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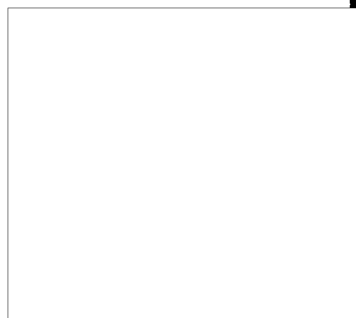Proc

POPULATION AND LABOR FORCE ESTIMATION PROCEDURES FOR SOVIET CITIES

by

Foreign Manpower Research Office
Bureau of the Census

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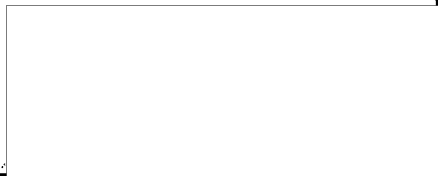Foreign Manpower Research Office
U. S. Bureau of the Census

Under the Contract Monitorship of the

Intelligence Methods Branch

Office for Social Science Programs

Air Force Personnel and Training Research Center

Air Research and Development Command

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PREFACE

During the years 1953 to 1955, the Foreign Manpower Research
Office of the U.S. Bureau of the Census carried on a series of research
studies in demography directed towards the estimation of certain types of
data for cities and other urban agglomerates. The products of this research
are embodied in 47 reports covering 47 areas. For the most part, the areas
for which estimates were made were properly termed cities insofar as
boundaries could be defined. In some instances, however, the estimates
pertained to larger urban units comprising both a central city and selected
suburban areas deemed to have demographic, economic, or military significance.
Each study featured four types of estimates, namely: (a) estimates of total
population; (b) estimates of population distributed by age and sex; (c)
estimates of population by ethnic composition; and (d) estimates of labor
force size and industrial composition.

The principal purpose of this report is to present and discuss
analytically some of the problems that have been encountered in this
research, and to set forth and evaluate some of the techniques developed to
cope with these problems. Because of differences among cities with respect
to data available, and because of important variations in city structure
and function, complete standardization of method has still not been realized.
Yet there are a number of methodological elements in common which have been
handled successfully, and there are also a number of elements which, although
not as yet susceptible to a standardized approach, offer hope that they will
become so after further research.

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The entire research program, the methodology of which is considered in this report, was conducted by the Foreign Manpower Research Office under a series of transfer-of-funds arrangements with the Air Force Personnel and Training Research Center, Air Research and Development Command, USAF, and its predecessors-in-interest. The monitorship, guidance, assistance, and sympathetic encouragement provided by these supporting agencies and their staffs are gratefully acknowledged.

Comments and criticisms of the material covered in this report are invited and should be addressed to the Foreign Manpower Research Office, U. S. Bureau of the Census, Washington 25, D. C.

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SUMMARY

PROBLEM: The principal purpose of this report is to present
to intelligence consumers some of the problems encountered and techniques
developed by this office for coping with these problems during the
course of making demographic estimates on Soviet and Satellite urban
areas on which only fragmentary and obsolete census data were available.
The techniques described represent the lessons learned from several years
of research studies concerned with providing population estimates on
cities and larger urban areas as required. The products of this accomplished
research are contained in reports on 45 cities and urban areas (Appendix V),
17 of which were in the Soviet Union. They include estimates on (a) total
population; (b) population distributed by age and sex; (c) population by
ethnic composition; and (d) labor force size and industrial composition.

METHOD: The method used is that of analytical evaluation of the
various demographic techniques found most effective by the research staff
in arriving at acceptable population and labor force estimates on each of
the 45 Soviet and Satellite cities. It was hoped that from the experience
gained in making these city estimates (1953-56) some standardized methods
would be found effective for use on foreign cities on which only very
inadequate and obsolete basic census data were available. It was found,
however, that because of differences among cities with respect to data

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available and because of important variations in city structure and
function, complete standardization of method had not yet been realized
for any of the three types of demographic estimates made.

FINDINGS:

1.   The methods developed for making estimates of total popula-
tions and breakdowns for Western cities were found to be of little use
for estimating the population of Soviet cities because of important
differences in the amount and kinds of data available. Official census
data with acceptable completeness were available for only two census years,
1926 and 1939. Even these figures are not entirely suitable as they may
have been based upon varying urban boundary delineations. Hence four
general and partially overlapping techniques could be applied: (1) the
use of ratio devices based primarily on election districts; (2) methods of
apportionment (or breakdowns) of a known aggregate population for a group
of cities into that of individual cities for the same time period; (3)
extrapolation, or forward projection, of the trends of some period; and
(4) regression analysis, in which given certain data, the relationships
between certain variables can be statistically computed. Through combinations
of these techniques adapted to meet specific situations and conditions,
fairly reliable estimates and projections of total populations were made,
sometimes from the most fragmentary and incomplete basic data. These were
validated (confirmed) through convergence, closure, consistency and other
types of tests.

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2. The estimation of population distribution by age and sex primarily involved the method of component projection. This method consists of three parts: (1) estimation of the number of persons in the population at some base date for which data are available who can be expected to survive to the end of the projection period; adding to these (2) the estimate of the net change of population due to migration and (3) of the survivors of children born in the community between the base and terminal dates. The method of component projection was found to be workable, although somewhat laborious, except in cases where data were lacking either with respect to the base population or one or more of the components. An alternative approach called the functional estimation technique was suggested. It involves investigation of the possibility of ascertaining measurable relationships between patterns of economic activity and the distribution of the population by age and sex. No satisfactory method of measuring the ethnic composition of small areas in the U.S.S.R., short of an actual census, has as yet been devised.

