INDICATORS FOR TERRITORIAL POLICIES: CLOSING "GAPS OF UNDERSTANDING" IN TERRITORIAL COMPARISONS

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Introduction

Urban development planning after World War II had revived the discussion on the provision of the necessary basic data on small scale structures and developments among German municipal statisticians. This coincided with the introduction of automated data processing in the administration and the need to automate evaluations of the existing registers, of census data and surveys for sub-city units. In order to come as close as possible to the territorial planning units the Union of German Municipal Statisticians developed the hierarchical system of sub-city units, the so-called "Kleinräumige Gliederung", based on the postal addresses, grouping them by building blocks and by street names within the block ("Blockseiten") in such a way that they could be put together like a mosaic to form any requested planning area.

Comparability among the building blocks was not a relevant aspect until these territorial elements were used also for administrative purposes, especially for municipal, state and federal elections. These units had to be of similar size, i.e. for elections of a similar number of people entitled to vote. Research institutes liked to use these subdivisions because of their detailed structures and their equal size.

Statistical analyses of election results were one reason, why territorial comparability became a more relevant aspect also in urban research and statistics. Especially when it came to selecting areas requiring special political attention and making statistical data on these areas publicly available, confidentiality of small numbers had to be taken into account and the small units had to be grouped to form bigger aggregates. But problem areas should not disappear in the larger aggregates. It was necessary, therefore, to try and aggregate smaller units with similar characteristics, thus avoiding "adding up apples and pears". Sub-city typologies became an important topic of discussion. As different questions require different answers, it became clear that there was no typology that would serve all purposes equally well. The Federal Institute for Research on Building, Urban Affairs and Spatial Development BBSR chose a typology for their collection of sub-city data IRB (inner-city regional monitoring) that took "location" as the dominant criterion comparing the stock and change in the types of location (city centre, city rim, suburbs) rather than the individual districts. Here, the aggregates of sub-city districts per type are the objects of observation. If, however, the focus is on the individual sub-city districts and their distribution, the question of comparability arises, as in the two other data collections that will be included in the following analysis.

The MAUP

It is well known in geographical literature that results of regional comparisons do not depend only on the values of the content data but also on the delimitation of the territorial units. The values under consideration are aggregate values of the territorial units and it is obvious that the aggregates change, if the boundaries change. Openshaw analyses this problem in his paper on "The Modifiable Areal Unit Problem"[1]

"The MAUP is in reality composed of two separate but closely related problems. The first of these is the well-known scale problem which is the variation in results that can often be obtained when data for one set of areal units are progressively aggregated into fewer and larger units for analysis. ... there is also the problem of alternative combinations of areal units at equal or similar scales. Any variation in results due to the use of alternative units of analysis when the number of units is held constant is termed the aggregation problem."

The ESPON consortium analysed the MAUP in its effect on geographical comparisons[2] confirming that "the results of cartography, statistical analysis, and any spatial modelling are dependent on the definition of the studied units." After a thorough study of the state of the art they proceeded, "using case studies emanating from the different partners to support the reflexion on some specific ideas and hypotheses. This approach seemed fruitful as the MAUP has given rise to a large literature, as well classical as the question arised early among geographers and statisticians, as very contemporary as the development of GIS, the multiplication of databases combined with the reinforcement of confidentiality constraints, have given rise to a renewed interest that a change of zoning will lead to a change in the results, as well visual as statistical."

The trivial fact that MAUP exists and that it cannot be excluded by mathematical algorithms has made many analysts to simply ignore it. But this is not an acceptable solution, especially if the consequences of actions based on wrong indicators are taken into account. If public funds are directed to those areas that need support most urgently then the values resulting from comparative territorial analyses must be comparable if measured against each other.

German collections of municipal sub-city data as examples

In a European project on merging geo-references with statistical (content) data, elaborated by the German Urban Audit association, one work-package was to develop proposals for the collection of comparable sub-city data. Could one of the existing data collections be taken as prototype into which the other collections could be integrated or was it necessary to first develop standards for a new data collection to comply with the requirements of researchers and planners regarding

  - comparability,
  - selectivity
  - flexibility and
  - data availability (with regard also to the requirements of confidentiality).

