Planned Economic Development and Loglinearity in the Rank-Size Distribution of Urban Systems: The Soviet Experience

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Summary. In this paper, the city rank-size hypothesis is tested for the urban system of the USSR and the Republic of Ukraine using (1) census data for 1897, 1926, 1939, 1959, 1970 and 1979, (2) subgrouping each census year in 3 categories: largest cities (rank 1–5), middle-sized cities (rank 6–50) and smallest cities (rank higher than 50) in addition to the whole sample. Following the interpretation of the previous results, the relative changes in the ratios of the city distribution slope values from both systems are then observed and analysed for each of the specified group of cities.

1. Introduction

Several researchers have attempted to correlate economic development with the degree of urbanisation of a given region or country (Zipf, 1949; Berry, 1961; El-Shaks, 1972; Brunet, 1976). While different approaches are proposed to explain the regularity in the distribution of cities in terms of competing forces interacting at an aggregate level, less attention seems to have been devoted to the study of economies where these forces have been constantly modified, such as in a state planned economy.

Harris (1970a) addressed this question in his extensive work on the USSR. Since his study covered only the 1959 census, nothing can be said on the dynamics of economic development with respect to a changing urban structure. Furthermore, it would seem interesting to observe how the regional changes occurring at the level of the component republics are reflected in the evolving superstructure.

The purpose of this paper is to examine, empirically, the dynamics of the soviet urban system in the light of the rank-size distribution hypothesis and to expand the analysis initiated by Harris on the USSR. The first part of this paper presents a brief review previous studies of the soviet urban system. In the second part, the rank-size hypothesis is tested

for each census year during the period 1897–1979, firstly for the USSR and then for the Republic of the Ukraine, to observe changes in the slope values of the distribution, expressed in logarithmic form, of several classes of cities. In order to assess how the changes in city growth of one of the major republics in the system might be related to the trends identified at the superstructure, a new set of analyses are carried out for the corresponding period, using the ratios of the slope values for the Ukraine and the USSR. Finally, a general interpretation, based on the summary of the findings, is proposed for further discussion.

2. Previous Studies on the Soviet Urban System

Refering to the interest of soviet scholars in the subject, Harris (1970a) reported that there were more than a thousand research studies of soviet cities. He also indicated that about 400 specialists were covering many aspects of soviet urban and population geography. While few details are mentioned specifically, Harris emphasized that:

> 'Soviet geographers and planners have devoted much attention to the question related to size of cities. The soviet literature on optimum size of

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cities and on the need for limiting the size of the great metropolises is particularly extensive ... showing that cities in the size range of 50 to 200 thousands are most efficient in terms of the urban economy ... (p. 46).

Actually, while some critical aspects of efficiency, such as economies of scale in production and also in the distribution of public goods and services, are certainly preoccupying soviet authorities, it could be supposed that other factors, like ethno-cultural and political considerations do not play a minor role in their planning policies. This point is clearly substantiated by another quotation from Harris:

> 'The 22nd and 23rd congresses of the Communist Party of the Soviet Union in 1961 and in 1966 adopted programs of fostering the growth of small and middle-sized cities. New industrial establishments are to be built primarily in middle-sized and smaller cities. A large number of monographs and articles have recently been devoted to the possibilities and problems of locating industries in small and medium-sized towns, particularly of the western parts of the USSR' (p. 47).

As to the specific works on the distribution of cities in the soviet urban network, Harris referred in particular to Davidovich and Konstantinov's use of '... ingenious graphs, statistical indicators and projections (to throw) light on the regularities that exist in the settlement patterns of the country' (pp. 49–50).

3. Testing the Rank-Size Hypothesis for the USSR and for Ukraine

(a) Data description

City population data were extracted from the Statistical Supplement compiled by Harris (1970b) for the 1897, 1926, 1939 and 1959 census years. The observations refer to actual political boundaries, while in fact these had been modified after each war period. The minimum city size of 10,000 inhabitants applied only to the 1959 census, while all data available were used for the previous years, rounding the figures to the nearest thousand. More recent information for 1970 and 1979, not available in the Supplement, came from official sources, the Narkhoz yearbooks. The minimum size of cities available was 50,000 for

1970 and 100,000 for 1979, providing us with a more limited but still substantial number of observations. One comment which should be made at this point concerns the problem of city boundaries. Since we deal with politically defined limits, not with urban agglomerations which would be more representative of the concentration of economic activities, any change in the boundaries from one census to another for any given leading city may obscure the analysis of the dynamics of the system. For example, data obtained for 1959 raised the population of Moscow from 5,046,000 to 6,009,000 inhabitants, a substantial 19 per cent increase, simply by redefining the city boundaries of the capital, while the other major cities remained unchanged.