3. Although estimates of the size and industrial composition of the labor force for all cities were made, no satisfactory standard procedure -- that is, one which when mechanically applied, will produce an estimate of total labor force distributed by branch of industry -- has as yet been found. The core of a number of procedures described in the report was, however, evolved. These procedures are generally applicable to most problems of labor force estimation.

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CHAPTER I
ESTIMATES OF TOTAL POPULATION FOR CITIES OF THE U.S.S.R.

The study of a city's current demographic and economic structure
requires an estimate of its current total population. Such an estimate has an
obvious descriptive value. It enables one to rank the city against other cities,
to compare it with cities in other countries, and to form certain general notions
about the kind of place it must be. Equally if not more important are certain
analytic uses of a total population estimate:

1. It may be compared with figures for earlier dates to indicate the
   magnitude and rate of population growth.

2. If taken in conjunction with vital statistics for the city, it permits
   the estimation of net migratory changes in the population.

3. Such an estimate suggests limits for changes in the composition of the
   population by age and sex and by ethnic origin.

4. It permits the development of crude approximations of the dimensions of
   change in the labor force. An estimate of total population is often
   useful for the analysis of other demographic and economic developments.

Recent Soviet Estimates

A recent important publication of the Central Statistical Administration
of the U.S.S.R., entitled The National Economy of the U.S.S.R.: A Statistical
Compilation and a similar publication of the Statistical Administration of the
R.S.F.S.R. entitled The National Economy of the R.S.F.S.R.: A Statistical
Compilation[1] have made available for the first time in many years a number of
important official population statistics. Of particular interest at this point

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are tables of population estimates as of April 1956 for each city of 100,000
population or more in the U.S.S.R., for each city of 50,000 or more in the
R.S.F.S.R., and certain smaller places. During the years when the methods
described in this report were being developed such figures were, in general,
unavailable for dates after 1939.

Subject to a few reservations, the recently announced official Soviet
city estimates may be regarded as reasonably accurate, and as ordinarily to be
preferred to estimates computed by the methods described below. These reserva-
tions may be summarized as follows:

1. The scope of the official estimates is not certain. Although there
is a presumption that the figures relate to the entire population, it is
possible that certain classes, such as members of the armed forces or persons
in slave labor establishments, may not be included.

2. The geographic area to which the figures relate is not specified,
except in the case of Moscow, Leningrad, and Baku. It may be presumed,
therefore, that the estimates for other places of 100,000 or more inhabitants
relate to the city proper in each case. Nonetheless, since boundary
descriptions are not given, there is some uncertainty about the precise
area referred to. A discussion of the significance of boundary problems
is given below on pages 5 to 6.

3. It is not clear whether the estimates given are on a de facto or
de jure basis. In large cities there is often a considerable difference
between these two populations. The de facto population comprises all
persons actually present in the area at a specified time, regardless of their
usual residence. The de jure population comprises all persons who usually
reside in a place even though they may be temporarily absent at a specific date.

4. The estimates, although cited in an official source, are probably of indifferent quality. Soviet authorities have indicated that they are based on voter registration statistics, population registers, school enrollment figures, and perhaps other series associated with specific segments of the population. Under such circumstances variations in the quality of the estimates are to be expected, but ordinarily there will be no test readily available to reveal inadequacies in specific figures.

One possible approach to the evaluation of the adequacy of the official estimates consists of comparing them with the population figures implicit in the number of election districts set up for the 1955 Republic elections. These districts were set up in December 1954 and the corresponding derived population figures presumably refer to that date or to an earlier date. It is possible to make this comparison for 128 of the 135 cities of 100,000 or more inhabitants according to the official April 1956 estimates. In 1 case the 2 figures proved to be identical, in 53 the 1956 estimate exceeded the 1954 figure implicit in the voting district data, and in the remaining 74 cases the 1954 figure exceeded the 1956 official estimate. For the most part, the differences were well within the error of estimate of the 1954 population. Moreover, even in the case of those few cities, such as Voronezh, Tashkent, and Molotov, for which the 1956 estimate exceeded the 1954 estimate by a figure amounting to a relatively large proportion of the possible error inherent in the 1954 estimate, no inference as to the adequacy of the 1956 official estimate may be drawn, because of the possibility of growth during the intervening period. Similarly, the comparison is not particularly useful in the case of those cities for which the 1954 estimates exceed those for 1956. In almost all of the 74 cases the difference found is

attributable to boundary differences or else amounts to only a minor fraction
of the possible error inherent in the 1954 estimates. The only exceptions are
Moscow, where the difference of 411,000 amounts to more than twice the maximum
error inherent in the 1954 estimate; Kirovabad, where the difference is almost
3 times the maximum error; Tallinn, where the difference is more than twice the
maximum error; and Kaliningrad, Saratov, Omsk, Chita, Vilnyus, and Kaunas, where
the difference in each case exceeded half of the maximum error. Unless there is
reason to postulate population losses in these 9 cities between late 1954 and
early 1956, the comparison indicates that the official figures should be used
with caution as they are probably understated. In the case of Vilnyus, Kaunas,
Tallinn, and Kirovabad, however, the understatement, although relatively large
in terms of the inherent error of the 1954 estimates is small in absolute terms,
and may be disregarded.

Another approach to the evaluation of the 1956 estimates involves the
use of official data on square meters of dwelling space in some of the larger
cities. These data were published for 32 cities in the same source as the
official population estimates. If the housing space data are expressed in
per capita terms on the basis of the 1956 official population estimates, it is
found that the per capita housing space for most of these cities varies very
little. The mean of the per capita housing space figures for the 32 cities
is 7.19 square meters, and the standard deviation is 1.55 square meters. One
per capita figure, namely 12.04 square meters for Riga, falls more than three
standard deviations from the mean. The very high value of the figure for Riga
brings into question both the population estimate and the housing space information
for that city. The housing data are not particularly useful in the evaluation

of the population estimates for the other cities, except in the negative sense that they do not show anything unusual.