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[1] Openshaw, Stan, The Modifiable Areal Unit Problem, in: Concepts and Techniques in Modern Geography No. 38, Geobooks Norwich (1984)

[2] ESPON: European Spatial Planning Obervation Network, www.espon.eu. ESPON 3.4.3, 2006: The modifiable areas unit problem. ESPON Scientific Support Project (www.espon.eu/mmp/online/website/content/projects/261/431/index_EN.html)

As the size of the territorial units is an important criterion for all these aspects, the analysis of the existing collections focuses on the size structure of these collections:

- IRB data collection of sub-city data for BBSR,- Urban Audit collection of sub-city data for Eurostat

- KOSTAT collection of sub-city data for anybody.

In a paper based o the final report on the project, these collections have been shortly described as follows (excerpts)[3]:

Urban Audit

In accordance with the requirements of Eurostat, the units were to be of a comparable size of between 5,000 and 40,000 inhabitants, be structurally homogeneous and form contiguous areas covering the administrative area of the city. The small-scale units were determined by Eurostat in cooperation with the cities and are identified by a hierarchical SCD code. The location of the units is digitally described by the polygons of their boundaries. Whilst the Urban Audit for the city as a whole is made publicly accessible on the internet by Eurostat and the KOSIS Association Urban Audit, the SCD data and its geometric description is reserved to the internal use by the European Commission – and in Germany - to the use of the participating cities. SCD data is proportionately adjusted to the Urban Audit data for the cities as a whole. At present, Urban Audit SCD data is available for 41 cities and their 724 units for year 2011.

IRB collection to monitor inner-city spatial development

Inner-city Spatial Monitoring (IRB) of the Federal Office for Building and Regional Planning (BBSR) is based on the so-called 'second level' hierarchical sub-city division. In 2013, it comprises 2,918 units of 51 cities. The units are identified by the official administrative code of the municipalities combined with the cities own code of their territorial sub-divisions. With the support of the cities involved, these units were assigned keys designating the following structural types

- City
- City rim (city and city rim are generally summarised as 'city centre').
- Rim of the inner city
- Outskirts

Results are made available by BBSR to the cities involved. The cities have access to the general data collection after it has undergone extensive quality checks by BBSR. The institute has by contract agreed to neither publish nor distribute the data of the individual area units. The history and importance of this project has been described in more detail in a BSSR publication; that also illustrates the territorial dispersion of the participating cities in a map.[4]

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[3] KOSIS-Gemeinschaft Urban Audit: The German Urban Audit, Data, Indicators, Information, Mannheim 2015 (based on: Merging Statistics and Geographical References, funded by the European Union, final report, 2015.
[4] Gutfleisch, Ralph and Sturm, Gabriele, StadtZoom - analysis of small scale comparative city monitoring, in: Informationen zur Raumentwicklung (Information on Spatial Development), BBSR, issue 6/2013, p.475

KOSTAT

KOSTAT originates from an initiative of the KOSIS Association and the Association of German Cities and Towns (Deutscher Städtetag). It is confined to a few population data which are provided on the so-called 'third level' of the hierarchical system of small-scale municipal sub-divisions and are made available to third parties for a fee. It includes (in 2013) 9,145 small-scale units of approximately 100 cities. These units are identified by the official administrative code and a municipal three-digit code. The data collection is supplemented by street directories of the majority of participating cities, which describe the location of addresses in the corresponding territorial units. The surrounding coordinates of territorial units are also available for some of the cities.

All these projects are based on the hierarchical system of small-scale statistical sub-divisions of the municipalities following the recommendations of the Association of German Cities and Towns.[5] The cities aggregate their small-scale statistics according to the requirements of the project.

This paper focuses on the size of the spatial units as they were analysed for the European project "Merging Statistics and Geographical References". For this reason, the first part is taken from the report submitted for the Merging Project. The second part will then show how the differing size levels of the units in these projects affect their selectivity, i.e. the possibility to detect territorial particularities.

