concept in defining functional regions is that of labour markets. Commuting conditions are the most important principle for the delineations of functional regions in OECD countries (OECD, 2002). By applying the right commuting conditions, functional regions that correspond to local labour markets can be established. Within such areas labour demand and supply are relatively well matched. In particular for research and policy making purposes these areas should exhibit functional similarities and policy makers should be aware of the functional interdependencies between regions. If functional regions are defined without using functional linkages between the spatial units of analyses, it is possible that these regions have a higher degree of interdependence with spatial units external to that region.

The aim of labour market regionalization in this paper is to define areas on the basis of travel-to -work. That is, to define functional regions in which the proportion of workers both living and working there is maximized. The problem of regionalizing areas into functional regions in turn can be viewed as a problem of how to aggregate subareas into regions that exhibit some functional similarities. This aggregation approach includes a set of the smallest identified areas (municipalities for the Netherlands), a set of criteria, an aggregation procedure and some insights into the evaluation of these aggregation procedures. There are thus different methods that can be applied in order to define regional labour markets. These methods differ, among other things, in applying different cut-off points which lead to different regionalizations of areas.

Casado-Diaz (2000) for example sets thresholds of a minimum size of the area of 3,500 resident workers, at least 75% of the jobs should be fulfilled by the residents of that area and at least 75% of the residents should work in the area (p. 845). Moreover, a 70% threshold was accepted if the size of the area exceeded 20,000 residents. Travel-to-work areas (TTWA) in the United Kingdom have been developed using the same thresholds (Coombes et al., 1986; OECD, 2002). The determination of the threshold value determines to a great extent the number of local labour market areas defined. A low threshold would yield more local labour market areas and thus their usefulness and economic and policy meaning would be reduced. The thresholds used have been developed to approximate self-contained labour markets that cover a country.

Van der Laan and Schalke (2001), however, used two other criteria in order to classify local labour markets. The first criteria is that the largest outgoing commuting flow should exhibit more than 25% of all outgoing commuters for every municipality and the second is that the difference between the two largest outgoing flows should be 0.6 times the smaller flow (p. 206). With these criteria the municipalities are selected where commuting clearly is concentrated on a specific municipality. This is an example of a regionalization algorithm which is an aggregation procedure that clusters municipalities to construct functional regions.

Others defined centres of employment by using travel-to-work (commuting) flows made by working residents. These commuting flows make it possible to measure the coherence of an area in terms of a large proportion of the workers resident and work in that area. This corresponds to a great extent with the self-containment thresholds used by Casado-Diaz (2000). In defining the centres of employment on the basis of coherence of a region regionalization algorithms are used.

Beside differences between municipalities in terms of commuting behaviour of workers, municipalities differ in their structure of the labour force. Municipalities consisting of more (than the average municipality) households with children will automatically be characterized by less out-commuters. Moreover, older people for example also tend to commute shorter distances. It is clear that there are large differences between municipalities caused by the behaviour of different sub-groups of the working population. This implies that the working population who resident in a specific municipality is composed of different sizes of sub-groups which yields different behaviour at the municipality level. The division of the working population into sub-groups characterized by for example occupation or educational level may lead to a decrease in interpretability and robustness (Casado-Diaz, 2000). Some commuting flows at a specific educational level does not occur or represent a very small percentage of the working population for a given municipality.

Next to background characteristics of workers and the structure of the labour force, the relative demand of labour of a municipality (employment), wage differences and differences between housing conditions also influence the commuting patterns of workers. A higher demand of labour (for certain occupations), a higher wage or better housing conditions cause the supply of labour either to migrate or to commute to that specific municipality.

For a better understanding of regional labour markets and their dynamics, commuting behaviour of workers can be analysed in the context of the choice to commute for the home-to-work journey. Although many studies have analysed commuting behaviour, an actual definition of regional labour markets in the Netherlands has never been made. The commuting decision may depend on background characteristics of the workers like the level of education, the income of the commuter or region-specific variables. This paper deals with the market mechanism of the regional labour market and especially with how the market mechanisms handle the problem of allocating labour activities across space.