No doubt, with some ingenuity, there could be devised ways of evaluating the adequacy of the official population estimates in terms of additional pieces of information, and this type of evaluation should be attempted wherever possible. It does not appear, however, that a general quantitative expression of the accuracy of all the city estimates given for 1956 can be had, and the user will usually have to be content with the data as they are despite the areas of uncertainty which have been touched on above. In any event, the official estimates are likely to be superior in quality to those which can be derived by the methods described below.

Area Delineation

Before a city's population may be estimated meaningfully it is necessary that there be a clear understanding of the territorial boundaries to which the estimate must apply. It is not enough to manipulate statistical data which appear to apply to a place having a specified name. To a large extent the delineation of the city or urban area for which estimates are sought depends on the purposes of the study. The object of the investigation may be the legal city as it was constituted on a given date; or a subdivision of the legal city; or the city plus its populated suburbs; or a somewhat larger territory, often called the metropolitan area, in which the legal city and fairly extensive outlying areas are joined by social and economic ties into a single community; or even a target complex, comprising portions of the legal city plus selected contiguous and noncontiguous territory of strategic importance. Each of these types of area would, in general, have a different population. It is also

conceivable that an urban area with a large commuting labor force might have a unique spatial distribution of daytime population and that the centers of concentration of the daytime population would become the object of the research. In such a case the area to be studied might properly be defined in terms of the concentrations of daytime population, with the purely residential quarters regarded as outside the scope of the study.

Although research requirements inevitably govern the delineation of the area for which the population estimate is desired, the nature of the statistical data available to make the estimate may require important modifications. It is not always possible to attain an ideal if the data are not quite in point. For example, when there have been changes in area over time the statistics available for a city generally do not relate to a constant area, and it is not always possible to extricate the changes in population size resulting from boundary changes from those attributable to natural increase or net migration.

At the very least it is necessary to determine the geographic area associated with each Soviet population statistic to be employed in the research, so that this may be compared with the area for which a current estimate is required, and, if possible, adjusted to conform to the latter. A proper areawise interpretation of Soviet data should be attained before further work on the population estimate may be pursued profitably.

Evidence of area changes.

Direct evidence of area changes by comparison of numerical measures of area at two dates can rarely be had for recent periods. As a rule the statistics available on the area of Soviet cities are 20 to 25 years out of date. In some instances area measurements for the late twenties and early thirties

are found in handbooks of that period, but this is infrequent. Large-scale maps
and town plans, usually for prewar dates, may be measured to determine the area
within administrative boundaries. Sometimes reports showing population density
are found. These, together with the corresponding population estimates, permit
the computation of the area as of the date to which the figures apply. Apart
from such help as may be found in these sources, evidence of territorial
redelineation over time comes mainly from Soviet announcements of administrative
changes and from the comparison of statistics on population with the same date
of reference but different dates of publication.

The chief sources of published information on changes in the extent
of administrative-territorial units in the U.S.S.R. are: (1) a series of
administrative-territorial handbooks,[2] and (2) the Journal of the Supreme Soviet
of the U.S.S.R.[3] These sources provide a qualitative account of territorial
changes. For example, with reference to the city of Tula, these sources indicate
that the metallurgical center of Kosaya Gora was administratively subordinate to
the city in 1938 but detached by 1950, and that the settlement of Novo Tul'skiy
was absorbed by Tula early in 1940 and became a district of the city by 1951.
Such information provides an interpretive framework for the analysis of population
statistics applying to intervening dates. This type of material, however, does
not deal with the number of people involved in each territorial change.

A quantitative evaluation of the effect of territorial changes on
population can sometimes be obtained by comparison of figures for the same place
published before a territorial change and republished with revisions after the
change. For example, boundary changes between 1926 and 1939 for cities with
more than 50,000 inhabitants in 1939 will be indicated by a comparison of the
1926 city population figures released in 1939 with those given in the 1926 census.

The annexation of Kosaya Gora by the city of Tula, to which reference has already been made, could have been discovered from such a comparison:

POPULATION OF TULA IN 1926

As reported in 1939...............	155,005
As reported in 1926...............	152,677
Difference...............	2,328

The difference between these figures is identical to the population reported for Kosaya Gora in the 1926 Census. In this case a precise interpretation of the difference was possible because of the detailed information provided for 1926. When the information for the year of the comparison is more limited, it may not be possible to identify the parcels of territory involved. Nevertheless an indication of the number of persons affected may still be gained. Thus, we have for certain cities of the Uzbek Republic:

Table 1.—POPULATION OF SELECTED UZBEK CITIES: 1939

City	Source A	Source B
Tashkent........................	585,005	567,000
Samarkand........................	134,346	138,100
Kokand........................	84,665	86,300
Andizhan........................	83,691	86,300
Namangan........................	77,351	79,800

Source A: Izvestiya, 2 June 1939.
       B: Akademiya nauk Uzbekskoy SSR. Institut
          ekonomiki. Uzbekistan, Tashkent, 1950,
          p. 72.

From these data the inference may be drawn that between January 1939, the date of the census, and the date when the figures in column B were compiled by the Institute of Economics of the Uzbek Academy of Science, a contraction of the

boundaries of Tashkent and an expansion of the boundaries of the four other cities took place. Another possible inference is that the figures in column A are provisional figures released shortly after the enumeration, whereas those in column B are final tabulations. There is, however, other evidence for Tashkent to support the hypothesis of a change in area.

The case of Tashkent illustrates still another means of detecting boundary changes, i.e., by the use of election data. At a later point, the use of election materials in making estimates of total population will be discussed in detail, but their use in connection with problems of area delineation should also be noted.[4] This use of election data requires a list of election districts with a description of the limits of each district and a large-scale map showing street names. With the use of such materials, for example, both the 1939 and 1950 city boundaries of Tashkent can be plotted.