The relative size of the spatial units as a criterion for their comparability

Urban Audit aims to compare cities as a whole, whilst IRB attempts to compare, across cities, sub-city functional types (e.g. city centres or city rims) with regard to their structures and evolution. Their respective size is, in so far, a significant criterion for comparisons, as it determines if a sub-group of a certain size will show up or disappear in the average of the greater total.

It is important, therefore, that analysts and users of territorial comparisons understand the effects that significantly different sizes of the units compared can have on the presumably comparable results. For this reason, Eurostat requests the population size of the sub-city districts in the Urban Audit to lie within the range of 5,000 to 40,000 inhabitants. IRB groups the territorial units by their locational type comparing the aggregates and averages of each type rather than the values for each territorial unit in the aggregate. Thus, the problem of different sizes arises only if the results for the individual units within one type are to be compared with one another. KOSTAT, by contrast, requests very detailed territorial subdivisions to enable flexible groupings of the units to compose comparable aggregates.

Why does the population size of the units matter in territorial comparisons? When comparative indicators refer to the total population or related quantities, like the total number of households or dwellings, these denominators of the calculated fraction determine the value of the indicator (e.g. unemployment rates) just as much as the nominator of the fraction (e.g. the absolute num-

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[5] Kleinräumige Gliederung des Gemeindegebiets, Empfehlungen zur Gliederung des Gemeindegebiets und Zuordnung von Daten nach Blöcken und Blockseiten sowie Entwurf einer Empfehlung zur Ordnung des Straßen-/Hausnummernsystems als Grundlage der Lokalisierung und Zuordnung von Daten unter Einsatz der ADV, in: Reihe H, DST-Beiträge zur Statistik und Stadtforschung, Heft 6, Köln 1976.

ber of people out of work). The proportion P = M/N, where M is the number of units in the group and N signifies the number of units in the total population. The more the group under consideration is territorially clustered, the greater is the risk that relatively small groups disappear in the great mass of the total population. Areas with a small number of inhabitants increase the chance that the population of the area is mainly composed of the members of the group so that the numbers "M" and "N" are not so far apart and this territorial concentration of the group becomes more clearly visible in comparison with other areas.

Comparing unemployment in different parts of the city by their unemployment rates, the same number of 500 unemployed people in two different territorial units will lead to an unemployment rate of 10 % in an area of 5000 15-65year olds and of 5 % in a unit with 10000 15-65year olds. This is trivial, but it is very often overlooked when trying to highlight areas with a high degree of unemployment by displaying unemployment rates of the sub-city districts of different population size in a table or on a map. The calculated figures are correct but convey the wrong impression if referring to differing population sizes.

As population size matters in all population-related comparisons, the variation of these sizes is a relevant criterion for territorial subdivisions to be used in territorial comparisons. This can be shown by looking at the size structure of the units in the data collections of Urban Audit, IRB and KOSTAT.

Due to different target settings, the size of the territorial units, as measured by the number of their inhabitants, constitute different levels:

**Size structure in the data stock of Urban Audit (2011), IRB and KOSTAT (2013)**

Data collection	Number of small-scale units with data	Total population	Population of the average unit	Population of the central unit (median)	Population of the smallest unit (minimum)	Population of the largest unit (maximum)
Urban Audit	724	19,048,589	26,31	25,842	4,787	84,783
IRB	2,918	21,126,712	7,24	5,682	0	87,783
KOSTAT	9,145	26,554,999	2,90	1,579	0	87,783

KOSTAT, with the largest coverage (26.6 million inhabitants) and with more than 9,000 territorial units has the smallest units of all three data collections in terms of population, with an average of 2,900 inhabitants and half of the units with less than 1,600 inhabitants. IRB covers 21.1 million inhabitants, comprising 2,900 small-scale units with an average of 7,240 inhabitants, of which half have a population of less than 5,700 inhabitants. Urban Audit covers 19 million inhabitants, comprising only 724 units, but has the largest units with an average population of 26,000, of which half have more and less than this number of inhabitants. In KOSTAT, almost all spatial units have less than 20,000 inhabitants; for IRB the upper limit is around 35,000 and for Urban Audit more than 50,000 inhabitants. The following graphs describe the size structures and the differing sizes in the cities involved:

