Methods and Data Considerations Related to the Size Distribution of Settlements: The Turkish Case

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Abstract

Since Zipf, research on the rank-size distribution of settlements has generally dealt with the upper tail of the distribution. Previously Turkish rank-size distribution was examined only for the upper part by Dökmeci and others. Parr had pointed on the similarity between the log-normal distribution and the rank size distribution at the upper tail. Within this paper the whole dataset of Turkish settlements is analyzed for the period 1980-2000, thus, an analysis with no threshold population is undertaken. The results reveal a lognormal distribution. Furthermore, the rank-size distribution from 1950 until present is examined using a threshold of 2.500 population separately for different size and rank clusters. Also definitions of administrative units (provinces, districts) and settlement units (cities, towns, villages) are given for the Turkish legal system.

1. Introduction

The general aim of this paper is to discuss data considerations related to the evaluation of the settlement system in general (as opposed to the urban system which only includes settlements above a certain threshold) such as proper measurement of the rank-size distribution in terms of slope and linearity. Also, in particular, a comparison between the log-normal distribution and the rank-size distribution is evaluated using data from the entire settlement system of Turkey. Although the examples are from the Turkish data at settlement level, the clues given could be useful for analysis of other settlement systems, too.

Parr (1985) suggested that in many cases the linear rank-size distribution might be the upper part of a truncated (cut-off) log-normal distribution. Mostly, data related to settlement sizes below a certain cut-off point is not available, so the large part of the log-normal distribution may not be visible if average or median population size is well below the given cut-off point.

As Malecki (1980) points out, rank-size studies produce different results according to the minimum threshold of city size selected. Many empirical studies have examined various urban systems but most of them focused on large cities. Within this respect, Malecki examined the effect of arbitrary selected minimum threshold settlement size on the shape of the resulting rank-size distribution using American census data of 1940, 1950, 1960 and 1970 for the American Midwest states. He analyzed the same data set with different minimum thresholds in order to reveal the pure effect of the threshold as such and concluded that explained variance (r^2) was lowest for the complete data set and that any subset with a threshold population gave a better fit. Another important finding is that below the 500 threshold, below which unincorporated settlements are a significant part of the system, rank-size distribution approaches concavity, which, as he puts forth, is consistent with the findings of Parr (1970 in Malecki, 1980).

Thomas (1985), on the other hand, tested the hypothesis that the regularity of the rank-size distribution is highly dependent on the number of cities of an urban system included in the analysis, in other words the sample size, arguing that rank-size conformity was largely effected by the sample size of an urban system. Furthermore, he stresses the need for standard principles and procedures in defining and delimiting cities and/or urban entities. Especially comparative intra-country studies, which uses data from respective UN Demographic Yearbooks, face the problem of highly variable city definitions of different countries. Furthermore, in accordance with findings of Malecki, Thomas concludes that regularity and slope of rank-size distribution is strongly related to the minimum threshold population limiting the size and number of cities and that rank-size parameters derived from a small sample of large cities may be quite different from the parameters to be derived from the whole urban system.

Nevertheless, intra-country and intra-regional comparisons using q-values computed from the upper tip of settlement systems continued from Berry and Garrison (1958) to Soo (2002). Although Berry and many others distinguished between log-normal and primate distributions, Carroll (1982) showed that the two cases are not contradictory and that the slope of the distribution has to be taken into account. In his article, where he provides a thorough review of the empirical rank-size research from 1913 onwards, Carroll puts forth that "*widespread misconception in literature contends that national city systems can be classified along a continuum of size distributions with primacy at one extreme and rank-size regularity at the other*" and demonstrates that even if there is a perfect linearity in the log to log rank-size distribution, for different slopes of the distribution, that is q-values, different ideal primacy ratios emerge. As a result, if primacy ratios are considered according to the restrictive rank-size rule, misleading conclusions can be derived while comparing different urban systems. Alternatively, Carroll argues for the measurement of the evenness of the rank-size distribution instead of searching for a particular slope, that is –1, slope of unity. Further, he suggests that city-size distribution can be classified along a continuum ranging from complete evenness to total concentration. If the evenness of the city size distribution is to be explained by another variable, the slope q of the rank-size distribution can serve as the dependent variable.

The above given critique is definitely not to argue that valuable work of scholars related to intra-country analysis is useless, the point is only that the computed slope values within most of these studies reflect the pattern of the upper parts of the settlement systems of given countries or regions, therefore,e may not be representative of the respective systems in general.

The aim of this paper is not to compute which model or formulae better fits the data but rather to focus attention on this issue and to encourage researchers to compare the rank-size distribution and the log-normal distribution using data of their own countries. Therefore, no goodness-of-fit analysis is undertaken, but the reader will be presented clues for further research. For recent work on mathematical models related to size distribution of cities see Reed and Jorgensen (2003), Gabaix (1999), Brakman et.al. (1999) and Fonseca (1989). Furthermore, the rank-size formulae of Zipf, Lotka and others will not be repeated here for the n^{th} time – it is assumed that the audience of this paper is familiar with the concept of the rank-size distribution and the formulae associated with it. But it should be noted that many scholars, including the very authors of this paper, have in some of their previous works mistakenly referred to the rank-size distribution as log-normal distribution and vice versa. Since the upper parts of the two distributions produce nearly identical results it is very important to obtain data from the lower part of the settlement system, but first let us review existing work on rank size distribution of Turkish settlements.

