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## **Alternative Territorial Breakdowns of Statistics for Supporting Rural Policies**

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***Paper prepared for presentation at the XI<sup>th</sup> EAAE Congress  
(European Association of Agricultural Economists),  
'The Future of Rural Europe in the Global Agri-Food System',  
Copenhagen, Denmark, August 24-27, 2005***

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# Alternative territorial breakdowns of statistics for supporting rural policies

## Abstract

In order to support rural policy making with appropriate information, alternative territorial breakdowns of statistics are necessary. This paper shows how the widely used criterion of 150 inhabitants per km<sup>2</sup> can be fine tuned to better account for local specific conditions, in particular high population densities. Alternative population density thresholds are confronted with local perceptions of rurality, aggregated in a rurality index. The method is illustrated for two regions that differ in urbanisation level. The rurality index not only increases the discriminatory power, but also helps to find a less erroneous and more robust proxy for international comparable breakdowns of statistics.

Keywords: rural development, rurality index, OECD, central limit theorem

JEL classification: C10 ; O18 ; R12

## 1. Introduction

Rural development gains importance at various policy-making and decision levels. At global level, rural development is still considered as a mechanism to stop poverty, and, on the other hand, rural poverty may be a driving factor of environmental degradation. For a historical review of the poverty-environment debate, see Swinton (2004) and for an overview of the link between rural development and poverty reduction, see Mikos (2002). At EU level, rural development not only became the second pillar of CAP, but also social and economic coherence policies have important territorial differentiations in outcomes. At local level, the complement nature of urban and rural areas regains attention, in particular in highly populated areas, where rural areas demand extra protection against sub-urbanisation forces.

Rural policy support not only needs new types of indicators (e.g. mobility, access to social services, ...), but, even more important, it becomes necessary to use alternative breakdowns of existing statistics. Currently, the NUTS territorial breakdown of statistics is widely used to furnish policy makers or analysts with appropriate and harmonised information. NUTS stands for 'Nomenclature of territorial units for statistics' (Official Journal of the European Union, 2003) and is established in order to harmonize data collection, compilation and dissemination across the European Union. It is a hierarchical classification of territorial units, containing at least three levels. For example, Belgium (which is the member state level or the NUTS 0 level) has three NUTS: 1 level territorial units (the regions Flanders, Wallonia and Brussels) 12 NUTS 2 levels units and 45 NUTS 3 level units. In Belgium, there is a further hierarchical level of detail, in which the administrative municipalities (n=589) are considered as the NUTS4 level.

However, besides this usual system, which predominantly structures the data according to existing administrative units, alternative or complementary breakdowns are necessary to allow the analysis of differences between rural and urban development. The availability of statistics at a very detailed level (e.g. the NUTS 4 level in Belgium) already facilitates the re-classification of territorial units that allows a rural-urban breakdown of statistics. Then the question emerges what kind of re-classification criterion to use for maximally coping with the real differentiation in rural and urban areas. Such a criterion should be simple, easy to calculate and applicable for general purposes. The OECD criterion, based on population density with an operational threshold of 150 inhabitants per km<sup>2</sup>, already satisfies to a great extent (OECD, 1994). The arbitrarily nature of the threshold is, however, to be seen as a main disadvantage.

The objective of this paper is to develop a method for detecting a more appropriate population density threshold for delimitating rural and urban areas in densely populated regions. Such a method should maintain the simple international applicability of the usual OECD criterion, but enrich the concept with local perceptions on rural areas. The concept is based on a misallocation analysis, this is an analysis of the relative share of rural and urban area (classified as such through the local perception) that becomes, with the simplifying criterion, wrongly assigned as urban and rural area, respectively. The optimal threshold is then the one that results in a minimum misallocation. Because the allocation error remains high, even at optimal thresholds, the concept of rurality indexing is introduced.

The paper is organised as follows. First, an overview is given of general requirements for rural-urban delimitations, some aspects of use and misuse and the various dimensions of the rural feature (section 2). Next, in section 3, the basic idea of the misallocation analysis is explained. The method has been applied for two different regions in Belgium (section 4). At this stage, already usable results are available, but still unsatisfactory, in particular in the high populated region. In order to further decrease misallocation, a more aggregative view, operationalised with a rurality index is proposed in section 5. In section 6, the rurality index is used instead of separate perceptions, in what we call the adjusted misallocation analysis. Section 7 concludes.

## 2. Rural-urban delimitation

Categorising land into a rural and urban component has, for a long time, been self-evident. Indeed, the distinction between town and countryside had for a long time been facilitated through the vestige reality of their frontier. There is an evolution towards less evidence. Factors such as urban sprawl, mobility and telecommunication decrease both the physical and the mental distinction between rural and urban economies. On the contrary, the importance for continuing a rural-urban differentiation increases: a number of policies are based on such a differentiation. In this context, rural-urban delimitations became a necessary exercise, because they provide a territorial basis for differentiating planning instruments. In highly sub-urbanised areas, for example, spatial planning mostly aims at protecting or even restoring open space. Territorial breakdowns may thus become sensible matter, in particular when huge stimulating instruments, such as investment aid and subsidies, intervene.