Overall size distribution of small-scale units in each of the projects Urban Audit, IRB and KOSTAT in %

| Urban Audit 2011 | IRB 2013 | KOSTAT 2013 |
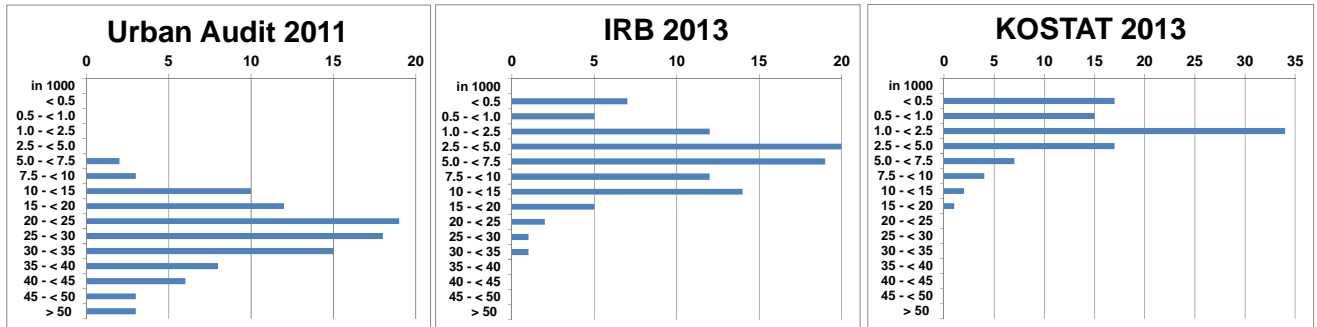
The territorial units are not nearly the same size, not between the projects, nor between the cities nor within the individual cities. And the population size per territorial unit that a city provides for one project differs from the population sizes provided for the other projects:

Median population of the cities' small-scale units (in 1000)
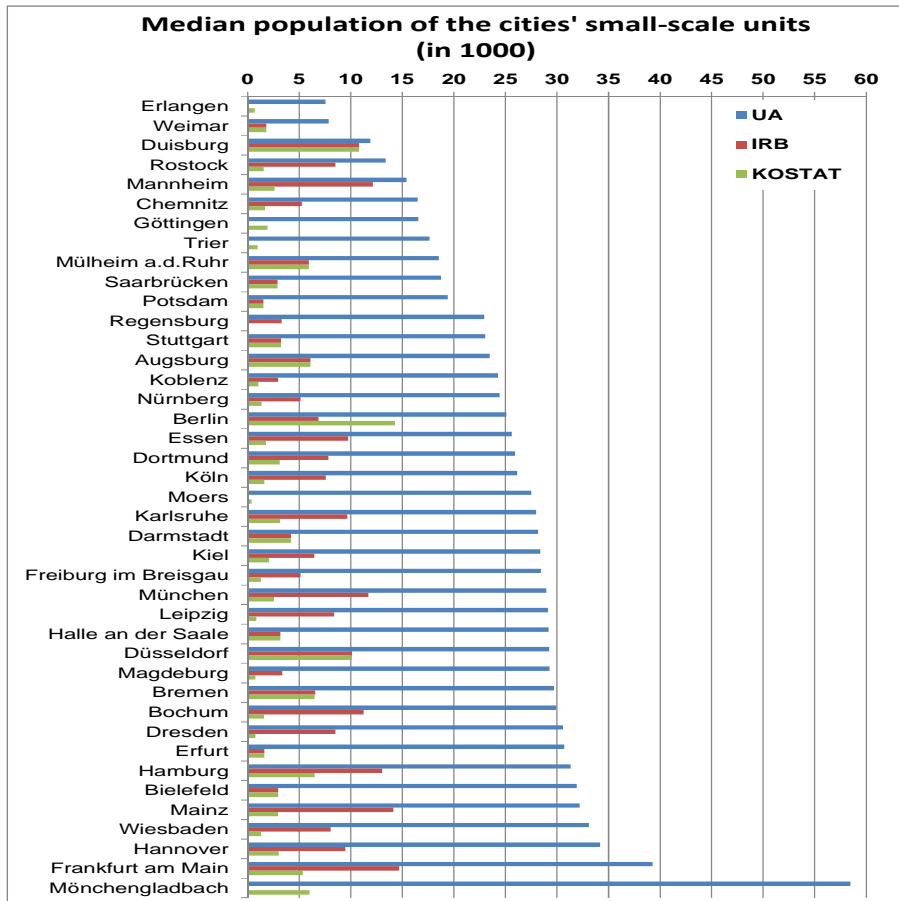
So far, the aspect of population size as a criterion for the comparability of indicators calculated for the territorial units has not been observed as a relevant factor for the delineation of the territorial units used in the existing data collections. Even for inner-city comparisons this is apparently a problem, when comparisons are based on indicators relating to population totals of different size:

Size distribution of the small-scale units of Urban Audit, IRB and KOSTAT in the cities
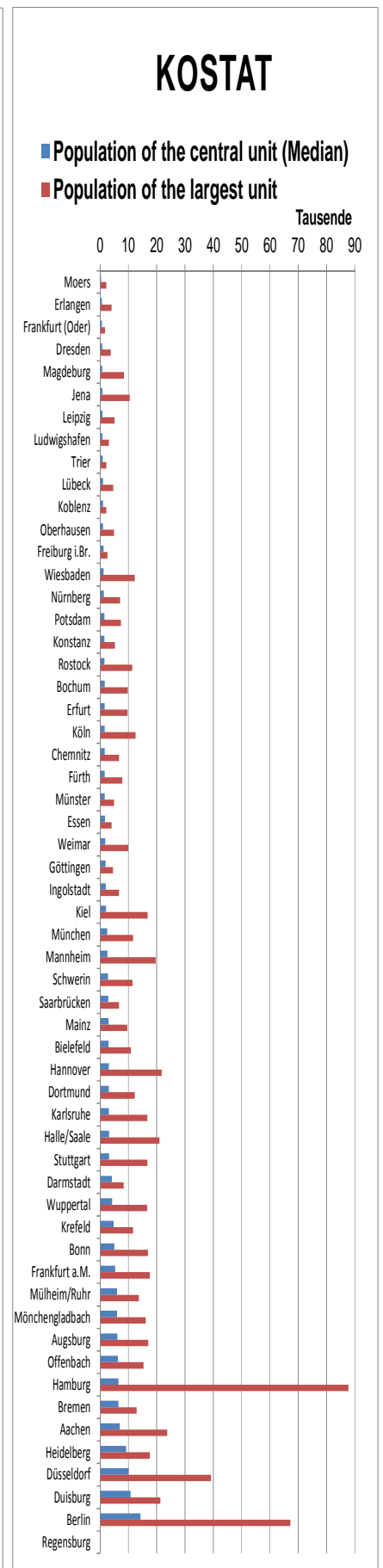