Using data from each census year, the city distribution slope values were calculated with a regression test for each of the following cases: first, the whole sample of observations, then the five largest cities, the middle-sized group (those ranked from sixth to fiftieth) and finally the smallest cities group for the remaining cities (51 and above). No particular claim is made for this choice of subdivisions and other cutting points could have been adopted. Furthermore, while there is an obvious interest to isolate the very largest cities in a distinct group, limiting their number to five could certainly be disputed on the basis of statistical relevance. The fact that several studies on the subject have selected the same basis allows for a direct comparison of the results, albeit recognizing the previous warning.

(b) Results for the USSR

Table 1 provides a summary of the results for the individual tests performed for each group of cities in each given census year. The number of cities varies in each sample, depending on the availability of the data from the source documents, as well as the cut-off point at the minimum size. However, the truncated distribution does not affect the comparisons for the two largest groups and, given a sufficiently large number of remaining observations, should have probably only a minor impact on the third group as well as on the whole sample, since they are computed in logarithmic form.

Overall, the city rank-size distribution was very close to 'normal' in 1897, under the Tsarist regime, with a slope of -0.979. This could be seen as a surprising result, given the state of the economy of

Table 1

Cities Rank-Size Distribution Slopes: 1897–1979 Census Years

USSR (Number of cities)	1897 (590)	1926 (903)	1939 (421)	1959 (473)	1970 (487)	1979 (269)
All cities	−0.979	−1.100	−1.032	−0.919	−0.885	−0.788
Largest cities (1–5)	−1.123	−1.115	−1.262	−1.288	−1.162	−1.086
Middle-sized cities (6–50)	−0.650	−0.773	−0.643	−0.609	−0.604	−0.592
Smallest cities (51–end)	−1.203	−1.301	−1.340	−1.099	−1.038	−0.987

Ukraine (Number of cities)	1897 (151)	1926 (243)	1939 (277)	1959 (303)	1970 (74)	1979 (38)
All cities	−0.808	−1.081	−1.046	−0.950	−0.980	−0.844
Largest cities (1–5)	−0.754	−0.437	−0.394	−0.354	−0.427	−0.486
Middle-sized cities (6–50)	−0.743	−0.702	−0.911	−1.071	−1.067	−0.933
Smallest cities (51–end)	−1.399	−1.708	−1.231	−0.918	−1.182	N/A

this period and the lower degree of urbanisation. Since then, the soviet urban system is characterized by an initial rise to −1.100 in 1926, and thereafter a constant decline to a significant low value of −0.788 in 1979. This pattern seems very typical of the behaviour suggested by El-Shaks (1972) for an economy starting first from a level of underdevelopment with a distribution similar to the rank-size type, then reaching the primate pattern during its early stage of development, to eventually return to the linear form. The disturbing fact in this case comes from the 'degrading' of the distribution from 1959. Many important events have not been properly captured in the evolution of the system, like the 29 year period from 1897 to 1926 including the change of regime in 1917 and the subsequent internal revolutionary conflicts, the shorter 13 year segment covering the Great Famine of 1933 in the Ukraine, and the 20 year period including the devastating effects of World War 2.

The primate pattern of the system becomes evident when examining the largest cities group for any given year, including 1897 (−1.123), suggesting a permanence of leadership throughout the two political regimes. A similar continuity is found in the middle-sized group, where the very low range of values from −0.773 to −0.592 does indicate a lack of a solid urban basis at the intermediate level. However, two different patterns could describe the

changes in the smallest cities group. Until 1939, the trend is upwards, from −1.203 in 1897 up to −1.340. The slope then dropped much lower, varying more closely around the target value of −1.0 with a range of values from −1.099 to −0.987 (see Fig. 1).