Because in an international context many types of rural areas are possible, the first problem is to define rurality in a more or less neutral way. While looking for delimitation criteria, one should keep in mind that a difference exists between delimitation criteria and descriptive criteria. Once the rural area is defined, its performances can be measured with descriptive indicators (OECD, 1994, 24). An additional problem, linked to the definition of the rural area, is its changing nature in time and space. This creates difficulties for comparison at an international level and for the clear and stable identification of what should be considered as rural (Cannarella, 2003, 45). The variety of rural area definitions reflects the multitude of approaches to deal with the rural complexity, like geomorphologic, sociological, agronomic, demographic, landscape ecological and cultural-historical viewpoints. Only by looking at the countryside from these different angles, a more complete understanding can be gained (Lhermitte, 1993, 24). According to Peeters (1999, 239) it is even an illusion to suppose that a single and clear definition exists. Montresa (2001, 10) for instance thinks of an area as rural if the following three conditions are met. The agricultural employment exceeds the national average, while the productive differentiation and the demographic density are lower than the national average. Schmitt (2000) noticed that the rural area is often seen as the opposite of the urban area and as a homogeneous area with little differences inside of it. This also means that besides rural and urban no areas would exist. With his "*zonage en aires urbaines et son complement rural*", Schmitt, however, describes a continuum of urban-rural areas on the basis of variables, such as available working places, commuting level.

The European Union distinguishes following types of rural areas:

- integrated rural areas, with a growing population, an employment basis in the secondary and tertiary sectors, but with farming still being a key use of land;
- intermediate rural areas, relatively distant from urban centres, with a varying mix of primary and secondary sectors;
- remote rural areas, with the lowest population densities, often the lowest incomes, and an older population which depends heavily on agricultural employment (EC, 1997, 12).

Because of the diversity of these rural areas, the main principles of the European rural development policy are decentralisation of responsibilities and flexibility. This makes it possible for each member state to select the most appropriate measures for its relevant geographical areas according to their own needs, priorities and capacities (Van Depoele, 1999, 237). This approach makes it possible to adapt the rural development policy itself to the local needs of each rural area on the basis of the problems it faces and has to deal with. The realisation of such a territorial based development policy supposes the existence of a policy framework that is based on a profound analysis of the local situation. Only in this way it is possible to have a correct understanding of how the rural area interacts with its regional-economic environment (Peeters, 1999, 239). Before such an understanding can be reached a territorial delimitation of the rural area is, however, necessary.

Although the notion rural is universally used and that it describes parts of a country that are characterised by a relatively low population number or density or by certain socio-economic features, there is no universal accepted definition of the rural area. Moreover, national definitions are continuously under debate and are adjusted from time to time, reflecting for example changes in socio-economic and administrative structures or in mobility and communications (OECD, 1994, 19). As a result, it is not that easy to determine which indicators should be used to define the rural area. Therefore one uses often some easy to find indicators. The OECD developed appropriate internationally comparable indicators to give countries the capacity to monitor rural economies and to have a consistent information basis for systematic general description as well as for cross-national analysis. The population density was used as a neutral indicator because it does not refer to any specific perception of what rural problems and potentials are. The arbitrary judgement to use 150 inhabitants per square kilometre as the threshold was based on a series of considerations, such as:

- population density thresholds used by member countries and other international organisations;
- the national distribution of local community population and area over a gradient of different population density classes;
- the wide range of settlement patterns across the OECD.

Population density has advantages: its availability for different types of geographical units, its universality, its neutralisation of the size effect in comparisons and its political neutrality.

Applying the OECD threshold of 150 inhabitants per square kilometre on Belgium gives a picture as shown in figure 1. The map is drawn at the NUTS4 level. In order to allow the reader to get familiar with the two regions, they are graphically took apart (confront with figure 2). The non coloured area is then considered as rural area. With this perception, the northern region Flanders, hardly has rural areas, but also in the south, Wallonia, a conglomerate of towns and urban sprawl appears. This does not cope with local perceptions. Figure 2 shows one of these local perceptions, the “city district” perception, in which central town and their sub-urban sphere of influence give rise to an urban conglomerate.