Previously, rank-size distribution of Turkey was examined by Erişen (1972), Dökmeci (1986), Kundak and Dökmeci (2000), Zeyneloğlu (2001), and by Türk and Dökmeci (2001). Erişen

used a cut-off point of 20.000, Dökmeci and others analyzed cities above 10.000. Dökmeci, Kundak and Türk used only population figures of province and district centers (that is administratively urban settlements) while Erişen and Zeyneloğlu included all settlements above the given cut-off point regardless of administrative status. Erişen and Zeyneloğlu also adjusted population figures for city proper boundaries, others accepted the administrative division as is. The thorough results will not be repeated here, but the evolution of the urban system can be summarized as that the initially convex distribution of 1927 gradually evolved into a linear distribution until the 1990's. Especially medium sized cities between 50.000 and 500.000 increased their weight within the urban system as compared to the upper and lower part (as low as 10.000). The slope of the rank-size distribution starting with -0,735 in 1927 gradually reached the slope of unity (-1) by the 1990's, which is also valid for data from the recent 2000 census. The Turkish experience resembles that of Italy between 1921 and 1971 (Cori, 1984) with the difference that the initial rank-size distribution in Italy was concave. Also the subsequent effect of counter-urbanization, if it will happen ever, is still missing for Turkey.

The main question of this paper is that whether the size distribution of Turkish settlements fits the bell shape of the log-normal distribution or the linear distribution of the rank-size curve. Since all previous research dealt with the upper part of the settlement system, the concavity at the end of the rank-size line (which is the case if the settlement system is log-normally distributed) has not been revealed yet. One reason may be the problems of data access especially for censuses older than 1980, which are not available in electronic format. The researcher usually has to conduct manual data entry, which limits the scope of the analysis and leads to the selection of high cut-off points. Population figures for 1980, 1985, 1990, 1997 and 2000 censuses, on the other hand, are available in electronic format and are utilized within this paper at full scope without the selection of a threshold population, but first a general summary will be given on the Turkish settlement system.

Analyzing the data and the computed figures like slopes (q-values) without proper knowledge on administrative division, shift in boundaries or changes in definition of cities and other settlements may result in misinterpretation of findings. At this point recourse to the Turkish legal system, where besides administrative divisions, settlement units are also defined, will be useful. The 'Village Law' defines a village as a locality comprising of continuous or scattered households (including their cropfields and yards) sharing common amenities like mosque, school, pasture and forest land (Turkish Compiled Statutes, 2000, Village Law, Article 1, Paragraph 1-2; *T.C. Yürürlükteki Kanunlar, 2000, Köy Kanunu, Fasıl 1, Madde 1-2*). Settlements below 2.000 are referred to as villages, those between 2.000 and 20.000 as towns and those above 20.000 as cities. Cities may also be divided as small, medium and large cities and metropolitan centers, which are Istanbul, Ankara and Izmir.

Table 1 indicates the figures of the settlement system divided into 5 main size groups, which also divides the total population of the country into roughly equal parts. Until present, the studies on the size distribution of the Turkish settlement system had either dealt with a total of 900+ province and district centers regardless of size or with settlements above a threshold population regardless of administrative status. Thus, until now the structure of the bulk of the settlement system, that is the distribution of villages and towns remained unexplored.

Table 1 Settlement Units and Population according to Size Clusters (2000 Census)

	Size group	Population in size group	Percent of population in size group,	Number of settlement units in size group
villages	**1 – 1.999**	14.039.752	21%	34504
towns	**2.000 - 19.999**	13.559.335	20%	2841
small and medium cities	**20.000 – 199.999**	14.662.376	21%	280
large cities	**200.000 - 1.999.999**	11.373.404	17%	26
metropolitan centers	**2.000.000+**	14.169.060	21%	3
Total population		67.803.927	100%	37654

Source: 2000 Population Census, SIS.

The above given distinction based on settlement size should not be confused with the division of settlements according to administrative status, which is independent from population size. All province and district centers regardless of population size are entitled to form a municipality and are classified as urban. All (administrative) villages above population 2.000 also can be incorporated as a municipality but are classified as rural with the rest of the villages[1]. Nevertheless, the actual number of settlement units may be higher than the total number of villages plus district and province centers. A settlement has to contain a population of at least 150 to be recognized officially as a village. Settlements below 150 have either to be attached to another village within at least 1 hour travel time or two or more settlements have to be combined to form a village with a population of at least 150 (Turkish Compiled Statutes, 2000, Village Law, Article 1, Paragraph 89-90; *T.C. Yürürlükteki Kanunlar, 2000, Köy Kanunu, Fasıl 1, Madde 89-90*). This should not be interpreted that all villages in Turkey have a population of at least 150. There are even villages with a de facto and/or de jure population of 0. A village only ceases to exist officially if the legal entity of the village is annulled by the Ministry of Interior (Turkish Compiled Statutes, 2000, Provincial Administration Law, Article 2, Paragraph 89-90; *T.C. Yürürlükteki Kanunlar, 2000, İl İdaresi Kanunu, Madde 2, Paragraf Ç*). Nevertheless, all hamlets officially are a part of a neighboring village and appear in the statistics as such without special notice.