The 1939 boundaries thus derived proved to be the same as those shown in an official map for 1938.[5] The 1950 boundaries have not been verified independently, but an internal check is possible, as follows:

Tashkent is known to have 7 city rayons. The same electoral figures used to delineate the 1950 city boundaries may also be used to delineate the 7 constituent city rayons. Figure 1 shows both the 1939 and 1950 boundaries of Tashkent as delineated in terms of the electoral information. The difference in area is striking. The Tashkent estimate for 1939 cited in source B in table 1 could therefore refer to 1939 population within 1950 boundaries.

Figure I.--BOUNDARIES OF THE CITY OF TASHKENT, 1939 AND 1950, AND RAYONAL BOUNDARIES, 1950

CITY OF TASHKENT

69° 20' E

41° 20' N

SCALE

0   1   2   3

KILOMETERS

LEGEND

—·—— CITY BOUNDARIES IN 1939

———— CITY BOUNDARIES IN 1950

— — —· CITY RAYON BOUNDARIES, 1950

CITY RAYONS IN 1950

1. KIROV   4. FRUNZE
2. OKTYABR'   5. LENIN
3. STALIN   6. TSENTRAL'—NYY
                     7. KUYBYSHEV

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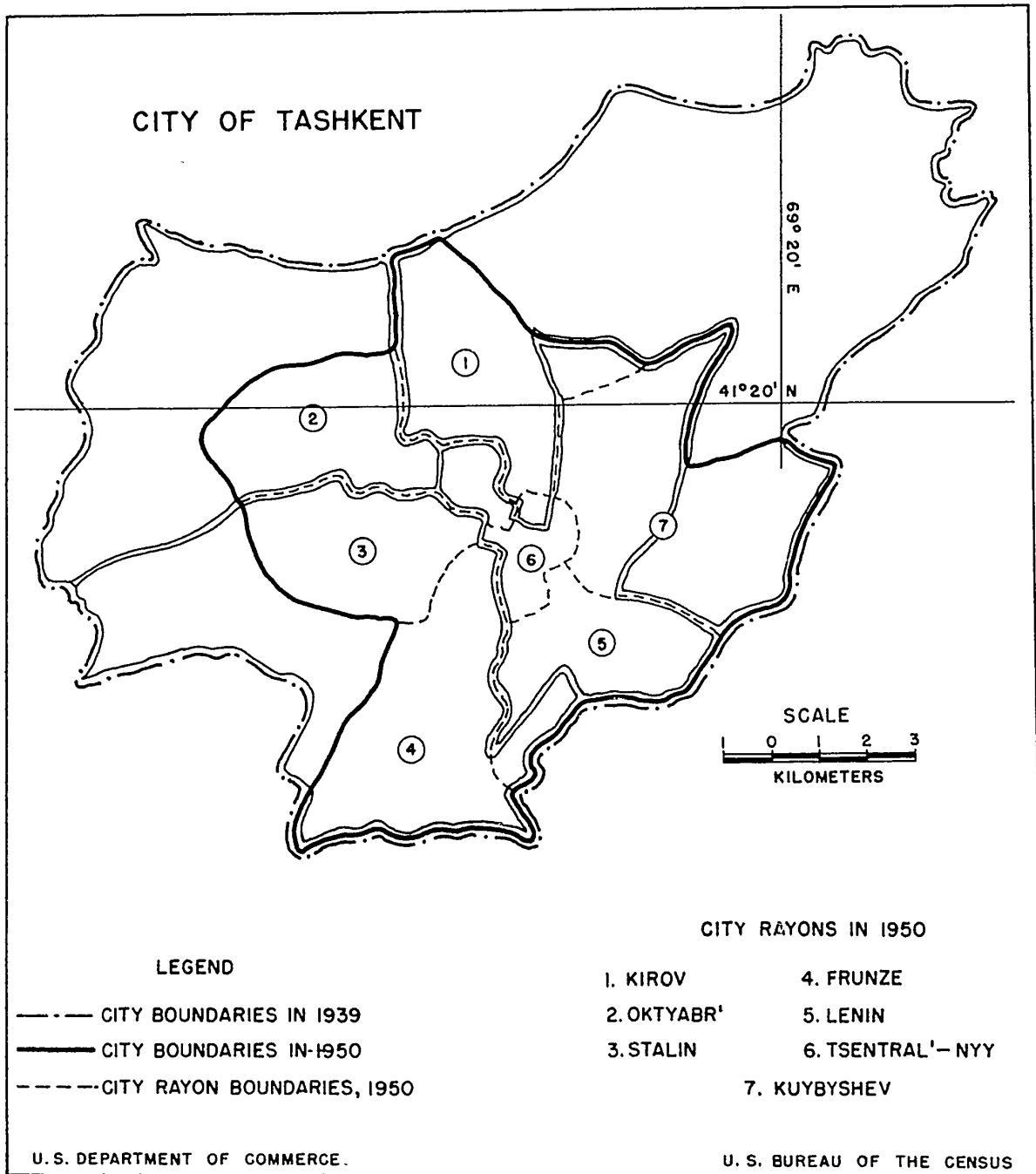
SOURCE: SEE TEXT

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Finally a word of caution is needed with regard to the interpretation
of disparate population statistics such as have been presented above. All
discrepancies between population figures for the same date are not to be taken
as indicative of changes in area. For example, there are certain intercensal
figures reported for Tula which differ because one set of figures relates to the
total population and the other to the civilian population.