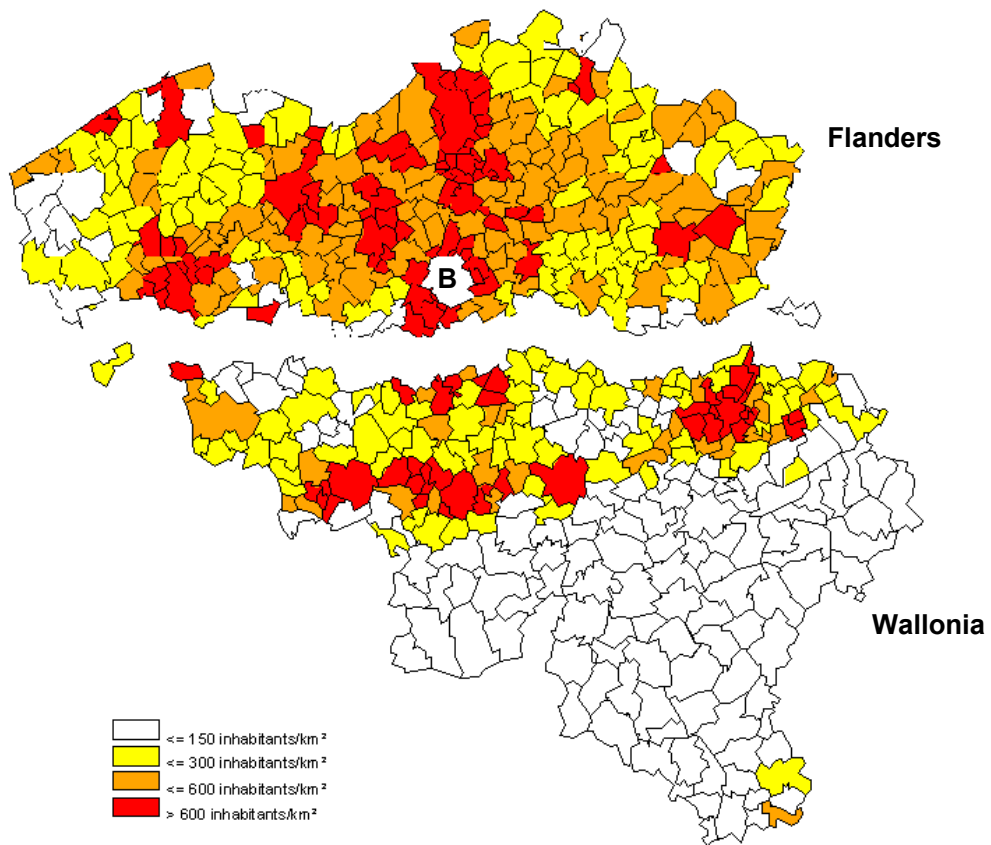


Figure 1. Population density of Flanders (the north) en Wallonia (the south)

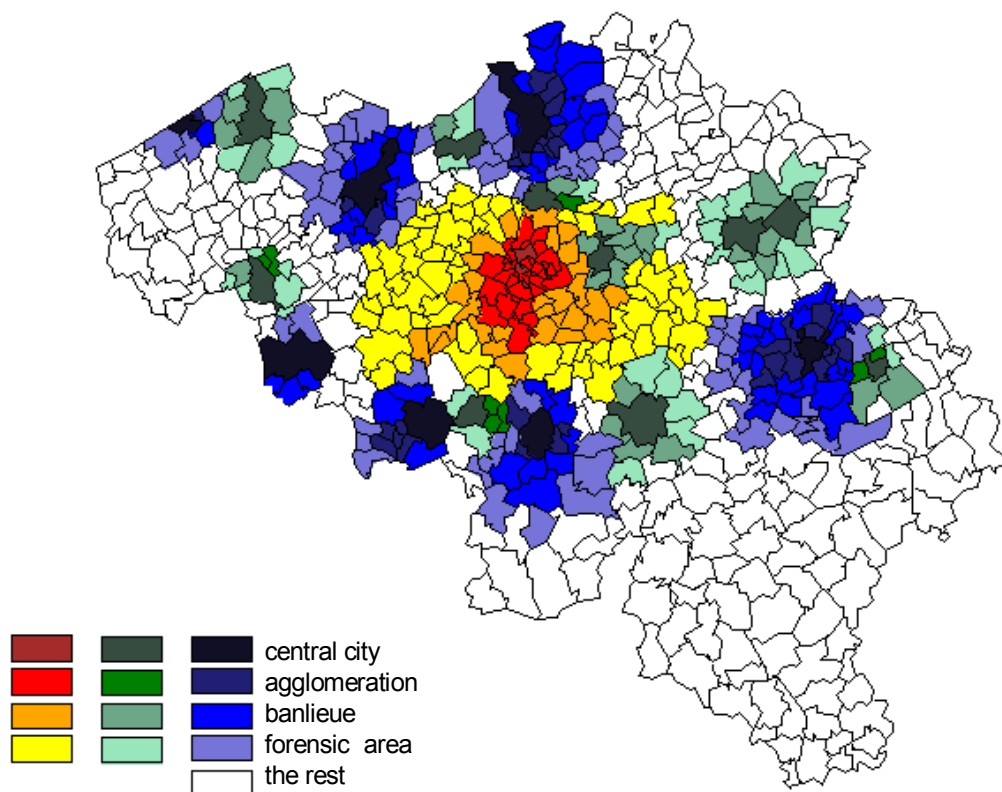


Figure 2. City Districts of Belgium

### 3. Misallocation analysis: principles and elaboration

The principle of the misallocation analysis is as follows. Two urban-rural delimitations are compared. The first one (hereafter called the “a priori”) is the local perception, or one of the local perceptions, of the territorial breakdown in rural and urban areas. This one is considered as the “true” version or the reference. The second classification (hereafter called the “proxy”) is based on a simplifying criterion. Figure 1 and figure 2 may serve here as an example of a “proxy” and an “a priori”, respectively.

Apart from the exceptional case that the “a priori” and the “proxy” coincide, or that they yield exactly the same outcomes, there will always be some territorial units that are differently allocated. “Real” urban municipalities (in the example, and also in the remainder of the research, the NUTS 4 level territorial units are used) wrongly assigned with the “proxy” as rural units are considered as type 1 errors. Inversely, rural “a priori’s” allocated in the urban group with the “proxy” gives rise to a type 2 error. The principle is schematically represented in table 1.

Table 1. Schematic representation of the misallocation analysis method

<i>“a priori” delimitation</i>	Rural	Urban
<i>“proxy” criterion</i>	(max n°)	(max n°)
Rural		Type 1 error
Urban	Type 2 error	

The two errors are expressed to the maximum number, “a priori” counted in each group in each group. These relative error scores (with values between 0 and 1) are then added up in the combined error score. The final selection of a more appropriate population density threshold is then steered by searching for a minimum combined allocation error (figure 3).