The aim of this paper is to provide a regionalization procedure without using arbitrary cut-off points. The regionalization procedure will develop functional regions in terms of the demand and supply of labour. Functional regions are in this respect regions consisting of municipalities which have more interaction with each other than with municipalities lying outside the region. The interaction between municipalities can be investigated by analyzing commuting patterns of workers. In clustering municipalities with functional similarities, the cut-off points are of great importance. The arbitrariness of these cut-off points is avoided by using the behaviour of commuters together with individual municipalities. This different individual behaviour at municipality level gives an impression of the relative labour market attractiveness of that municipality and this relative labour market attractiveness is chosen as cut-off point.

This paper is organized as follows. The first section explores the relevance of defining functional regions in policy perspective. Section two will deal with the determinants of the commuting decision of workers. The next section will give a description of the data that will be used to identify specific regions. Section four examines a model in which the behaviour of commuters is estimated. The next section will show the results and actually define functional regional labour markets in the Netherlands. The last section contains some final remarks which in particular indicate the importance of the choice of a functional regionalization of the labour market.

2 Policy relevance

The definition of a regional labour market is very important in the lights of future labour market policies. In particular labour market policies that affect employment in a specific region. In analyzing regional labour markets administratively defined areas are normally taken as units of analysis. However, it has been recognized that areas defined by administrative boundaries do not provide insight into the functional relationship between these areas. In particular for research and policy making purposes these areas should exhibit functional similarities. On the one hand, labour market policies targeted on these administratively defined areas may be less effective if the administrative boundaries do not follow functionally linked labour market areas. On the other hand, it may be very difficult for local planning authorities to set policy goals with regard to another subdivision of areas than the administrative subdivision. Amedo (1968) for example stated that the decisions made concerning the planning, distribution and allocation of resources among the various regions derived are not likely to be the most effective and meaningful relative to the decision that would be made if the underlying regional patterns were known.

If governments (at the national or at the intranational level) construct labour market policies on the basis of the unemployment level of a specific region, they have to be aware of the correctness of the boundaries of this region. The determination of the unemployment level in a region may consist of municipalities with a very low unemployment rate whereas there may be municipalities with very high unemployment level within this predefined region. The effectiveness of labour market policies for this region may be very small especially if the structure of the regional labour market varies much. Instead of defining a regional labour market as a market between administrative boundaries a regional labour market should be defined as an area where people are attracted to and where the labour market is in balance. The balancedness of a region can be in terms of supply and demand of labour. The discrepancies between demand and supply of labour in a predefined region depends on the definition of this region.

In Germany (OECD (2002)) for example the local labour markets are used for structural analyses of labour markets, regional economic competitiveness, job opportunities and territorial disparities (p. 17). These areas can potentially benefit from Regional Support Policy but are not responsible for the implementation of policies. The areas only serve as a functional territorial unit in which the administrative bodies or firms can benefit from subsidies. Other countries use the functional regions to provide socioeconomic territorial analyses (Canada, France, Italy, Sweden and the United States). Beside using functional regions for socioeconomic analyses Norway uses these regions in forecasting regional policies and for planning objectives.

The Netherlands consist of various functional labour markets. The administrative regions are characterized by provinces (12, based on NUTS 3) and the smallest units of measurement are municipalities (498, based on NUTS 5). The functional labour markets are named RPA (12 and 24), CWI (6) and COROP (40). The COROP division for example is constructed on the basis of nodal division principles. This means that every region consists of a central municipality and beside this criterion the regions should be within the boundaries of the provinces. These functional labour markets are often used for structural analyses of labour markets, territorial disparities but also as functional territorial units in which specific administrative bodies (unemployment agencies like CWI) plan their policies. In particular the structural analyses of labour markets vary in their use of functional regions. As a consequence comparison between these analyses are difficult. In light of these discrepancies between the use in functional regions and the possibly lower effectiveness of labour market policies, it is important to construct functional regions that exhibit similarities in their structure of the labour force.