The possibility that ostensibly comparable figures contain concealed
elements of incomparability unfortunately looms large. Soviet society offers
numerous illustrations of special population groups such as the armed forces,
security troops, slave laborers, members of ethnic minorities, and the like, which
may sometimes be omitted from statistical tabulations without so stating. Moreover,
especially for the years around 1926, there are numerous illustrations of figures
for the same place and date which differ because one was compiled on a de jure
basis and the other on a de facto basis.

Methods of estimation

Because of important differences in the amount and kinds of data available,
the methods developed for making estimates of total population for Western cities
are usually of little use for estimating the population of Soviet cities. But
regardless of the specific character of the data at hand, there are four general
and partially overlapping approaches that may be followed. These may be classified
as (1) ratio devices, (2) methods of apportionment, (3) extrapolation, and (4)
regression.

To understand the reasons for adopting particular procedures under any of the above headings, one should be familiar with the nature of available population statistics and with the strategy of solution of the problem dictated by them. (An outline, chronologically arranged, of the most accessible items is given in Appendix I.) In general, in dealing with larger places one will have total population figures for the two census years, 1926 and 1939, as well as several observed or officially estimated figures for the intercensal and postcensal periods. Between 1939 and 1956 few figures on total population for particular cities were released. This data deficiency is most serious because 1939 population figures for urban areas are likely to be poor indicators of current population size. The period 1939-1955 was one of relatively large growth of urban population. During this period the urban population increased by 30.9 million or about 55 percent. Part of this growth represents the annexation of urban territory and the formation of some 2,000 new urban places, but much of it reflects growth in cities which were in being in 1939. Thus, the absence of data for years after 1939 increases the possibility of errors of estimation in cases where a 1939 figure is available, and even more so in cases where this information is lacking.

This, then, is the background against which estimates of city population are to be made and evaluated. It may be taken as axiomatic that Soviet demographers have more data at their disposal and are thus able to produce superior estimates. Nevertheless, one may surmise that, due perhaps to the deficiencies of their registration system and to the lack of a postwar census, Soviet statisticians themselves are at times forced to rely upon materials similar to those available to Western demographers who prepare estimates for cities in their own countries.[6]

Ratio devices for estimating total population.

Under this heading are included estimation procedures which convert
a known or given value of one variable into an estimate of the value of a second
variable on the assumption that the ratio between the two variables is the same
as that during an earlier period, as that determined for some other place, or
as that given in a Soviet source for the same time and place. Thus, if A_i
designates the value of one variable at date i, and N_i the value of a second
variable at the same date, values of N for dates other than i may be estimated
as:

$$N_j = A_j \left(\frac{N_i}{A_i}\right).$$

The expression $\frac{N_i}{A_i}$ may be known for an earlier date, for another place, or for the
same date and place, even though N_i and A_i are not known separately. Sometimes
the ratio $\left(\frac{N_i}{A_i}\right)$ is given a value at date j by interpolation or extrapolation between
values of the ratio for two or more other dates.

Ratio devices based on electoral district statistics.

The most commonly used ratios for making city population estimates are
those involving election statistics, especially the ratios of elected deputies[7] to
the number of their constituents. Data on the number of eligible voters are also
widely available and may provide the basis for an estimate of population,
provided something is known or can be estimated about the ratio of voters to
total population. This is the chief problem that one encounters in using data
from voter registration lists. It is a problem that, as we shall see, is handled
explicitly in the case of election district data. On the other hand, there is
greater assurance that eligible voter lists are current than is true of lists

of election districts. The use of voter statistics is discussed further under the heading of apportionment techniques.

According to Soviet statements,[8] the number of election districts established (deputies elected) for any election is determined by dividing the population of the area concerned by the number of constituents per district as set by Soviet law. In general terms, Soviet law provides the value of $\frac{N_i}{A_i}$, where N_i designates population and A_i designates electoral districts. If the number of districts in a specified place, A_j, is known, then the population of that place may be estimated at:

$$N_j = A_j \left(\frac{N_i}{A_i}\right).$$

Information on election districts generally appears in the press about two months or so in advance of an election; for example, the lead time for the announcement concerning the R.S.F.S.R. local elections of 1947 was 55 days.[9] Sometimes the number of districts is announced directly, but the form of the announcement may vary from merely a detailed list of district names and territorial descriptions to a list of names of candidates for office.[10]

There are a number of points about the formation of electoral districts which are not entirely clear, and these obscurities may befog the interpretation of population estimates based upon electoral district data. The most important problem is whether the electoral districts were defined in terms of de jure or de facto population. The great flexibility that exists with respect to legal residence requirements for Soviet voters[11] permits the use of a de facto population base for electoral district delineation, and it is probable that this base is used more often than the de jure base. But one never knows which base was used in particular instances. Another important problem is the determination of the date

of reference of the population figures used by the Soviets in delineating electoral districts. The practice at the time of the December 1939 local elections was, generally, to form districts on the basis of the January 1939 census figures. Evidence of this is the fact that the aggregate end-of-the-year population estimate derived from election data for 29 of the largest Soviet cities differed from the first-of-the-year census count by less than two-tenths of 1 percent. This situation is found despite the fact that the instructions to the electoral commissions are to "establish the total number of election districts on the basis of the population according to the Census of 1939 with an account of changes occurring since the day of the census."[12]

There are, moreover, marked disparities between 1930 Census figures and 1930 electoral imputations in certain areas. In some cases these may be interpreted in terms of territorial changes. In other cases such an interpretation is not supportable and other hypotheses have to be considered. One explanation for which there is some support is that electoral commissions have taken account of large-scale population movements such as the transfer of troops, large labor contingents, and so on, as they were directed to do. Adequate data to test this notion are not available, but the following observations are offered in support of this general thesis.