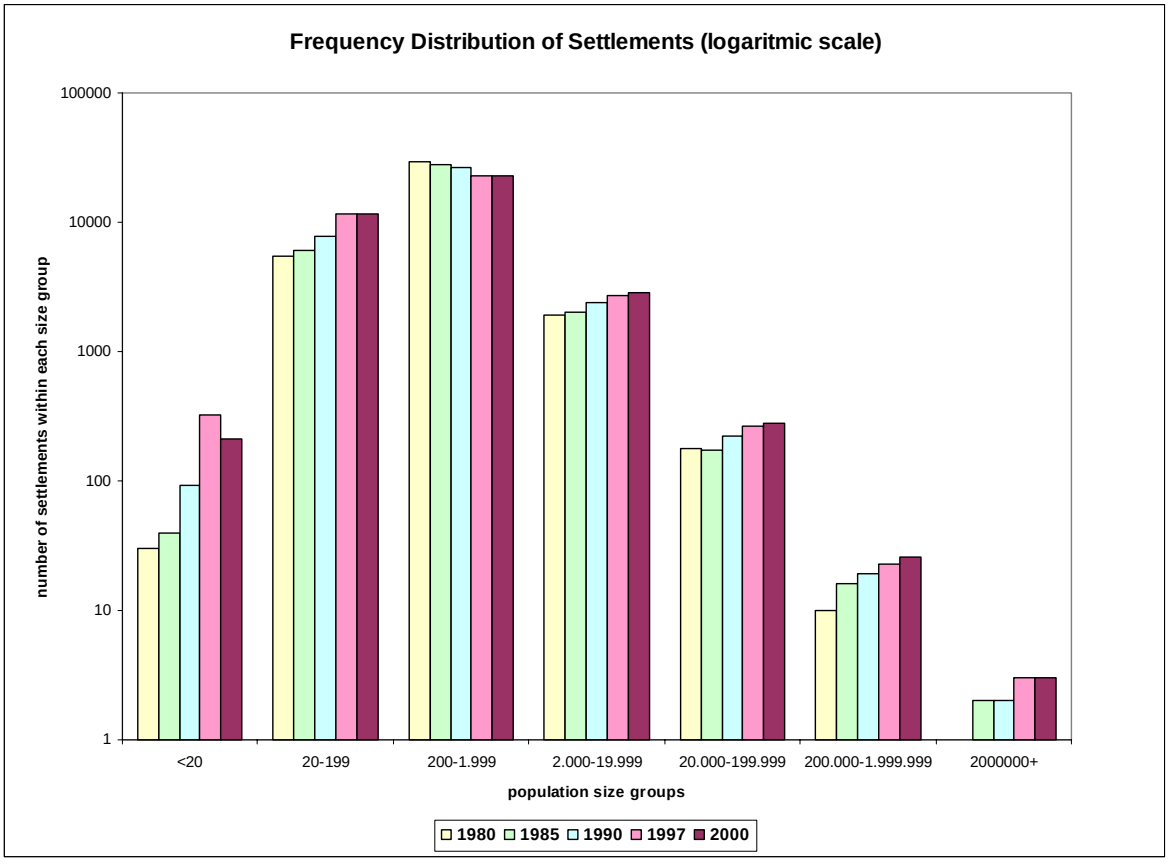
The above given critique should not be interpreted that each and every settlement unit should constitute an administrative entity itself. Also in France, for example, a commune (the equivalent of the Turkish village and also municipality) may consist of several settlement

[1] The Turkish Municipal Code was modified in 2004 shifting the threshold of municipal incorporation up to 5.000, however, throughout the whole analysis period of 1950-2000 the threshold was 2.000.

units (Dalmasso, 1984), nevertheless these distinct population agglomerations are recorded and indicated in the census as such if they have a population of at least 50.

The General Directorate of Village Affairs (*Köy Hizmetleri Genel Müdürlüğü*) (2001) lists 35.100 villages (that is unincorporated settlements) and 41.317 hamlets (that is settlements administratively attached to another proximate village) for the year 2000. Together with province and district centers a total of 80.000 localities are present in Turkey. It is important to bear in mind that many hamlets acquired village status throughout the analysis period, resulting in the entry of relatively small elements into the settlement system while the population of existing villages from which the new villages seceded fell as a result of boundary shift. Thus, it may happen that without an actual movement or change in population among settlement units, the settlement units can shift among size clusters mistakenly leading the observer to think that the settlement has lost population and therefore shifted to lower ranks or size groups. Actually, in most of the time, the newly established settlement unit is a former locality an already existing settlement.

Figure 1 Frequency Distribution of Settlements 1980-2000



It should be kept in mind that in most urban systems, especially in the old world, there can be no such event as “city formation” or “city entry” into the urban system unless new territory is conquered or previously arid land is developed for settlement. Generally, new settlements are

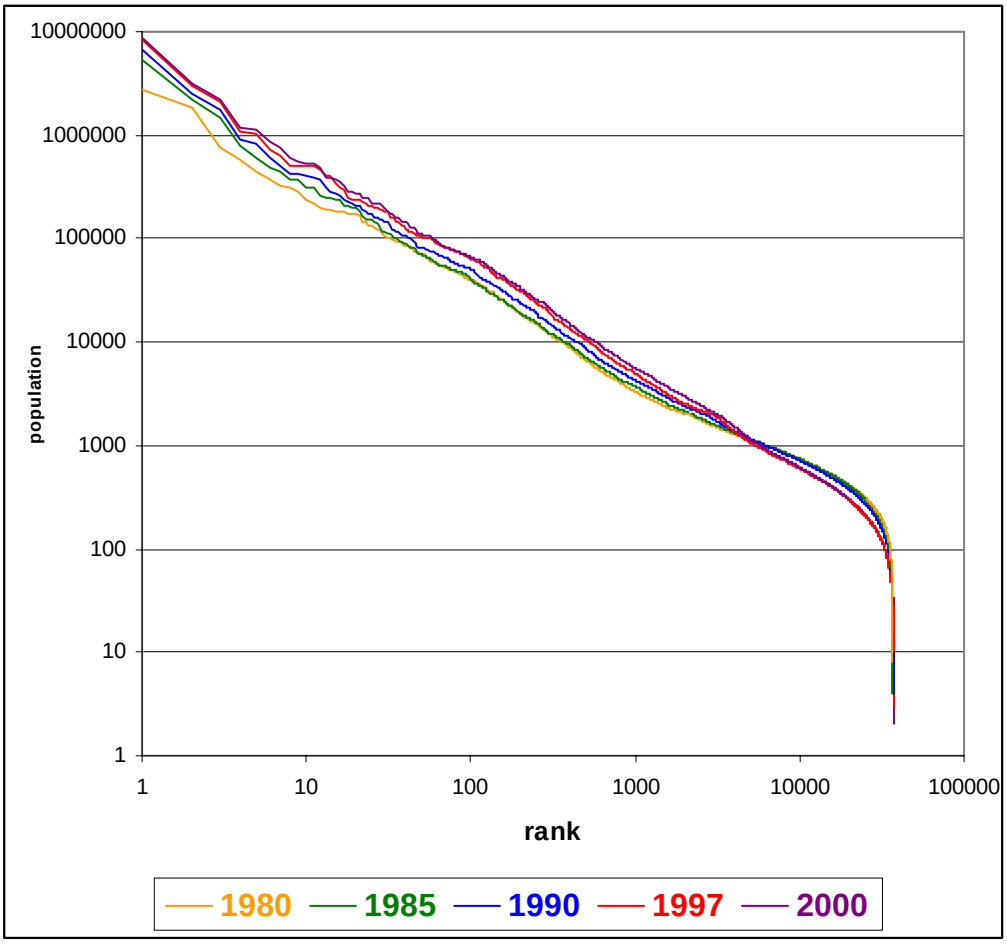
either formed by seceding parts of existing settlements or by the administrative unification of several existing settlement units.