At this point, two remarks should be made. Firstly, the slope values in 1979 are lower but still close to those in the pre-soviet era of 1897. Secondly, the slope for each city group test shows a declining trend since 1959. In fact, all values are inferior to −1.0 in 1979, except for the largest cities group (−1.086), a reminder of the undisputed dominance over the system by the two leading Russian cities, Moscow and Leningrad. Eventually, if the indicated trend persists, the major cities group could also see its slope value pass below the −1.0 mark in the future. A possible interpretation to be given for the previous behaviour of the sytem is that the urban structure of the USSR has evolved to a state somewhat similar to the one of the pre-revolutionary years, giving rise to secondary influence centres, with the emergence of regional capitals at the intermediate level. The increasingly strong basis of smallest cities, combined with the permanent presence of highly decentralised and competing economic centres at the intermediate level may only increase the tension between the leading cities and the lower urban levels for further power sharing.
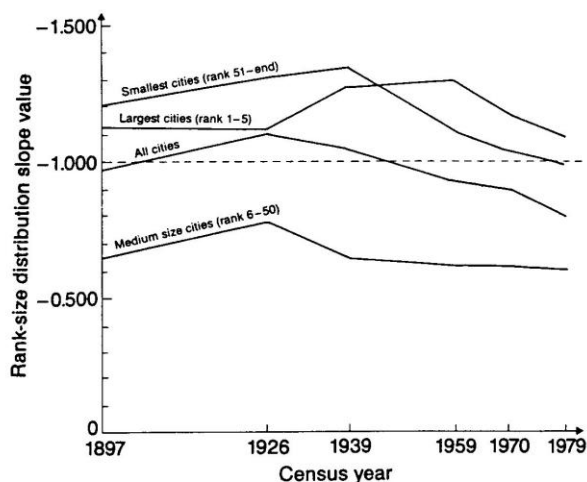
Fig. 1. City rank-size distribution slopes: USSR (1897–1979).

Fig. 2. City rank-size distribution slopes: Ukraine (1897–1979).

(c) Results for the Republic of Ukraine

In order to assess the changes within the USSR and to parallel them with the overall modifications, a complete set of tests has been undertaken on the Ukraine, the largest non-Russian federated republic. Similar conditions are used in the selection and the processing of data as those applied to the USSR and a summary of the results is provided in the lower part of Table 1 with graphic representation on Fig. 2.

With the exception of 1897 and 1979, results for the whole urban system of the Ukraine provide slope values generally close to a normal rank-size distribution. Detailed analysis indicates that the leadership of the system, such as represented here by the five largest cities, was seriously weakened after 1897, as a result of a change in the political regime. As a word of caution, it should be mentioned that data represent population within city limits, not urban agglomeration which would otherwise affect the slope values and allow for a more meaningful interpretation of the apparent lack of strong leadership in the urban network of the Ukraine, as seen in the previous remark on redefining Moscow city limits. The middle-sized cities conform more to linearity, since 1939, while the smallest cities group displays generally high slope values, suggesting a sharp drop of the curve at that extremity, except in 1959 (−0.918). Insufficient numbers of observations for 1970 and 1979, due to an increase of the minimum city size, should warn against hasty interpretation for that group.
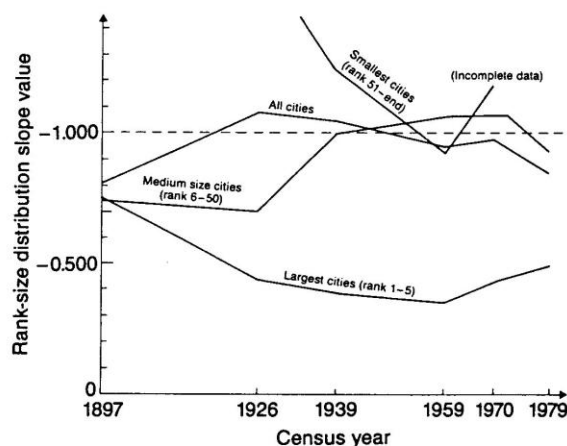
4. Trends in Changing Urban Patterns in the Ukraine and in the USSR

Given the different patterns associated with each system examined previously, it should be enlightening to analyze further any possible relationship existing between them. In other words, do they develop independently of one another or do the interactions manifest themselves only at certain levels and for some given period? Such hypotheses could be formally tested using appropriate mathematical techniques to determine their validity. The preliminary nature of this investigation will comprise only a graphical representation of the possible relationships.