3 Data

For the analyses the OVG data (2001) is used from Statistics Netherlands. This survey reports the travel behaviour of households. The OVG observed all the mobility decisions of individuals in the Netherlands during 2001. Also other motives to travel are observed like doing shopping or for sports. Only the home-to-work journey is used to analyze the commuting behaviour of workers. Unfortunately, the OVG does not contain any information about housing decisions of individuals. Beside the willingness to commute, the willingness to move plays a very important role in the commuting behaviour. People who are more willing to move choose not to commute. And this willingness to move depends on the income of the individuals (individuals with less income will not be able to move often), on the prices of houses (if the prices are high people are less willing to move) and other factors.¹

The data of Statistics Netherlands contains accurate information on interregional commuting. Table 1 summarizes this information for the provinces of the Netherlands by containing the ratio of employed residents working outside the region (the out-commuters) to the employed residents living in the region. Beside these out-commuters there are also the in-commuters, this ratio contains the employees who work in the region but resident outside to the employed residents living in the region. The table shows that on

¹For more details about the factors of the willingness to move see...?...?

average a region is characterized by a higher out-commuting ratio than the in-commuting ratio.

Table 1

The in- and out-commuting ratio for the twelve provinces of the Netherlands

	Commuting flows	In-commuters	Out-commuters	Total				
	Groningen	0.12	0.11	+				
	Friesland	0.04	0.1	-				
	Drenthe	0.13	0.2	-				
	Overijssel	0.08	0.11	-				
	Flevoland	0.12	0.35	-				
	Gelderland	0.1	0.16	-				
	Utrecht	0.31	0.24	+				
	Noord-Holland	0.19	0.08	+				
	Zuid-Holland	0.09	0.11	-				
	Zeeland	0.03	0.08	-				
	Noord-Brabant	0.07	0.1	-				
	Limburg	0.03	0.09	-				
Source: OVG, 2001 (CBS)								

There are three regions where the ratio of in-commuters is greater than the ratio of out-commuters. These ratios, however, are constructed using the administrative boundaries of the regions. The amount of in- and outcommuters can be misleading when it is used for labour market policies. The most northern region for example, Groningen, can be seen as an attractive labour market as the in-commuters ratio is greater than the out-commuters ratio. But the value of these ratios depend to a great extend on these boundaries. Specific municipalities on the boundaries of the region may cause this positive sum of ratios, whereas the rest of the municipalities are characterized by low employment levels.

4 The model

In constructing an analyses that is not based on arbitrarily chosen cut-off points it is important to take a close look at the choice of workers to commute to reach their work location. Spatial distribution of population and employment is related to two fundamental choices made by people: (i) where to live and (ii) where to work. The model developed here focuses exclusively on the workplace decision, and it abstracts from residential decisions. In this section we present a basic model for explaining the determinants of commuting between municipalities. These determinants of commuting depend on the maximization of the utility of individuals. Every individual is confronted with a labour supply function in which it maximizes its utility given a specific basket of goods that can be bought and the amount of leisure time. That is:

$$U = u(Q, t_l)$$

where Q is the basket of goods and t_l is the amount of leisure time (in hours). Every individual consequently is confronted with two restrictions. These restrictions consist of a budget constraint concerning the basket of goods and a time constraint concerning the maximum amount of hours that can be utilized (24 hours a day).

$$P * Q = w * t_s + I_e$$

This is the budget constraint where P * Q stands for the basket of goods that can be bought given a specific price/quantity rate (where P is the price of the goods and Q the quantity), w is the wage, t_s is the amount of hours the individual supplies itself and I_e is the income that can be earned without supplying labour. The time constraint is characterized by:

$$T = t_s + t_l$$

where T is the maximum amount of hours that can be utilized a day (24 hours). This maximum amount of hours consists of leisure time and the amount of hours the individual supplies labour. Beside these time components, workers are confronted by the choice to commute or not. This commuting decision (among other things) is influenced by the time it takes to reach the work location given residential location. That is, the time constraint van be expanded with commuting time.

$$T = t_s + t_l + t_c$$

This means that individuals are constrained by the available time and that they have to make a decision on how to utilize this time. If we assume that individuals work the same amount of hours, that is t_s is equal for every worker (8 working hours a day). The time individuals are prepared to travel to reach the work location depends on the valuation of leisure time of these individuals. That is, individuals who have a larger valuation for leisure time will be less willing to commute a great distance.