Thus, the increase in the number of small villages (-199) as opposed to medium and large villages (200-1.999) indicated in Figure 1 should be interpreted accordingly. While for the period 1980-2000 Turkey exhibits moderate population growth, all size clusters with one exception increase their frequency of settlement units accordingly. The modal size cluster of 200-1.999 is the only size cluster which constantly decreases its frequency, but this should not be interpreted that existing villages decline in population so that these villages step down to lower size clusters. The continuous decline in this size cluster has another important reason, which will be further evaluated in the next chapter.

2. Rank-Size Distribution versus Log-Normal Distribution

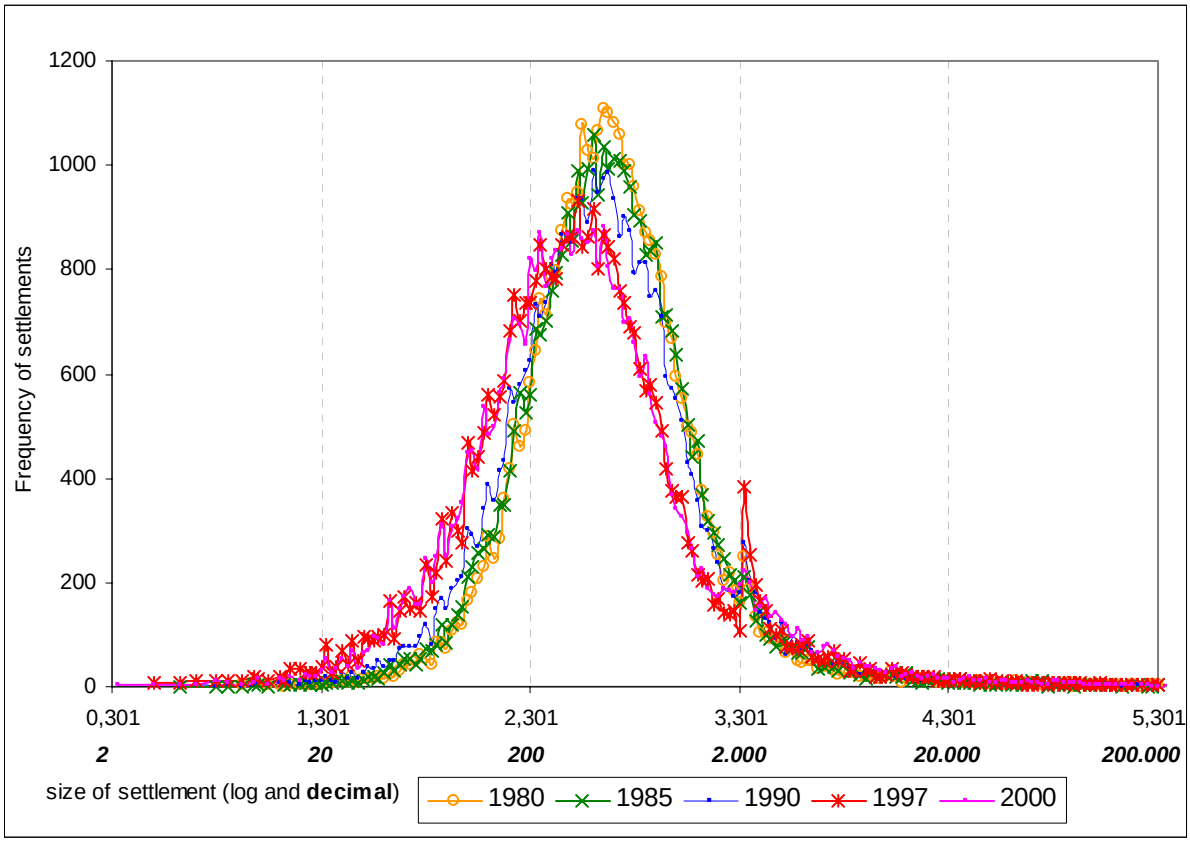
If taken all settlements (regardless of size or administrative status) into account the rank-size curves for every census given in Figure 2 exhibit concavity at the lower limb of the distribution, which is typical for log-normal distributions.

Figure 2 Rank-size distribution of settlement units



To obtain a more detailed view of the log-normal size distribution of Turkish settlements, Figure 3 has been prepared. Population size figures are grouped into tiny frequency groups with a logarithmic interval of 0,025. The decimal value of the interval width varies from 0,12 ($10^{0,326}$-$10^{0,301}$) to 529.353 ($10^{6,951}$-$10^{6,976}$). Between the decimal values 2 and 10.000.000 a total of 268 frequency clusters are formed, from which Figure 3 is drawn.

Figure 3 Log-normal distribution of settlement units



Thanks to the sliding scale of Figure 3 the overall structure of the log-normal distribution is clearly visible without the distorting effect of piling at certain single population sizes. If the figure had been drawn using single values, the mode values (Table 2) of 100 in the year 2000 or 150 in 1997 would have wrongfully appeared as the centers of the log-normal distribution curves. Furthermore, at the upper part of the graph large cavities would appear because of increasing population differences between consecutive settlements in terms of size. Therefore, when working with settlement sizes at logarithmic scale, frequency intervals with a logarithmically increasing interval width is recommended for visualization.