Starting with the slope values obtained from the regressions, the changes in a system could be expressed in terms of the other system, such as with the ratio of the slope values. Trends for the component region will vary relatively to the overall changes between periods.

When the curve indicates an upwards trend, the changes have benefited the component region, providing its absolute slope value is inferior to −1.0 as expected in lognormal distribution. Similarly, it could be claimed that the superstructure has lost some of its relative primacy if its own absolute slope value was originally above −1.0.

Examining Fig. 3, it should be noted that the vertical axis represents now an index of positive numbers, the ratios of the slope values. The base value of 100 stands for the neutral case, when both systems exhibit the same individual slope values,
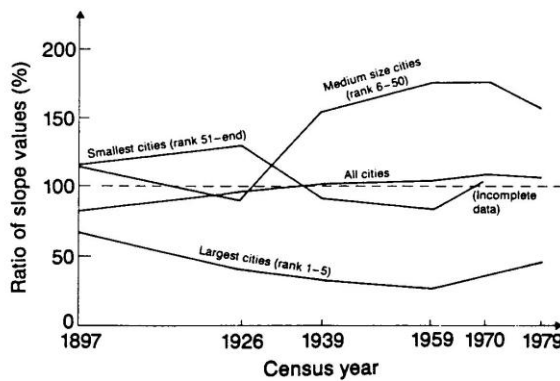
Fig. 3. Ratios of city rank-size distribution slopes: Ukraine/USSR (1897–1979).

while horizontal trends would indicate that the same rate of change occurred in both samples for the given period.

When considering all cities in the sample, a persistent trend is noticed in favour of the Ukraine, despite the fact that both individual values for 1979 are quite low. In other words, the departure from normality has been more serious for the USSR. Undoubtedly, it will be difficult to ascertain the extent of this proposition, since the samples have a disproportionate number of observations for that given year (269 against 38). However, a steady move towards normality seems evident for the Ukraine, corresponding to a certain form of decentralisation at the level of the USSR. In fact, dual moves towards normality were present from 1926 to a point before 1959, when both systems developed their urban structure simultanously, rather than at the expense of each other. Supplementary tests, available upon request from the author, have explored that particular aspect. By developing an extra series of tests with data for the USSR without the Ukraine, some comparisons were made with results for the Ukraine, as if both were totally separate entities.

The obvious discrepancy between both systems is with the largest cities group, marked with a slight improvement only after 1959, the period of the Kruschev era and some measures of decentralisation. Symmetrically, the relative absence of developing middle-sized cities in the Soviet Union corresponding to the potential of that economy is a relative advantage to the component republics, such as the Ukraine. The unbalance between the two systems at those two levels

of urbanisation could, in fact, simply represent the expression of the development planning made by the political authorities. To conclude, all the ratios are either rising or are already located in the upper portion of the graph (above the 100 per cent mark) and, given the absolute values observed in Table 1, it appears that the urban structure of the component republic, the Ukraine, is either relatively more linearly distributed or improving towards it (or both), at a faster rate than the one in the USSR with opposite effects eventually applying to the latter.

5. Conclusions

The results presented in this paper, while confirming those of Harris (1970a) for the 1959 census year, place them in a necessary perspective. In fact, when seen from a number of different aspects, that period has been marked by several changes in trends. Outlining these tendencies can serve to understand how effectively the state planning practice, in the presence of major events, may result in a particular form of evolution as evidenced by its urban network. Advocates of the rank-size distribution may find a wide range of possible interpretations for opposing theses and there is a temptation to engage in extrapolation. What has been observed, however, was only that the graphic representation of the results seems to be compatible with the thesis of El-Shaks (1972) in describing economic development with a departure from and then a return to the rank-size distribution, but only until 1970. The graphs also showed that the leadership of the USSR could be achieved mainly at the expense of the intermediate urban level, at least when contrasting the changes in the superstructure with one of its major republics. Finally, movements towards some kind of linearity seem to vary with time, despite of intervening forces devoted to their control, although at a much slower pace.

Given the tentative nature of this investigation, further analysis should be undertaken and more tests released for discussion. Urban agglomeration data, control of the minimum city size, variations in the definition of the subgroupings (particularly in the largest cities category), inclusion of other republics and possibly other factors such as those relating to density, ethnic composition and transportation costs should be analyzed. From the theoretical point of view, reassessing the economic and

the political viability of federated states and their components could prove both useful and desirable.

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