At extreme levels of threshold, all municipalities will be misallocated. At the lower extreme, all municipalities are considered as “rural”, and, as a consequence, all urban municipalities are misallocated, thus relative type 1 error obtains the values 1. No rural “a priori” is misallocated, so type 2 error remains zero. At the higher extreme, the inverse happens and type 2 error becomes 1 whereas type 1 error falls to zero. The combined error score varies from one to one, reaching a minimum in between. For example, when the city district delimitation in Flanders is used as the “a priori”, the population density proxy yields a minimum allocation error at the threshold of 475 inhabitants per km<sup>2</sup>.

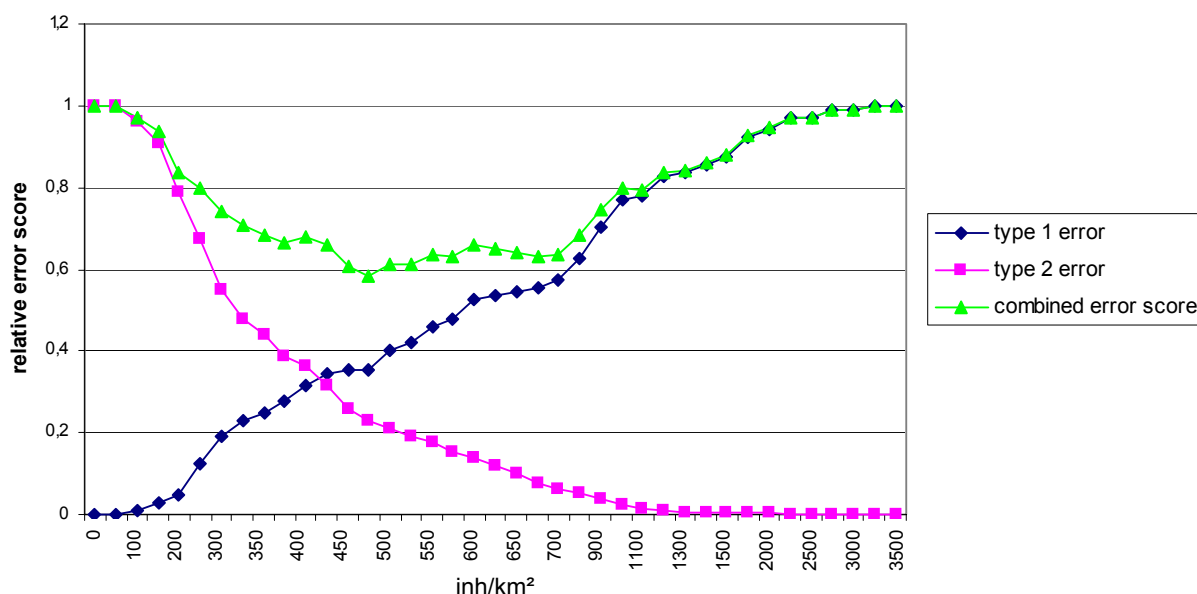


Figure 3. Relative error scores with the City District delimitation in Flanders as the “a priori” against the population density criterion as the “proxy”.

Variants to the method are possible. Instead of measuring the misallocation of municipalities, one could also consider the misallocation of population or space. We also have chosen for the relative share of misallocations within each group of urban and rural municipalities, instead of total misallocations to total municipalities. The reason for this is that we consider the urban and the rural group of equal value in a delimitation exercise that finally aims to be used as a territorial breakdown of statistics.

#### 4. Application to two Belgian regions

The method is applied on two Belgian regions. Politically and administratively, Belgium has three regions with outrageous autonomy. One of them, the Brussels-Capital, is not relevant for the study. On figure 1, Brussels-Capital is indicated with a “B”.

The other two regions have a different geographical structure with respect to possible rural-urban delimitations. Summarizing statistics are given in table 2.

Table 2. Summarizing statistics of Belgium and its three NUTS1 level regions, 2004

	Inhabitants (millions)	Surface (km <sup>2</sup> )	Population density Inhab/km <sup>2</sup>	Number of municipalities	Number of municipalities >100.000 inhab	Number of municipalities >50.000 inhab	Number of
Belgium	10,396,421	30,528	341	589	8	27	
Flanders	6,016,024	13,522	445	308	3	12	
Brussels	999,899	161	6,196	19	2	6	
Wallonia	3,380,498	16,844	201	262	3	9	