Table 2 below, summarizes the shape of the log-normal distribution mathematically. A slightly right skewed distribution, as can be seen from the graph above is indicated by positive skewness values. The overall distribution evolves gradually from a more concentrated to a more dispersed one as pointed out by the decrease of the kurtosis value. This is not surprising since both the mean and the median population sizes are decreasing despite population increase in the country as whole and the advance of the upper part as indicated by the increase

of the size of the largest city. Accordingly the range is widening and standard deviation values do increase over time.

Table 2 Evolution of the log-normal distribution of settlement units 1980-2000

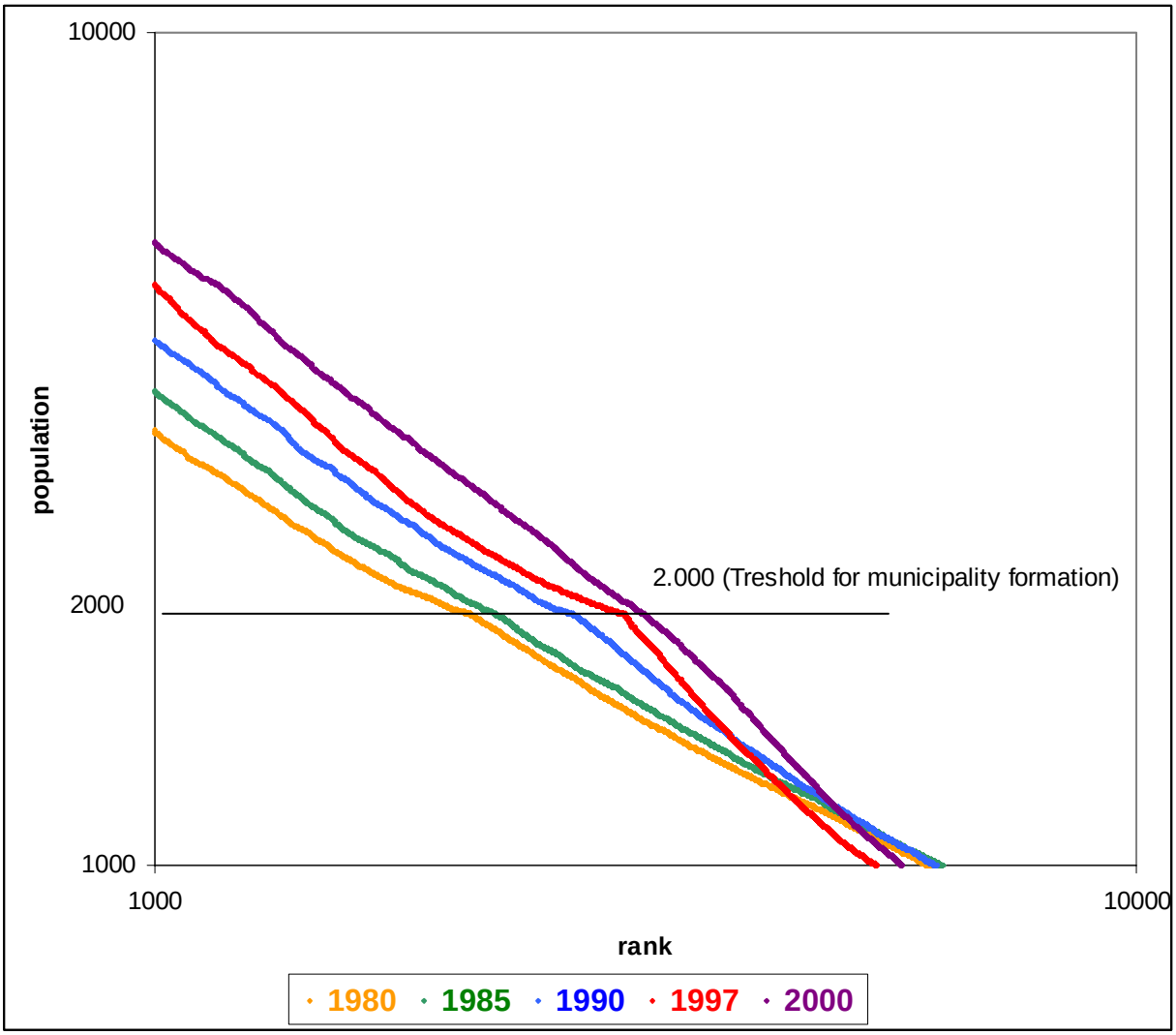
	1980		1985		1990		1997		2000	
	logarithmic values	converted to decimal	logarithmic values	converted to decimal	logarithmic values	converted to decimal	logarithmic values	converted to decimal	logarithmic values	converted to decimal
mean	2,674	472	2,669	466	2,635	431	2,533	341	2,549	354
std.dev.	*0,412*		*0,429*		*0,467*		*0,532*		*0,537*	
median	2,654	451	2,650	447	2,615	412	2,509	323	2,513	326
mode	2,455	285	2,462	290	2,176	150	2,173	150	2,009	100
kurtosis	**4,082**		**3,748**		**3,219**		**2,706**		**2,599**	
skewness	0,871		0,807		0,758		0,694		0,809	
min	0,903	8	0,602	4	0,602	4	0,477	3	0,301	2
max	6,443	2.772.708	6,738	5.475.982	6,821	6.620.241	6,917	8.260.438	6,945	8.803.468
number of settlements	36722		36610		37010		37623		37654	
number of settlements legally formed since previous census			0		400		613		31	

In contrast, the (decimal) arithmetic mean for average settlement size increases from 1.218 in 1980 to 1.801 in 2000 moving in the opposite direction of the logarithmic mean which, as shown above, decreases over time. It should also be noted that mode values are calculated from ungrouped data and may not be visible as peaks in Figure 3, which is compiled from grouped data.