1. The greatest disparities are found in regions where such population transfers are believed to have occurred, e.g., in the border areas of the Northwest and Far East. Yet, in some instances where sizeable disparities have been encountered there has been no evidence of unusual population transfers. This, it seems, could be as much a matter of the incompleteness of information regarding population movements as it is a denial of the hypothesis.

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2. In a few instances a comparison of order of battle information believed to reflect troop movements during the year 1939 seems to provide a fairly exact reconciliation of the differences between census figures and electoral imputations. Thus, for example, in Arkhangel'skaya oblast the available order of battle indicates the presence in 1940 of two divisions that were not there at the time of the census. The difference between census figures and electoral imputations in this case is around 30,000, which is a reasonable figure for the troop concentration described. Conversely, in Novosibirsk and Kuybyshev, differences of a similar magnitude are associated in each case with the removal to border areas of one division and several miscellaneous military formations. It should be repeated, however, that there are numerous other cases where the order of battle sheds little light upon differences of this type. This should not be surprising since in most cases the imputations for December 1939 are greater than the census figure for January 1939, while at the same time, the order of battle is more complete for the period before the census than for the period following.

Districts established for nonlocal elections, i.e., for deputies to national or republican bodies, frequently cut across the boundaries of lesser civil divisions, thereby impairing to a degree their usefullness in connection with estimates for small areas.[13] This is an inevitable result of the Soviet aim of equal representation for all electors; although an apparent compromise with administrative convenience is made in the provision that oblast, krai, and republic boundaries be respected in the formation of election districts. The inaccuracies thus produced are claimed to range between 3 and 5 percent[14] of the prescribed representational norm in the case of All-Union elections where maximum deviations are to be expected.

Another source of estimation error is, of course, that due to rounding.
For example, a city with a single election district for the election of one deputy
to the Supreme Soviet of the U.S.S.R. (estimated population: 300,000) theoretically
could have a population anywhere between 150,000 and 450,000. However, as the
following tabulation (table 2) indicates, gross errors of this magnitude do not
appear to occur in actual practice. Taking all the cities which in 1939 fell within
this theoretical range, it is clear that an attempt was made to vary the structure
of election districts in accordance with population differences. Cities having a
population close to 300,000 comprise one election district or its equivalent; larger
cities comprise more than one district; whereas smaller cities form only part of
one district.

Table 2.—ELECTORAL DISTRICT COMPOSITION OF SELECTED SOVIET CITIES:
ALL-UNION ELECTION OF DECEMBER 1937

City	Population, January 1939[1]	Electoral district composition[2]	Notes[2]
Stalingrad....	445,476	1 entire district and part of another	...
Sverdlovsk....	425,544	"	...
Novosibirsk...	405,589	"	...
Kazan.........	401,665	"	...
Voronezh......	326,836	1 district	...
Yaroslavl'....	298,065	1 district	...
Zaporozh'ye...	289,188	Parts of 2 districts	...
Ivanovo.......	285,069	Part of 1 district	which also includes 1 rural rayon
Arkhangel'sk..	281,091	Part of 1 district	which also includes 1 rural rayon
Omsk..........	280,716	Part of 1 district	which also includes suburbs
Nizhni Tagil..	159,864	Part of 1 district	which also includes suburbs and 1 rural rayon
Penza.........	157,145	Part of 1 district	which also includes 3 rural rayons
Smolensk......	156,677	Part of 1 district	which also includes 2 rural rayons
Shakhty.......	155,081	Part of 1 district	which also includes a smaller city and 1 rural rayon

[1] Izvestiya, 2 June 1939.
[2] Ibid., 12 October 1937.

Despite the care that may have been taken in delineating election districts in conformity with the population requirement, All-Union electoral districts are probably of limited usefulness for estimating city populations. This results from the fact that there is no requirement that such electoral districts conform to city boundaries. Thus, in only 2 of the 14 cities listed in table 2 does the electoral district coincide with the city. In the other 12 cases a knowledge of the boundaries of the electoral districts is absolutely necessary, if more than a very rough guess of the city's size is desired. To illustrate, we know that Stalingrad contained one electoral district plus a portion of a second. Hence its population could have ranged from about 300,000 to 600,000, depending on the proportion of the second electoral district in the city, and on the deviation of the population actually in each electoral district from the norm of 300,000 prescribed by law. The same observation may be made about Kazan, Novosibirsk, and Sverdlovsk. The information provided by the electoral district data merely permits the conclusion that each of the cities has a population of from 300,000 to 600,000, more or less. Similarly, each of the cities: Ivanovo, Arkhangel'sk, Omsk, Nizhni Tagil, Penza, Smolensk, and Shakhty, are included within a single electoral district, together with some adjacent territory. All that can be said from the data on electoral districts is that each of these cities has a population which was probably less than 300,000. The census taken about a year later places these in the range from 155,000 to 285,000. A rough indication of the extent to which the population of any of these cities differed from 300,000 may be had by noting the number of extra pieces of territory that have been included with the city in a single district (table 2, column 4). There will rarely be enough additional information available to yield estimates of the population of these extraneous satellite territories. Even where such information may be found, there still remains the problem of estimation

error, which for a single district may range up to $\pm\frac{R}{2}$,[14] R being the legally prescribed ratio of population per election district.

Obviously, fine discriminations and close estimates are not warranted by the All-Union electoral data. However, such data are much more useful for estimating oblast populations, because each oblast has an integral number of electoral districts, all but one of which are defined so as to attain as closely as possible the legal requirement of 300,000 inhabitants per district. It is probable that one election district in each oblast has a population which is appreciably different, unless it happens that the total population of the oblast is close to being an integral multiple of 300,000.

There is no evidence that the system of delineation of All-Union electoral districts has changed since 1937; it may be presumed that more recent electoral district data suffer from the same limitations.