Source: National Institute of Statistics



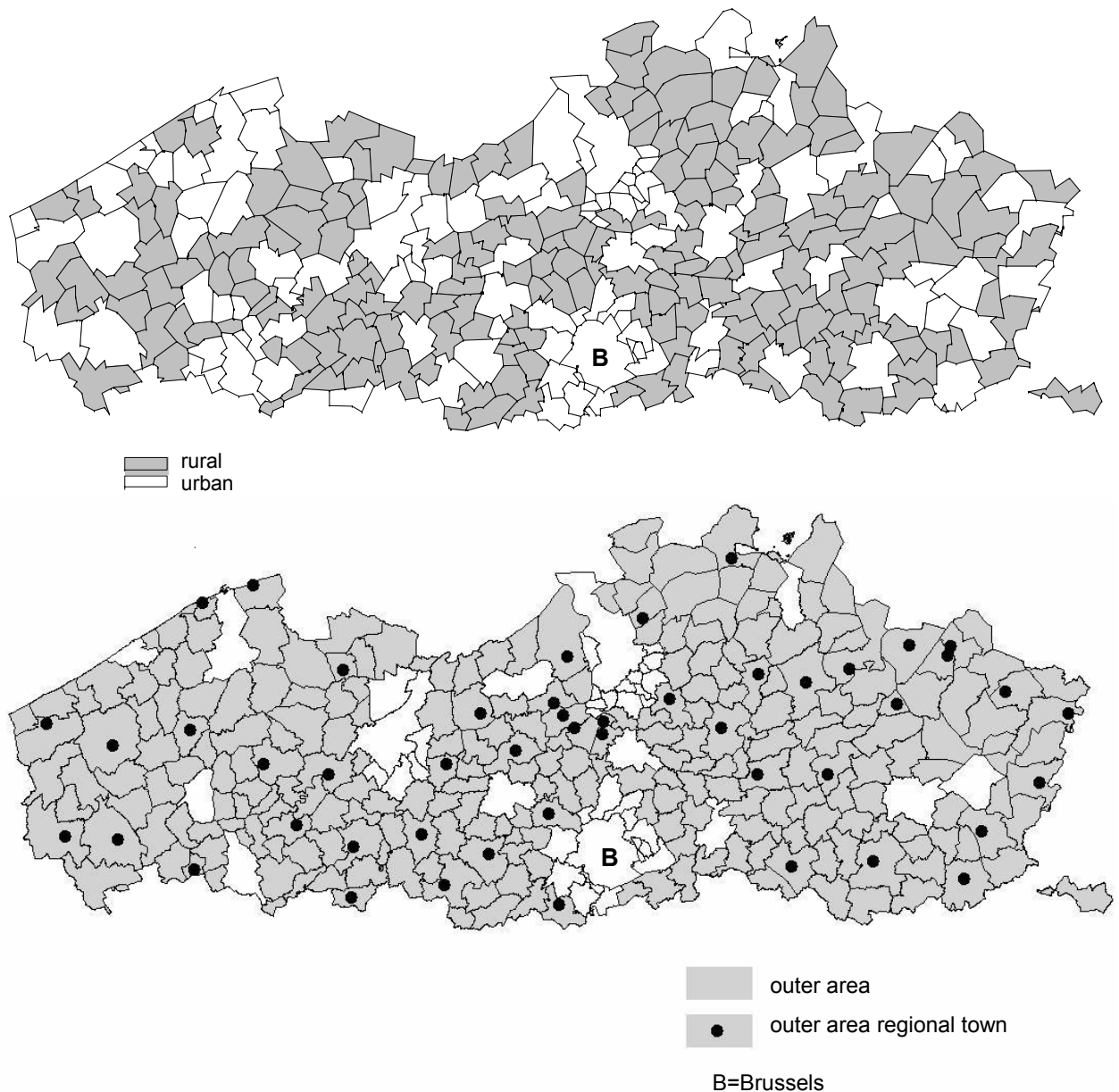


Figure 4. Two perceptions of outer area, based on the Flemish Regional spatial planning documents:  
a. based on a threshold of open space (Source Vervloet D., 2003)  
b. based on a farmers' union perception (Source: Karel Lhermitte, Boerenbond)

The results of the misallocation analysis are given in figure 5 and 6 for Flanders and Wallonia, respectively. One of the "a priori", used is the OECD criterion with threshold 150 inhabitants per km<sup>2</sup>. Misallocation is zero when the proxy coincides with the "a priori", this is at 150 inhabitants per km<sup>2</sup> level. Further raising of the threshold rapidly increases misallocation.

For Flanders, three "a priori" delimitations are used: first, the already mentioned City Districts delimitation (figure 2), which is based on an urban centric approach, secondly, an open-space based delimitation derived from a land use study (Everaet, 1992) and thirdly, an outer-area based delimitation based on the spatial planning document. The open space and outer area are very similar concepts: the first has a more physical and descriptive nature (the actual non-built land use), whereas the second stresses on the combination of open space and sparse population. Outer area comprises built area and even, such as the perception gives in figure 4b, small regional towns. Outer area does not only reflect actual land use (of which predominantly open space), but also normative objectives to safeguard the area from further urban sprawl.

The results of the misallocation analysis clearly show that the local perceptions of rurality are associated with higher population density thresholds than the one used in the OECD delimitation: 475 inhabitants/km<sup>2</sup> and 500 inhabitants/km<sup>2</sup> for the City Districts and the Everaet classification, respectively. The normative spatial planning based delimitation is at best approximated with a population density threshold of about 600 inhabitants/km<sup>2</sup>. The combined error score remains high even at the optimal thresholds: the relative combined error score, varies at optimum from 0,4 to 0,6 for the Everaet and the City District delimitation, respectively.

For Wallonia, the situation is different. There, the City District classification best matches the OECD criterion, higher or lower thresholds increase the misallocation. On the contrary, the open space perception of rural-urban delimitation is at best approximated with a proxy of 600 inhabitants/km<sup>2</sup>, which is slightly higher than in Flanders. The reason behind this, is the higher population density with respect to built area: for a similar open space perception of rurality, population density is higher in Wallonia.