Another important observation is that especially for the 1997 and 2000 censuses, peaks appear at the lower part of the distribution line at certain population sizes like 50, 60, 75, 100, 200, 250 or 500. For readers who are familiar with the concept of 'age heaping' these heaps may not be surprising. In small villages census records are usually taken by local officials (village headman, health worker and alike) and the census may not be conducted as carefully as it is in larger centers. Instead of performing an accurate count sometimes a lump-sum figure for the total village population may be given, which, as it does in the case of age heaping, result in the prevalence of certain easy memorable numbers like 100, 1000 or their products or products of their quarters. This kind of 'census heaping' may also happen at larger villages (may be up to population size 5.000), but due to the characteristics of the logarithmic scale these heaps may not be easily recognizable as they are in the lower part of the frequency line.

A clear and visible heap, however, is present at population size 2.000, which is also the threshold for incorporation of municipalities. Especially for the 1997 census the size of the heap is extraordinary large compared to neighboring clusters. At this point help from the rank-size distribution is sought. Figure 4 gives the rank-size distribution of Turkish settlements for the 1980-2000 period zooming around the population size of 2.000. As can be seen from the graph, especially for the 1997 population count, the rank-size distribution reveals a refraction point at population size 2.000 (sudden knick in the slope) while at 1980 and 2000 the line passes relatively smoothly through the 2.000 limit without refraction.

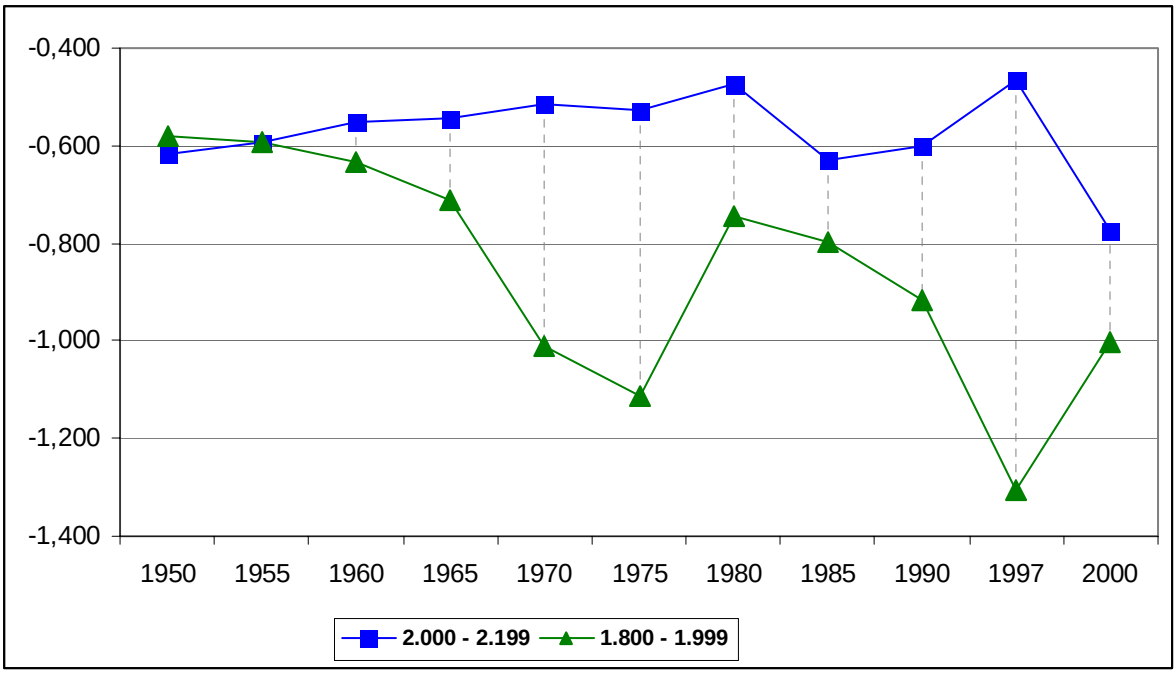
Figure 4 Rank-size distribution focused at the refraction point of 2.000



The refraction at population size 2.000 can be interpreted as a sign of fraud in census. Many settlements with a population closely below 2.000 undertake attempts to overenumerate with the aim of municipal incorporation. Overenumeration in census may be conducted in two ways. One is to record imagined persons as residing in a particular settlement, the other is conducted in the form of temporary movement of people from on village to the other for the day of the census. Especially at the 1997 Population Count, as it was called by SIS, instances occurred where neighboring villages made illegal agreements on moving population from the less populated village to the more populated one, so that the larger village would pass the 2.000 threshold necessary for municipal incorporation. Once the larger village would have been incorporated as a municipality, it was expected to hand over a portion of the transfers it would receive from the central government. As a consequence, settlements below 2.000 population size were underrepresented in the census compared to their actual frequency, while settlements above 2.000 were overrepresented, resulting in the heap at population size 2000 and closely above.

If data is traced back to previous census years an even stronger rupture can be observed between the upper and lower parts of the 2.000 threshold. Especially for this study the population figures of all settlements above 1.800 population were entered manually from the 1975, 1970, 1965, 1960, 1955 and 1950 censuses. For the period 1950-2000 rank-size slopes (q-values) were computed separately for the upper (2.000-2.199) and lower (1.800-1.999) parts of the 2.000 threshold. While during 1950's the rank-size slopes of settlements below and above 2.000 were nearly identical -as it is expected- after 1960 the distortion of population figures began as indicated by the continuously increasing rupture between the slope of the upper and lower size clusters, reaching a difference of 0,59 by 1975. The 1980 census conducted under martial law exhibits a decreasing rupture but after 1990 the differences between the lower and upper part began to increase again reaching a value of 0,84. The decreasing rupture for the 2000 census is not surprising for scholars familiar with the 2000 census since SIS conducted thorough controls and corrections both during and after the census to curb overenumeration.