Electoral district data from local and Republic elections, when available, should prove much better suited for deriving city population estimates; in these instances it is believed that city boundaries are usually observed and not overridden in the formation of electoral district boundaries.

This, then, is the general character of election statistics in terms of their value as population indicators. When judiciously used for this purpose, they are among the most valuable items released by the Soviets. Their value depends upon:

    1. The type of election (All-Union, Republic, or local),

    2. the areal coverage of the data,

    3. the degree of obsolescence.

These matters are considered below.

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Types of electoral district data.

Variability in the usefulness of different types of electoral data for population estimates may be illustrated by reference to four different types of election held in Moscow between March 1950 and February 1951.

Table 3.—POPULATION ESTIMATES FOR MOSCOW, BASED ON ELECTORAL STATISTICS: MARCH 1950 TO FEBRUARY 1951

Type of election	Date of election	Legal ratio of population per delegate	Range of population estimate
To USSR Supreme Soviet	March 1950[1]	300,000 : 1	4,950,000 - 5,250,000
To RSFSR Supreme Soviet	February 1951[2]	150,000 : 1	4,725,000 - 4,875,000
To Moscow Oblast Soviet	December 1950[3]	30,000 : 1	4,215,000 - 4,245,000
To Moscow City Soviet	December 1950[4]	30,000 : 1	4,275,000 - 4,305,000

[1] Izvestiya, 12 January 1950.
[2] Ibid., 15 December 1950.
[3] Moskovskaya Pravda, 18 October 1950.
[4] Izvestiya, 19 December 1950.

In this illustration there is a range of more than 1 million persons between estimates based on different types of electoral district data. In part, this difference represents the effect of differences between the elections in the legal ratio of population per delegate, and in part it reflects variation in the area to which the electoral district data refer. There are, obviously, practical limits on the size of deliberative bodies. It follows that the larger the jurisdictional area, the greater the number of constituents per delegate. Thus, each delegate to the Supreme Soviet of the U.S.S.R. represents 300,000 inhabitants, whereas each delegate to the Moscow City Soviet represents only 30,000. Hence, the ranges of error in the corresponding population estimates are ± 150,000 and ± 15,000, respectively. Moreover, although an attempt is made to have the delegates represent recognized administrative units, equalization of representation throughout the Union, the Republic, or the oblast often necessitates

the crossing of boundaries of small civil divisions (e.g., cities, rayons)[16] in the delineation of electoral districts. In the case of the All-Union and Republic elections, the districts created for the city of Moscow include the city of Tushino,[17] the villages of Stalinskiy, Lublinskiy, Ryblevo, and Vidnoye, as well as several territorial sectors which penetrate deeply into the hinterland. The superiority of local election statistics[18] for population estimates does not, therefore, rest entirely upon the greater precision resulting from the smaller legal ratio of population per delegate; it also stems from the fact that local election data refer to the resident population of a recognized administrative entity (e.g., the city soviet) and not to the administrative hybrids which may be embraced by the election districts established for Republic and Union elections.

In addition to the factors discussed above, namely variation in the legal ratio of inhabitants to delegates and variation in the area represented by a delegate, there are other factors, more difficult to identify, which also cause variation among population estimates for the same area based on electoral data for different elections. Consider the following population estimates for Moscow Oblast and for a Moscow Subarea, as derived from electoral statistics for different elections:

Table 4.--RANGE OF POPULATION ESTIMATES BASED ON ELECTORAL DISTRICT DATA FOR SELECTED AREAS, BY TYPE OF ELECTION

Type of election	Range of estimates	
	Moscow Oblast	Moscow City Subarea
To U.S.S.R. Supreme Soviet.....	10,650,000 - 10,950,000	1,650,000 - 1,950,000
To R.S.F.S.R. Supreme Soviet..	9,975,000 - 10,125,000	1,980,000 - 2,280,000
To Moscow Oblast Soviet........	9,135,000 - 9,165,000	1,695,000 - 1,725,000

In each case, electoral district delineations respected the boundaries of the civil division to which the estimates apply. A few observations may be made about these data. First, for both Moscow Oblast and the Moscow City Subarea, the central value of the population estimate based on the oblast data is smaller than that based on either the Republic data or the All-Union data. Second, the central value of the estimate based on the Republic data is smaller than that based on the All-Union data in the case of Moscow Oblast, but larger in the case of the Moscow City Subarea. No pattern of regularity may be discerned from these data, but it is clear that there are variations, possibly random, for which no suitable explanation is at hand. The estimates based on the oblast data suggest that when the oblast electoral districts were delineated some classes of the population (possibly armed forces or slave labor) were not taken into account, but no proof of this has been found. It may be said, therefore, that the kind of electoral data chosen (All-Union, Republic, or local) can have a serious influence on the population estimate, and that in general, the local election data have the advantage of a smaller range of error and the possible disadvantage of a putative omission of some classes of the population.

These considerations are frequently academic, for local election information is much more difficult to find than other types. In addition, the imperfections of local election data must be kept in mind. One of the more serious of these is the indeterminancy which results from the practice of setting maxima on the number of districts for each city size group. This practice results in certain blind spots or ranges that are indeterminate with respect to population size. These are illustrated by the system adopted for the R.S.F.S.R. local elections of 1950.[19]

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Table 5.--LEGAL RATIOS OF POPULATION PER ELECTORAL DISTRICT,
BY CITY SIZE CLASS: R.S.F.S.R. LOCAL ELECTIONS OF 1950

City size	Population per district	Maximum number of districts permitted	Range of nondiscrimination[1]
Under 12,000....................	(2)	35	0- 12,000
12,000-99,999...................	350	250	87,500-100,000
100,000-149,999.................	400	300	120,000-150,000
150,000-249,999.................	500	400	200,000-250,000
250,000-349,999.................	600	500	300,000-350,000
350,000-499,999.................	700	600	420,000-500,000
Over 500,000....................	900	700	Over 630,000

[1] The population of cities in these size ranges cannot be determined more precisely from the number of electoral districts. See text for further explanation.