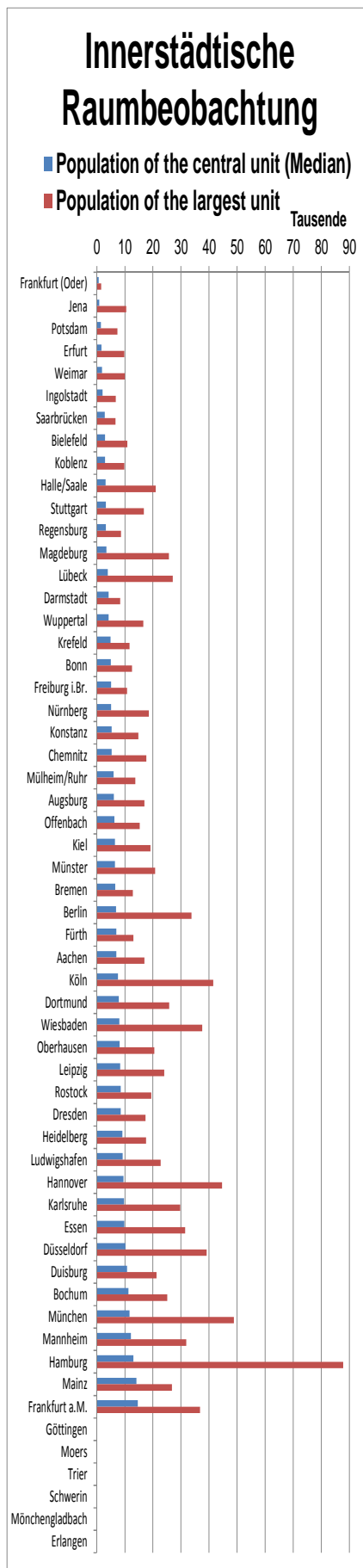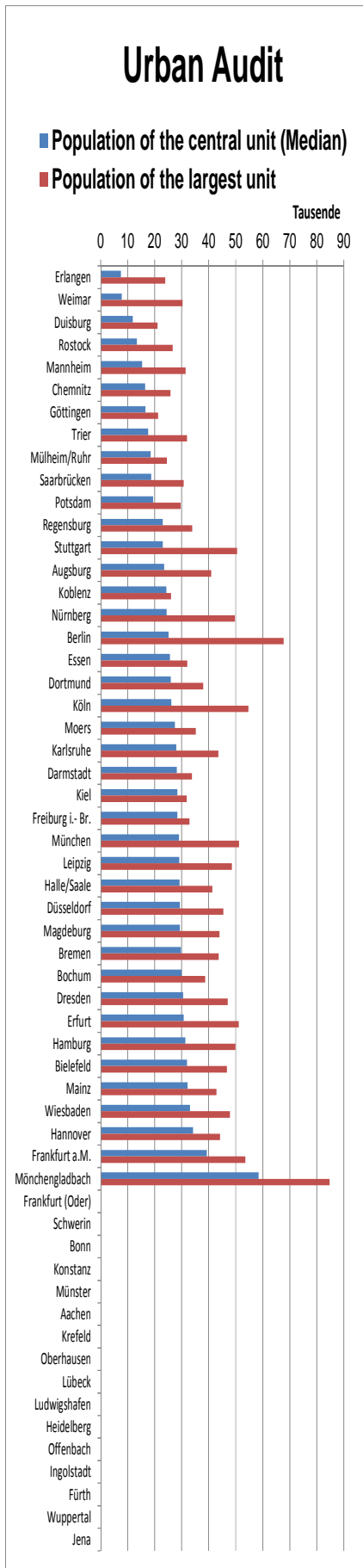
Effects of the population size on the visibility of territorial particularities