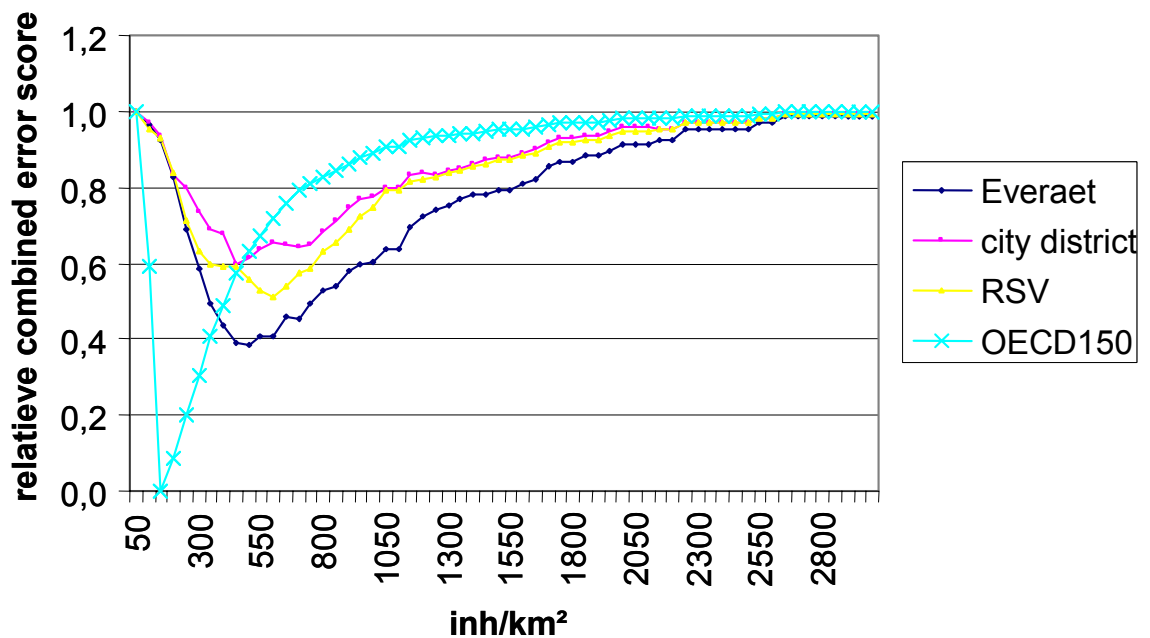


Figure 5. Results of the misallocation analysis of Flemish municipalities

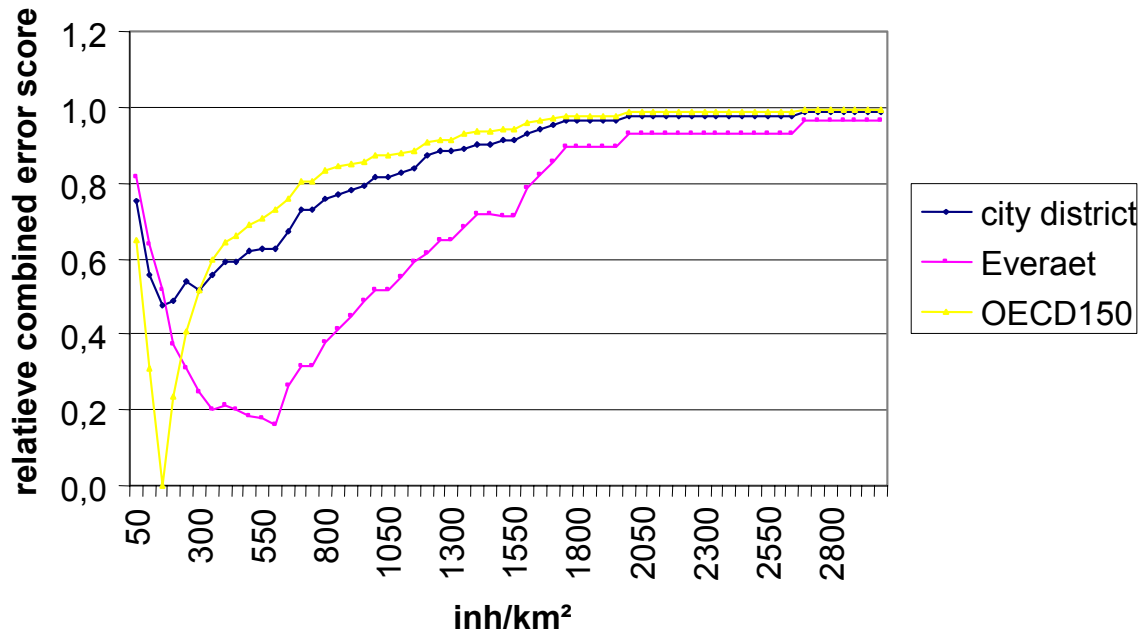


Figure 6. Results of the misallocation analysis of Walloon municipalities

## 5. Rurality index

The “a priori” classification in itself may comprise misallocations, simply because almost rural (or almost urban) municipalities are confined to a narrowing binary variable. In particular, in Flanders, many municipalities are in between a mere rural or mere urban state. Therefore, the binary variable “yes-no” or “rural-urban” will again be made continuous through recurrence to the original underlying factor. For example, for the OECD delimitation, the underlying variable is population density, which is a non-discrete variable. For the open space delimitation, the ratio of agricultural and nature occupation over total area is as well non-discrete. In order to account for various aspects of the complex rurality concept, these recurrent variables will then be combined in one score, which will be called hereafter the rurality index.