Commuting time depends not only on the distance that has to be travelled to reach the work location but also on the mode of transportation. Individuals who have a bicycle as their main mode of transportation will have a relative large commuting time compared to individuals who travel the same distance with their car. The same is true for people who are confronted with traffic congestion. They also have a relative large commuting time compared to people who have to travel the same distance but are not confronted with congestion. Therefor, the mode of transportation and the infrastructure determine to a great extend the time it takes to reach the work location. But as individuals utilize their available time, they take mode of transportation and infrastructure into account when they are choosing their work location.

The willingness of individuals to commute in terms of a specific commuting time depends, among other thing, on background characteristics of these individuals. Van de Berg and Gorter (1997) for example concluded that the larger the number of children, the lower the willingness of females to pay for commuting time. Thus, as the authors address, the value of leisure is relatively large for females with children. Also Rouwendal and Rietveld (1994) found in their research that individuals with children and older individuals have significant smaller commuting distances. Beside background characteristics also region-specific variables determine the relative willingness to commute. A higher unemployment rate for example leads to a larger willingness to commute. Thus together with region-specific variables, different groups of individuals can be distinguished according to their relative valuation for leisure and thus for commuting time.

Individuals take into account the quality of the infrastructure and the availability of mode of transportation when deciding to commute a specific distance to reach their work location. As commuting time depends on mode of transportation and the infrastructure, the distance that has to be travelled incorporates these factors. Thus:

$$t_c = f(d_{ij}, s_{ij}, tm(t_c))$$

The time it takes to travel from residential location i to work location j is a

function of the distance that has to be travelled, the quality of the infrastructure of this route and the availability for every individual to choose a mode of transportation. As distance increases, commuting time will laso increase; as the quality of the infrastructure increases there will be less congestion and thus the commuting time will decrease; and the mode of transportation indirectly depends on the commuting time, as the commuting time increases individuals will choose a mode of transportation that leads to smaller commuting time. As individuals may have preferences for mode of transportation (environmentalists) and the government may not improve the quality of the infrastructure, commuting distance may incorporate these factors. In turn, the observed choice of workers to commute incorporates all these effects.

5 The model estimated

The purpose of a labour market regionalization is to define areas in which the majority of labour market interactions occur. That is, an area in which the work location and the residential location of workers are located between the boundaries of the area. Functional regions are in this respect regions consisting of municipalities which have more interaction with each other than with municipalities lying outside the region. The interaction between municipalities can be investigated by analyzing commuting patterns of workers. In clustering municipalities with functional similarities, the cut-off points are of great importance. The arbitrariness of these cut-off points is avoided by using the behaviour of commuters together with individual municipalities. This different individual behaviour at municipality level gives an impression of the relative labour market attractiveness of that municipality and this relative labour market attractiveness is chosen as cut-off point. The choice of workers to commute to reach their workplace can be estimated using a Logit model estimation procedure. The choice of workers to commute appears to depend on sex, age, income, working hours, educational level and the presence of children in a family. The estimated model is:

Choice to commute $(1/0) = \beta_0 + \beta_1 * age + \beta_2 * sex + \beta_3 * educ + \beta_3 + back + ba$

 $\beta_4*income + \beta_5*work\ hours + \beta_6*children + \beta_i*municipality_i$

As was stated earlier, no information in the commuting flows by occupational level is available. Empirical equation stated above presents the background characteristics that are estimated where i = 1 - 489 (489 municipalities). The commuting decisions depends on several variables that are called attraction factors (have a positive sign). That is, if a worker receives a higher wage in a certain municipality, the chance a worker will commute becomes bigger. Other factors like the age of the worker and the presence of children have a negative influence on the chance that a worker will commute to reach the workplace. That is, if workers get older, they are getting less willing to commute to reach their workplace. Also the 489 municipalities influence the choice to commute of workers. This influence is a combination of the specific individual preferences concerning region-specific characteristics of regions and the availability of jobs. Some workers for example would like to resident in a municipality where there are enough facilities like a swimming pool, a pheripheral environment while others prefer to resident in a municipality close to their family. The estimated results are presented in table 2.

In order to prevent the use of arbitrarily chosen cut-off points to regionalize labour markets, the choice of workers to commute is used as a cut-off point. That is, municipalities that are characterized by a significant (at the 5% level) lower willingness to commute, corrected for background characteristics of the workers, are the starting point of the analyses. These municipalities are apparently more in balance in terms of supply and demand of labour. The remaining municipalities will be assigned to a municipalities on the basis of their largest out-going commuting flow. Thus pairs of municipalities will be formed. The construction of balanced municipalities is necessary as a starting point (instead of defining employment centres on the basis of an arbitrarily chosen employment level) to assign other municipalities to. Otherwise these municipalities would be assigned to a municipality that is much less balanced.