Taking the data stock in the three collections as they are, the effect of the different size levels and size structures can be illustrated by two examples showing how the differing levels of population size affect their capability to detect territorial particularities, how clearly sub-groups show up in relation to the total population or are "drowned" in the average of the area.

The proportion of seniors in all three data collections and the unemployment rates in the Urban Audit and IRB are taken as an example, looking at those cities, for which data were available.

The proportion of senior citizens is of special importance for the provision of social infrastructure, public transport and the housing market. In the Urban Audit sub-city districts with an average population size of 26,000, 14 out of 486 SCD had a proportion of > 30 percent seniors; in IRB with an average population of just below 6,000 inhabitants, this high share of senior citizens was reached by 81 out of 1578 spatial units, and in KOSTAT by 235 out of 3,348. None of the Urban Audit SCD had a share of more than 45 percent seniors in the resident population, whereas in IRB three districts were above this level, and KOSTAT showed 20 territorial units with this high proportion of elderly people.

The shares of territorial units exceeding the respective thresholds illustrate the effect of the different size levels of the three collections:

Proportion of seniors 65+ in the sub-city units	UA 2011	IRB 2013	KOSTAT 2014
< 30 %	97,1	94,9	93
30 – < 45 %	2,9	4,9	6,4
≥ 45 %	0	0,2	0,6

Unemployment also varies in its regional concentration. In the sub-city districts of Urban Audit and IRB, for which data is available, none of the comparatively large UA SCD has an unemployment rate (unemployed persons related to the labour force of 15 – 65 year olds) of 17.5 % or more; in IRB, 12 districts exceed this threshold. Accordingly, the dispersion of the proportions is greater, here.

Proportion of unemployed persons among all 15 - 65 year olds	UA-SCD	IRB districts	UA-SCD	IRB districts
	number of small-scale units		proportion of small-scale units	
total	463	1461	100	100
< 2,5 %	27	157	6	11
2,5 - < 5,0 %	193	532	42	36
5,0 - < 7,5 %	148	373	32	26
7,5 - < 10,0 %	52	197	11	14
10,0 - < 12,5 %	26	126	6	9
12,5 - < 15,0 %	14	47	3	3
15,0 < 17,5 %	3	17	1	1
17,5 - < 20,0 %	-	11	-	1
≥ 20 %	-	1	-	-

The following graph illustrates again the wider and more selective distribution of the proportions of the smaller IRB districts in comparison with those of the Urban Audit *).
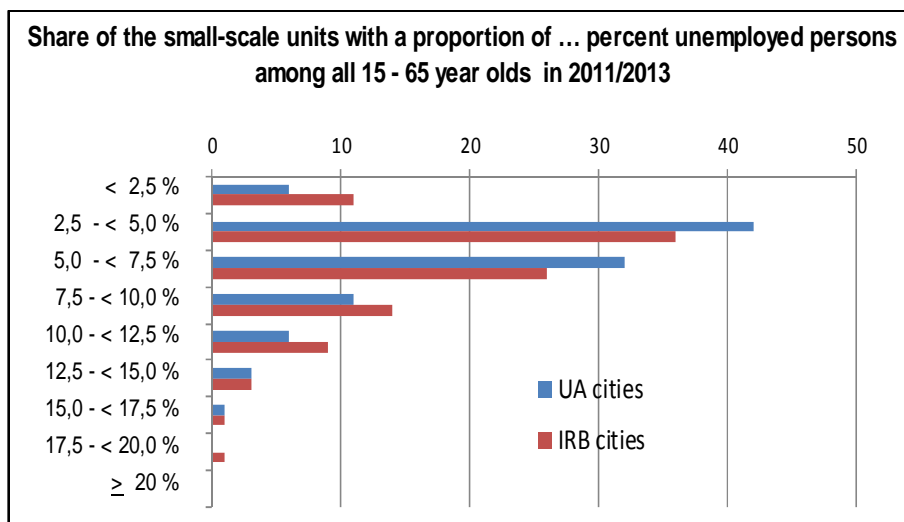
*) only cities with data for UA & IRB and districts with >1,000 inhabitants

The differing sizes impair comparability of the territorial units when looking at aspects related to population. If unemployment rates of > 15 % were taken as a threshold for political action, there would be – amongst all the cities compared - three cities selected in the Urban Audit, whilst IRB would show29 "hits" in 12 cities:

Urban Audit cities with ≥ 15 % unemployed in … SCD ≥1000 inhabitants*):			
Kiel	**1**	out of	9
Chemnitz	**1**	out of	14
Dresden	**1**	out of	17
IRB cities with ≥ 15 % unemployed in … IRB districts ≥1000 inhabitants*):			
Kiel	**2**	out of	9
Bremen	**2**	out of	18
Essen	**4**	out of	22
Köln	**2**	out of	86
Bielefeld	**1**	out of	74
Dortmund	**5**	out of	60
Saarbrücken	**6**	out of	51
Potsdam	**1**	out of	50
Dresden	**2**	out of	61
Leipzig	**1**	out of	63
Halle (Saale)	**2**	out of	33
Erfurt	**1**	out of	52