Figure 5 Slope values of the rank-size distribution above (2.000-2.199) and below (1.800-1.999) the 2.000 threshold



Nevertheless, for most of the period an unnatural rupture characterizes the rank-size distribution around 2.000. Scholars using Turkish census data should be aware that population figures around 2.000 (let's say a range between 1.200 and 2.500) may not be reliable and should not be included in the computation of rank-size slopes.

3. Threshold Population and Coverage

Previous studies on the size distribution of Turkish settlements revealed a decrease in the rank-size slope over time gradually reaching –1 by the 1990's[2]. The overall slope of the rank-size distribution, however, may not be valid for all size groups within the settlement system. The main question regarding this chapter is whether it is possible to compute a single slope value that represents the whole of the settlement system.

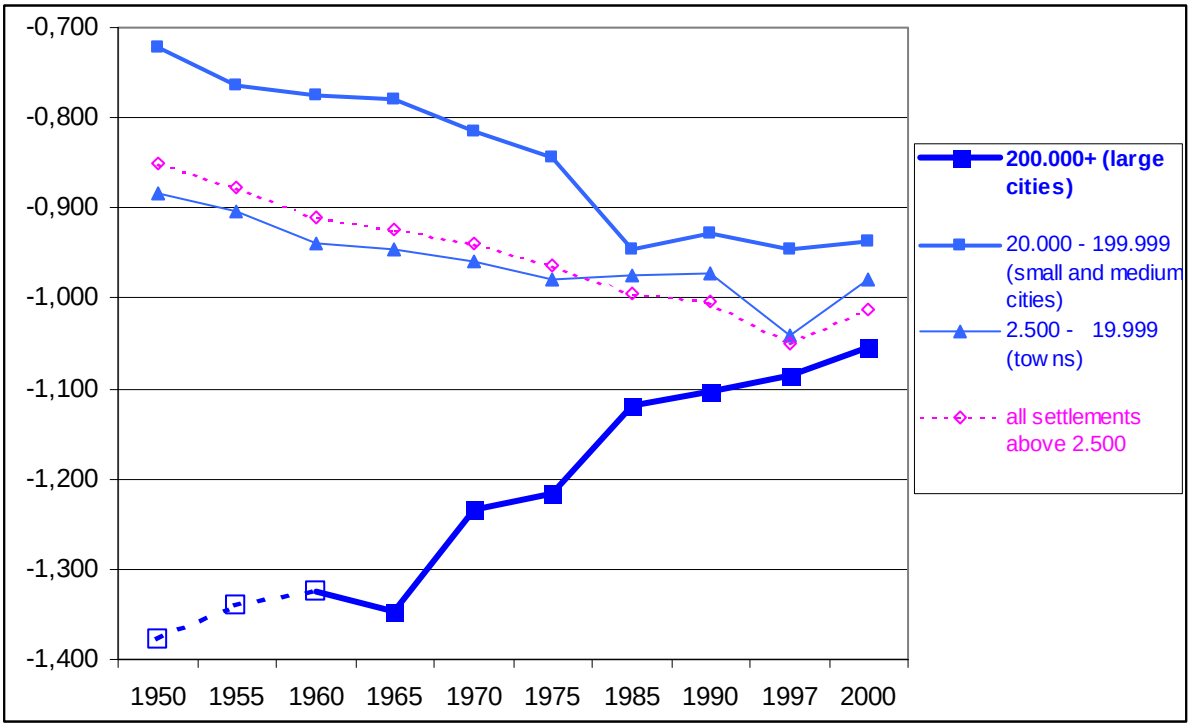
An important point to note is that due to the swarming effect of smaller cities the overall rank-size slope (for linear regression) will be similar to the rank-size slope of the smallest size group included within the analysis. Figure 6 and Table 3 present rank-size slopes for 3 arbitrarily selected size groups compared with the overall slope of the Turkish settlement system throughout the period 1950-2000. Due to the rupture at the refraction point of 2.000, settlements within this size group are not included in the analysis; instead a minimum threshold of 2.500 is determined. As can be seen from the graph, the particular values of the overall rank-size slope and its trend over time are nearly identical with that of the smallest size group (2.500-19.999), the towns. The next size group of 20.000-199.999 (small and medium cities) exhibits different slope values, but the falling trend over time is the same with that of the towns. The 3rd size group, larger cities (above 200.000), however, exhibits an absolutely opposite pattern, in that the initial slope value for this size group is around -1,3 and the values approach the slope of unity by increasing continuously. By the year 2000, all three size groups have converged at similar slope values close to –1, and can be analyzed as an integrated system. For earlier periods, however, it is difficult to calculate a slope value representing the whole of the system. The Turkish case, in this respect, may not be an exception. While dealing with rank-size slopes, researchers preferably should compute rank-size slopes for sub groups of settlements, in terms of size clusters, besides the overall slope value.

Table 3 Slope of the Rank-Size Distribution according to Size Clusters

	slope of the rank-size distribution									
	1950	**1955**	**1960**	**1965**	**1970**	**1975**	**1985**	**1990**	**1997**	**2000**
200.000+ (large cities)	*-1,379 **	*-1,341 **	*-1,325*	-1,346	-1,233	-1,216	-1,119	-1,104	-1,085	-1,055
N	3	3	4	5	8	9	18	21	26	29
20.000 - 199.999 (small and medium cities)	-0,723	-0,764	-0,775	-0,780	-0,815	-0,844	-0,946	-0,927	-0,947	-0,938
N	38	52	80	102	120	150	172	220	266	280
2.500 - 19.999 (towns)	-0,884	-0,904	-0,939	-0,945	-0,958	-0,979	-0,974	-0,973	-1,042	-0,979
N	439	547	645	786	1017	1189	1389	1637	1742	2138
all settlements above 2.500	-0,851	-0,878	-0,910	-0,923	-0,940	-0,964	-0,995	-1,002	-1,050	-1,012
N	*480*	*602*	*729*	*893*	*1145*	*1348*	*1579*	*1878*	*2034*	*2447*
** not significant at level 1%*										

[2] The 1980 census was left out of the analysis due to coverage problems and mismatch of administrative boundaries with the subsequent 1985 census.