Table 2					
Estimated results		В	$\operatorname{Exp}(B)$	S.E.	Sig.
Age					
	25 - 35	0.614	1.848	0.046	0.000
	35 - 45	0.477	1.611	0.030	0.000
	34 - 55	0.219	1.245	0.029	0.000
	55 - 65	ref	ref	ref	ref
\mathbf{Sex}	Male	0.215	1.239	0.027	0.000
Ed. level					
	Low	-0.800	0.449	0.069	0.000
	Middle	-0.565	0.574	0.030	0.000
	High	ref	ref	ref	ref
Income		0.529	1.697	0.030	0.000
Working hours					
	12-30	-0.110	0.896	0.038	0.000
	> 30	ref	ref	ref	ref
Children					
	1-2	0.128	1.131	0.016	0.000
	2-4	0.081	1.007	0.005	0.000
	> 4	ref	ref	ref	ref
Nagelkerke R ²	0.219				

Source: OVG, 2001 (CBS)

6 A functional regional labour market

After using the behaviour of commuters to identify relative balanced labour markets, the commuting flows between municipalities are examined. This definition of regional labour markets is based on self-containment. Selfcontainment states that municipalities should be balanced in terms of a regional labour market. It assumes that within the area great commuting flows occur and less commuting is with areas outside (see Coombes et al., 1986; Cervero, 1995). The largest out-going commuting flows are selected and these municipalities are assigned to another municipality on the basis of this largest out-going commuting flow. This assignment procedure consists of several steps. The first step is to assign all the remaining municipalities to one of the balanced municipalities if their largest outgoing commuting flow is directed at these balanced municipalities. This leads to 50 clusters of municipalities. Still there are municipalities that can not be assigned to one of these balanced municipalities as their largest outgoing commuting flow is not commuting to these municipalities. The 50 clusters of municipalities of step 1 are then the starting point of step 2.

In step 2 the largest out-going commuting flows are again calculated but now for a different construction of the directed regions. The municipalities that not have been assigned to one of the balanced municipalities are one category of directed regions and the 50 clusters from step 1. The largest outgoing commuting flows are constructed on the basis of this new division of regions. The remaining municipalities from step 1 are then assigned to other municipalities of the clusters on the basis of this new out-going commuting flow. Step 2 is repeated until all municipalities are assigned to a cluster of municipalities. The minimum of clusters that is constructed is 50, but also these cluster may exhibit large outgoing commuting flows. Therefore, at the end of the assignment procedure of municipalities this procedure can be continued for the clusters of municipalities until some preferred amount of clusters is reached. 50 clusters of municipalities may in terms of effectiveness of labour market policies be too small. An optimal stop-point may again be the choice of workers to commute. Instead of using all the municipalities in the logit estimation equation, only the clusters of municipalities are used as an indicator for the balancedness of these clusters. The assignment procedure is then repeated until no cluster of municipalities acts significantly (at the 5% significance level) different from a reference cluster. This leads to the construction of 14 clusters of municipalities. Figure 1 shows the division of the Netherlands according to RPA (24-division).



Figure 1: Division of the Netherlands according to RPA $\left(24\right)$



Figure 2: Division of the Netherlands into functional regions according to the delineation procedure

Figure 2 shows the constructed clusters of municipalities based on the commuting decision of workers, it shows that some areas are large and located in pheripheral areas in the north of the Netherlands. Other areas, especially in the south of the Netherlands, the clusters do not consist of contiguous municipalities.



Figure 3: Division of the Netherlands into functional regions with one more aggregation

In the line of maximizing the effectiveness of labour market policies, it would be better if the municipalities are linked together in forming functional regions. Therefore, figure 3 presents the division of the Netherlands into functional regions where there is one more aggregation step added to the analyses. There are, however, still municipalities that are not linked to the contiguous functional region. Apparently these municipalities consist of a majority of workers who do not commute to a contiguous municipality.