In order to allow for a non-weighted summing up of continuous variables, they are transferred to a 0-100 scale. In some cases, with non normal distribution, a more complicated transformation takes place. For example, the population density, which despite its simplicity is not always to be interpreted as a usual interval variable. The difference between 100 and 150 inhabitants per km<sup>2</sup> is enormous in rurality perception and anyhow much larger than the difference between 550 and 600 inhabitants per km<sup>2</sup>. It’s not difficult to understand that a similar absolute difference between 3050 and 3100 is negligible. A transformation of the original data should account for this non-normality in data and in their interpretation. The transformation has been done with a log-inverse function and an exponential function (see Johnston, 1985), with a parameter choice that finally yields a transformation values of 50 for the average population. The Shapiro-Wilk W statistic is used in order to test normality.

Besides the transformed population density variable, other criteria are used:

- the open space (original variable, expressed as a percentage over total land area);
- city district delimitation (the municipalities not belonging to the city districts receive a full “rural” quote, the inner city nucleus a full “urban” quote and the other finally fall in between);
- delimitation of urban areas in the Flemish spatial planning document (“stedelijke” en “regionaalstedelijke gebieden”). With respect the urban delimitation, this normative approach seems to be much more restrictive than the city district is.

- opponent to the city district classification but also built on the normative planning documents for Flanders is the already mentioned “Landelijke Gilden” delimitation (figure 4b). Here, still more area is considered as rural;
- a rural centric approach, based on own calculations, in which the population density of adjacent municipalities are aggregated.

The distribution of the Flemish municipalities according to the resulting rurality index is given in figure 7. Although Flanders, with its high population density has lot of municipalities that are difficult to classify as mere urban or mere rural, the rurality index distribution show three more or less distinguishable sub-populations distribution. Due to the central limit theorem, results of such an aggregation procedure will tend to reach a normal distribution. The central limit theorem stipulates that the distribution of an average tends to be normal, even when the distribution from which the average is computed is decidedly non-normal (Weinert and Boik, 1995). In fact, what is happening is that, due to the explicit differentiation of the underlying variables into rural and urban, two distinct sub-populations appear. More, within the rural municipalities there is a third sub-population, with an overlapping distribution, detectable.

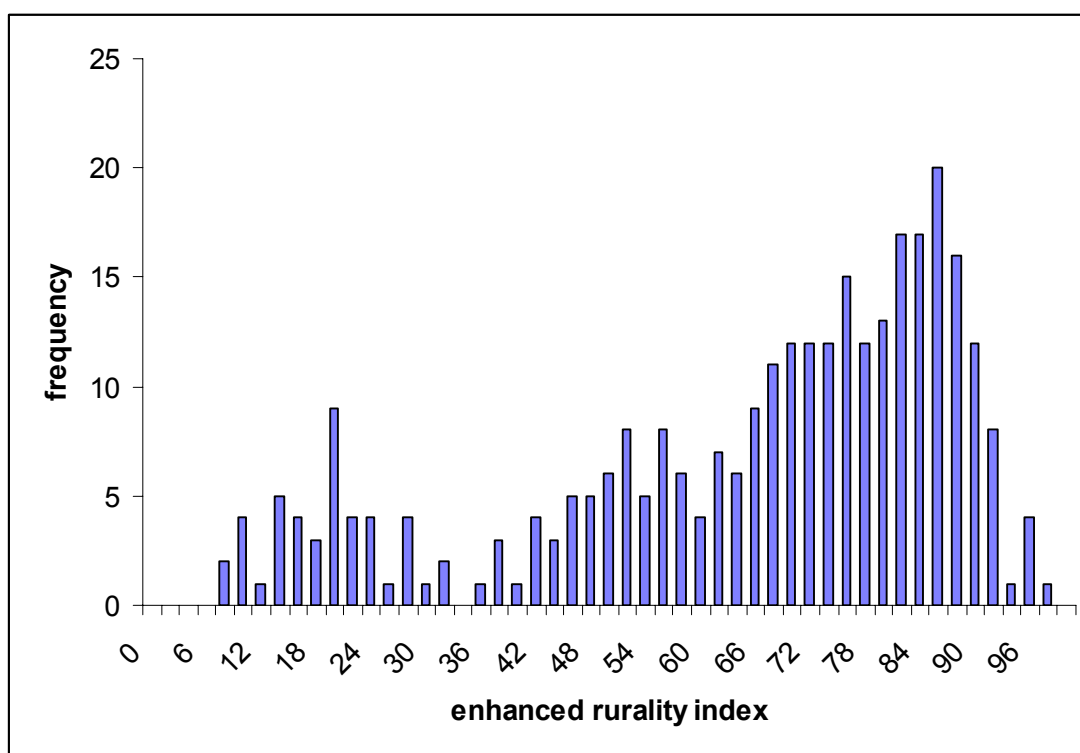


Figure 7. Distribution of Flemish municipalities according to their enhanced rurality index.

## 6. Adjusted misallocation analysis

The rurality index is used for a continuous misallocation analysis. Instead of looking to the binary misallocation of municipalities, the amount of rurality weighted with the total land area of the municipality is used to quantify misallocation. Moreover, the concept of “exclusive” rurality is used, this means that only the rurality above a threshold of 50% is taken into account. Alternatively, exclusive rurality about the level of 33.3% and 66.7 % is taken into account (figure 8).