Figure 6 Evolution of the Slope of the Rank-Size Distribution according to Size Clusters



Note: Slope values from 1950 and 1955 for the large cities size group are not significant at the 1% level.

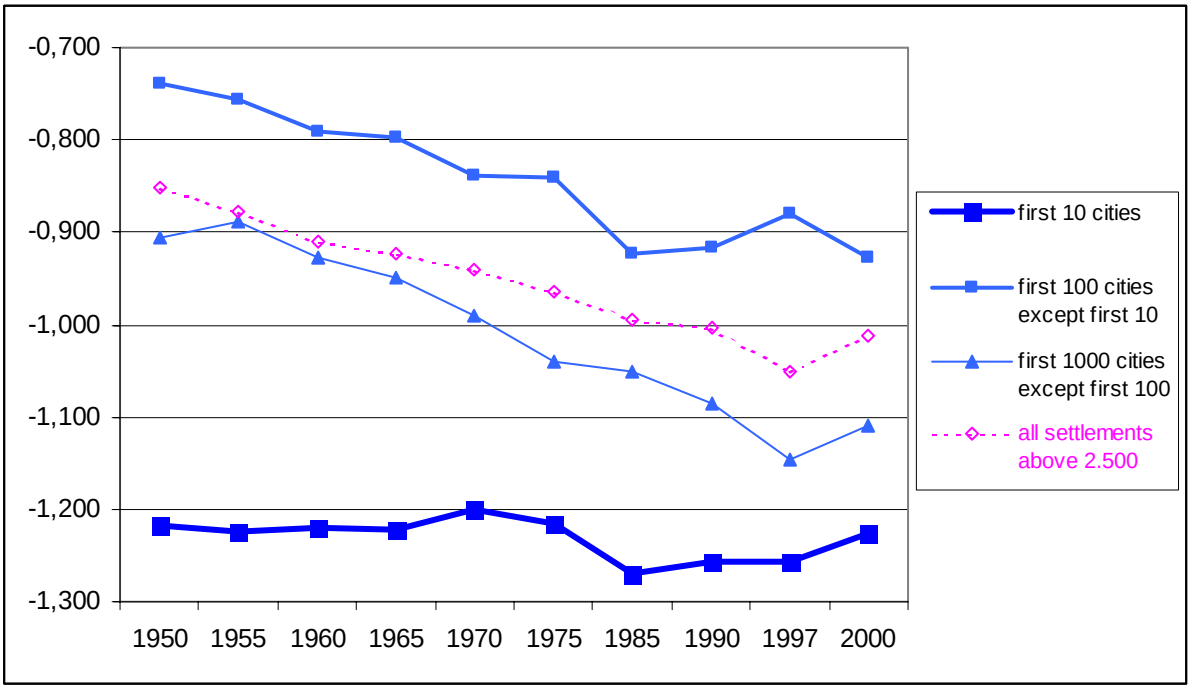
If population figures are compared over a long period of time (especially in times of rapid population increase) some size clusters are vacant in the past if threshold is too high, or too populated in the future if threshold is too low. To overcome this problem a clustering in terms of rank (rank clusters) can also be utilized, in that settlements are grouped as the first (in terms of rank) 10 settlements, the next 100, the next 1000, etc. Figure 7 and Table 4 present the results for slope values of the rank-size distribution of settlement groups according to their ranks. It should be noted that the first 10 settlements form a group, the next 100 settlements except the first 10 form the second. The last group consists of the next 1.000 settlements except the first 100. Note that also for this analysis only settlement units above 2.500 population size were selected, so that the 3rd group may contain less than 900 settlements.

The resulting slope values and their trends over time differ from those of the above given size clusters, but it is important to note, that again there are important differences among clusters in terms of slope and trends over time. The first cluster exhibits a fairly constant slope over the whole period. The slope of the next 90 settlements as well as the last and largest group of the next 900 settlements show falling slopes over the whole period so that the initial difference among them is maintained. As it is the case for size clusters, also for rank clusters, the slope values of the overall rank-size distribution are mostly located near the values of the 3rd group containing the smallest settlements among the three clusters.

Table 4 Slope of the Rank-Size Distribution according to Rank Clusters

	settlement units with 2.500+ population slope of the rank-size distribution									
	1950	**1955**	**1960**	**1965**	**1970**	**1975**	**1985**	**1990**	**1997**	**2000**
first 10 cities	-1,217	-1,225	-1,219	-1,223	-1,200	-1,216	-1,269	-1,257	-1,257	-1,227
frequency	10	10	10	10	10	10	10	10	10	10
first 100 cities except first 10	-0,740	-0,757	-0,791	-0,797	-0,838	-0,840	-0,924	-0,917	-0,880	-0,927
frequency	90	90	90	90	90	90	90	90	90	90
first 1000 cities except first 100	-0,906	-0,889	-0,928	-0,950	-0,991	-1,040	-1,051	-1,085	-1,147	-1,110
frequency	380	502	629	793	900	900	900	900	900	900
all settlements above 2.500	-0,851	-0,878	-0,910	-0,923	-0,940	-0,964	-0,995	-1,002	-1,050	-1,012
frequency	480	602	729	893	1145	1348	1579	1878	2034	2447

Figure 7 Evolution of the Slope of the Rank-Size Distribution according to Rank Clusters



4. Conclusion and Suggestions

In accordance with Parr's suggestions the rank-size distribution of the Turkish settlement system turned out to be a log-normal distribution revealed by the inclusion of all settlements into the analysis. Furthermore, it is shown that slope values of the rank-size distribution differ among size and rank cluster, and that the cluster with the smallest settlements usually determines the overall slope if values are computed with simple linear regression. It is possible that some settlement systems may not be represented by a single rank-size slope value; parts of the system may exhibit different patterns.

The authors would welcome suggestions and further research on the issue of comparison between log-normal distribution and rank-size distribution.

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