7 Conclusion

There are several extensions possible to the approach presented in this paper. One obvious extension is the use of more explanatory variables. As stated in the introduction workers decide either to migrate or to commute to reach their workplace. An appropriate extension is information concerning the migration behaviour of workers. The inclusion of weights for these two explanatory decision variables would then be another extension. The weights would represent a mechanism to express preferences for the desired relative size of each flow decision.

Commuting flows, however, change over time by for example the opening and closing of workplaces, the development of residential areas or infrastructural changes. The clustering of areas into functional labour markets needs to be reviewed to reflect these changes in commuting patterns every time period.

Acknowledgements The authors would like to thank Hans Heijke for helpful discussions.

8 References

Amedo, D., 1968, An optimization approach to the identification of a system of planning regions, *Regional Science Association*, vol. 23, pp. 25-44.

Bartel, A.P., 1979, The Migration Decision: What Role Does Job Mobility Play?, *The American Economic Review*, vol. 69, no. 5, pp. 775-786.

Baumann, J.H., M.M. Fischer and U. Schubert, 1982, A multiregional labour supply model for Austria: The effects of different regionalisations in multiregional labour market modelling, Paper presented at the 22nd European Regional Science Congress, Groningen.

Bentivogli, C. and P. Pagano, 1999, Regional Disparities and Labour Mobility: the Euro-11 versus the USA, *Labour*, vol. 13, no. 3, pp. 737-760.

Berg, G.J. van den and C. Gorter, 1997, Job Search and Commuting Time, *Journal of Business & Economic Statistics*, vol. 15, no. 2, pp. 269-281.

Casado-Diaz, J.M., 2000, Local Labour Market Areas in Spain: A Case Study, *Regional Studies*, vol. 34, pp. 843-856.

Cervero, R., 1995, Planned Communities, Self-containment and Commuting: A Cross-national Perspective, *Urban Studies*, vol. 32, pp. 1135-1161.

Cervero, R. and K-L. Wu, 1998, Sub-centring and Commuting: Evidence from the San Francisco Bay Area, 1980-90, *Urban Studies*, vol. 35, pp. 1059-1076.

Coombes, M.G., Green, A.E. and S. Openshaw, 1986, An efficient algorithm to generate official statistical reporting areas: the case of the 1984 Travel-to-work areas revision in Britain, *Journal of Operational Research Society*, vol. 37, pp. 943-53.

Laan, L. van der and R. Schalke, 2001, Reality versus Policy: The Delineation and Testing of Local Labour Market and Spatial Policy Areas, *European Planning Studies*, vol. 9, pp. 201-221.

Ledent, 1982, Long-range regional population forecasting, *Papers of the regional science association*.

Isserman, A., C. Taylor, S. Gerling and S. Uwe, 1986, Regional labor market analysis, *Handbook of Regional and Urban Economics*, vol. 1, ed. P. Nijkamp.

Jackman, R. and Savouri, S., 1992, Regional migration versus regional commuting: the identification of housing and employment flows, *Scottish Journal of Political Economy*, vol. 39, no. 3, pp. 272-287.

OECD, 2002, *Redefining territories: The functional regions*, OECD Publications, Paris.

Rouwendal, J. and P. Rietveld, 1994, Changes in Commuting Distances of Dutch Households, *Urban Studies*, vol. 31, pp. 1545-1557.

Renkow, M. and D. Hoover, 2000, Commuting, migration, and ruralurban population dynamics, *Journal of Regional Science*, vol. 40, no. 2, oo. 261-287.

Schubert, 1982, The development of multiregional economic models in Western Europe, *Multiregional economic modeling: practice ans prospect*.

Schwanen, T., M. Dijst, 2002, Travel-time ratios for visits to the workplace: the relationship between commuting time and work duration, *Transportation Research Part A*, vol. 36, pp. 573-592.

Snijders, T.A.B. and R.J. Bosker, 1999, *Multilevel analysis: an introduc*tion to basic and advanced multilevel modelling. Sage, London.

Starrett, B., 1978, Market Allocations of Location Choice in a Model with Free Mobility, *Journal of economic theory* 17, pp. 21-37.

Wales, T.J., 1978, Labour supply and commuting time, an empirical study, *Journal of Econometrics 8*, pp. 215-226.