*) only cities with data for UA & IRB and districts > 1,000 population

Conclusions and recommendations

- Looking at territorial units from a monographic perspective, the question of comparability is less relevant than when searching for territories with particularly high or low concentrations of specific phenomena in relation to the values of the other territories. As soon as the expected answers include a judgment on the relative magnitude of the figures provided, comparisons and comparability come into play. An example for the first type of questions is asking for the housing stock of each territorial unit, without an interest in how the stock in one territorial unit relates to the values of the other units. An example for the second type is the task to find out where in a city there are high concentrations of low income households, unemployed people or early school leavers.

- Territorial comparisons are based on aggregates, which may be aggregated data from smaller territorial units or from the resident individuals. The sum, average or other indicator is assigned to the territorial unit as a whole, no matter if it is composed of homogeneous or very different individuals or if those with a specific characteristic are spread evenly over the whole territory of the unit or if they cluster in parts of it.

- Size matters. It was pointed out that population groups of the same size are better visible in the proportions calculated for smaller territories than in those for areas with a larger population, as sub-groups tend to disappear in the averages of the larger areas. An equal population size of the territorial units will lead to indicators that are more comparable than if the (population) size differs a lot. And if the areas are relatively small, comparisons will reveal territorial concentrations of the relevant phenomena more easily than larger areas where these phenomena disappear in the greater averages.

- The calculated territorial indicators are more selective, if the units are delimited in such a way that the content within each unit is approximately homogeneous. Smaller units will show such internal homogeneity more frequently than bigger ones.

- With regard to comparative sub-city data, it would be ideal if one could group the smallest territorial elements according to the questions asked to arrive at homogeneous larger units for dissemination. This would require an organisation in which a central institution had access to these smallest elements to group and aggregate them according to the information required. However, it is hard to imagine that the municipal data providers would be prepared to share their responsibility for data protection with such a central institution. And last but not least, there is also some reservation among the data providers to disclose too detailed information on the individual neighbourhoods as they want to avoid stigmatisation.

- It is more realistic to try and agree on a standardised optimal solution. Looking at the existing internal municipal sub-divisions, an average size of 5,000 inhabitants per unit might come close to the requirements discussed here. The units would be small enough to reveal areas of particularly high or low concentrations of a problem under observation and large enough to avoid conflicts of confidentiality. To come close to this goal, municipal statistical offices would have to group their more detailed subdivisions in a way optimising their comparability and make the generated aggregates available for public use.

These findings are not new. The main purpose of this paper is to increase awareness of the phenomenon described when developing and applying aggregate indicators for territorial comparisons. This deserves special attention, when it comes to standardising comparative data collections, like those of the German municipal statisticians. But the aspects described are also relevant when applying territorial indicators to funding policies. Eurostat, e.g., publishes indicators for the Europe 2020 goals. Most of them refer to the population or to similar totals. As the administrative units observed are, by their nature, very different in size, it is important to look not only at proportions and similar indicators but also at the absolute numbers behind them. A high proportion of problematic cases in a small territory may be caused by a much smaller cluster than a smaller proportion of problematic cases in a larger territory with a higher number of problematic cases. Absolute values will at least show where there might be clusters of a relevant size. The higher number of problematic cases may be less of a problem for urban policy if they are spread evenly over the total population of the area and don't concentrate in certain locations. To avoid uncertainty, the Amsterdam Bureau for Urban Research calculates territorial concentrations directly by linking the individual cases under observation together at their location to show where they cumulate[6].

It was not possible to propose strict rules for the application of small-scale data in territorial comparisons. The important point was to create awareness of the requirements of comparability and to show how important it is to be quite clear about what is measured by an indicator when applied in a territorial comparison.

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[6] Crok, Simone, Monitoring diversity and integration in Amsterdam, Journal of the SCORUS conference „Competing and Caring – Urban Research for European Urban Policy", Amsterdam 2005, p. 16.