Misallocation reaches a minimum at a threshold of almost 600 inhabitants per km<sup>2</sup>. With respect to the misallocation error reported in section 4, the combined relative error falls drastically, to about 5%. This indicates that rurality indexing is a useful concept and that the simple population

density threshold helps to delimitate rurality from urbanity, even in the fuzzy classification situation of a highly sub urbanised area.

The question arises whether the exclusivity threshold of 50% rurality is the best choice. When using the threshold of 33.3% rurality (which also is the rurality value in between the two subpopulations found in figure 7), misallocation error further decreases. Now, the simple population density value at the minimum error shifts further towards 600 inhabitants per km<sup>2</sup> (figure 28). On the contrary, only taking the rurality above 66.7 into account doesn't seem a good idea: misallocation error becomes more than 20%.

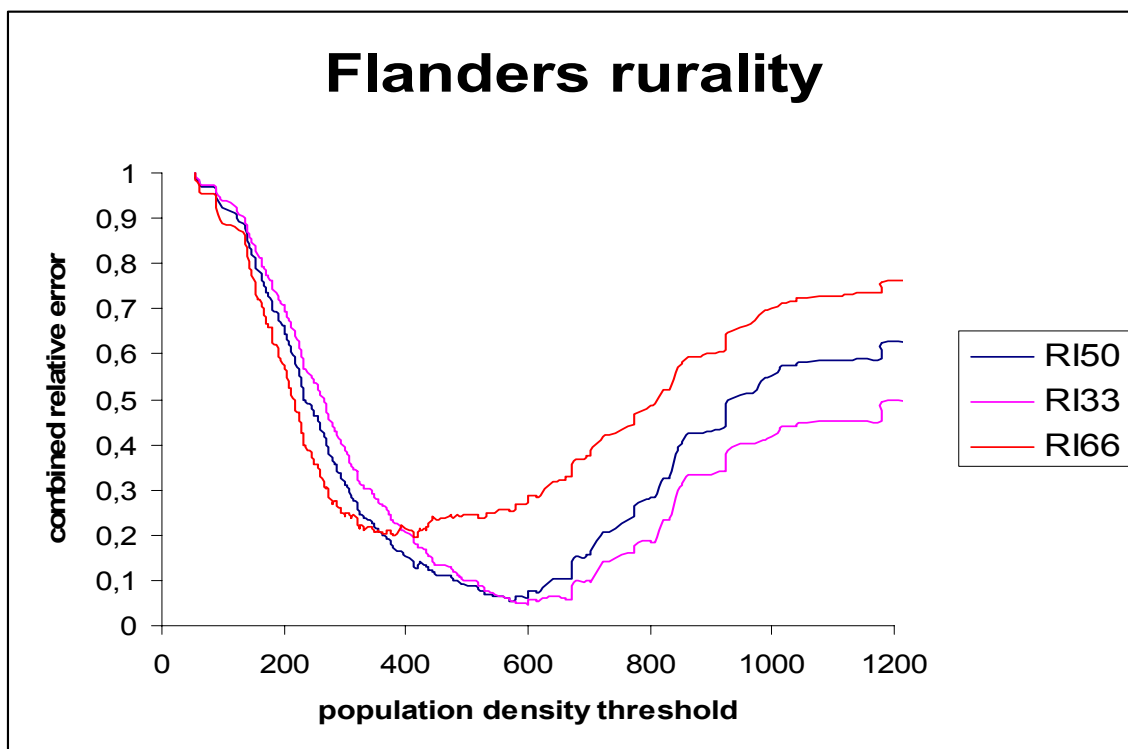


Figure 8. Misallocation analysis based on the enhanced rurality index and various levels of exclusive rurality. RI50: only rurality above 50 % is taken into account, RI33: only rurality above 33.33 % is taken into account, RI66 only rurality above 66.67% is taken into account.

## 7. Conclusions

This paper shows a method that is easy to develop and to transpose to other countries. The ease of development is due to a rather simple principle. Moreover, this principle can be programmed and run with conventional software (our analysis is worked out both in excel and SAS). Transposition of the method supposes that local categorisations of rural areas exist. But even the case that “a priori” perceptions of rural entities are scarce, conventional statistics can help. Statistics on population and land use can be transformed and recombined to components of rurality index that allow to cover a more or less complete range of rurality dimensions such as populations density, share of open space, proximity or rural centrism. In the case of Flanders, with a large set of municipalities that could hardly be categorised in rural or urban area, the rurality index led to nicely distinguishable subsets of municipalities. This effect of increased distinction is seen as a result of the central limit theorem.

The rurality index concept not only enriches the discriminatory power, but also allows for a closer match with the proxy indicator. Contrary to the one-dimension delimitations, the multidimensional rurality definitions can easily be approximated by the simple population density criterion. Moreover, the combination of the enriched rurality concept with alternative thresholds of the proxies leads to extremely low misallocation of the territorial units.

Conclusions with respect to the OECD criterion are clear: the population density remains a worthy proxy indicator, only the threshold values have to be adapted to local realities. Appropriate thresholds can easily be detected with a scientific sound method instead of fixing rather arbitrary values. This approach to identify the threshold of population density that minimizes misallocation of rural/urban area with reference to an “a priori” local perception of rural will then lead to different thresholds for different countries. The fact that the threshold differs across countries should, however, not be seen as a factor that diminish international comparisons, on the contrary even: a county-specific threshold will allow comparing rural with rural areas instead of zones with lower 150 inhabitants per km<sup>2</sup>.

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