[2] Number of districts fixed at 35. Therefore population per district

$$= \frac{\text{Population of City}}{35}$$

Thus, when the number of electoral districts or delegates for a city is 35 or below, or precisely 250, or 300, or any other number shown in the second column above, the central value of the city population may fall anywhere within the range of nondiscrimination shown in the third column. But if the number of districts is 36, or 251, or 301, etc., the central value of the population estimate is determinate.

Except where such blind spots are encountered local election statistics are ordinarily superior to other types of election data for the derivation of city population estimates. Their scarcity, however, demands constant attention to the development of substitute techniques. One such procedure aimed at utilizing All-Union and Republic information for making small area estimates -- this being a prime advantage of local election data -- is presented in appendix III.

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Obsolescence of electoral district data.

One objection sometimes made to the use of election data for population estimation is that the estimates reflect not the true population of the area, but rather the population figure that happened to be used when the electoral districts were defined. There is reason to suspect that the Soviets themselves may not always have adequate, complete, and up-to-date population figures to use in delineating electoral districts. Moreover, an examination of electoral district statistics reveals an alarming degree of stability over time, supporting the hypothesis that population changes are not always reflected in the number of electoral districts assigned to an area. It has also been maintained that new electoral districts are formed only where there have been relatively large population increases in an area. These objections, if valid, indicate serious limitations on the usefulness of electoral district data for population estimation.

There are numerous references in the literature to the inadequacies of the Soviet statistical system and population data.[20] One Soviet source speaks of local population estimates being made on the basis of sel'soviet registration books and household books.[21] Illustrations of methods of estimating population for specific purposes are found in textbooks on city planning and educational administration. The fact that officials must resort to a variety of estimation techniques to obtain figures which are assertedly not to be had on a reliable basis from censuses or other sources does not necessarily indicate that local population data are poor. A good current estimate is preferable to an obsolete census figure. Thus, the alleged inadequacy of local population figures does not necessarily mean that an adequate estimate is not available. It is not clear, however, that the delineators of election districts always use good current population estimates as a guide.

The evidence that adequate population estimates, even if available, are not always used in the delineation of election districts stems mainly from the stability over time of the number of election districts associated with an area. For example, up to 1955 there were 7 Republics which had a constant number of electoral districts in each All-Union election. Similarly, in the R.S.F.S.R., 42 of 69 oblasts each had a constant number of electoral districts in All-Union elections held between 1938 and 1951. It may very well be true that, at least in connection with All-Union elections, obsolete population data are often used in delineating election districts.[22]

The case is less clear in Republic elections. Between 1938 and 1951, 15 out of 16 Republics did have changes in the number of electoral districts used in Republic elections. And, in the R.S.F.S.R. Republic elections, there were 42 oblasts which had changes in the number of electoral districts between 1938 and 1951, as compared with only 29 R.S.F.S.R. oblasts having such changes in the All-Union elections. In the case of local elections, there is even less evidence of stability in the number of electoral districts, over time. Thus, there may be some merit to the contention that obsolete data have been used in delineating electoral districts; but the problem seems to be more serious in the case of the All-Union elections than in the Republic elections or in the local elections.

It must be granted, however, that the suspected deficiencies in electoral data by virtue of obsolescence have not been demonstrated unequivocally. It can be shown that there are a number of areas in which the number of election districts has changed over time, and these include both areas having changes in geographic boundaries and areas not having such changes. The only way for an area which has not had a boundary change to have a change in the number of electoral districts is by the use of changing population figures in electoral district delineation.

The remaining major criticism of electoral district data as the basis for population estimation is that recognition is given to population changes in delineating election districts only when there has been substantial growth, as by migration. As a corollary, it is sometimes suggested that important population losses are not taken into account in this process. Criticisms of this character are consistent with the evidence of stability in the number of election districts over time, particularly for the All-Union elections. No ready rebuttal of such criticism can be made in terms of the information at hand. Further investigation clearly seems indicated.

The inadequacies of election district data for population estimates are painfully obvious. Nonetheless, such data are often the most useful kind of information available upon which to base population estimates. The possibility that election district data for particular places may be obsolete should be kept in mind by both the makers and users of population figures based thereon, lest there be an unwarranted degree of confidence in the estimates.

Legal ratio of population per election district.

Once a set of election district figures for a particular area has been adopted, it is necessary to determine the appropriate legal ratio of population per district or delegate, so that the two figures may be multiplied to yield a population estimate. It has already been noted that these legal ratios vary by type of election. They may also vary over time, and for local elections, may vary with the size of the population of the area.[23] Values of the legal ratio by type of election, year of election, and size of area are given in appendix II. (See page II-I.) The only caution that need be observed is that the legal ratio of population per district or delegate conform to the data on number of districts which are being used.

Acceptance standards for population estimates based on electoral district data.

Because of the possibilities of error arising from the nature of electoral district statistics, population estimates based on them should not be accepted routinely or mechanically. Each such estimate should, if possible, be tested to determine whether the population change it implies is consistent with evaluations based on other types of data or with expectations based on general knowledge -- perhaps nonquantitative -- about the city's development. Two illustrations of this point are given here, in connection with estimates of population for Samarkand and Kokand, prepared on the basis of electoral district statistics.

Samarkand.--Development between 1939 and 1950 -- This is judged to be a relatively stagnant city with moderate growth anticipated as the result of a small area which contained about 4,000 inhabitants in 1939.

1939 population within 1950 boundaries.........	138,100
Estimated 1950 population......................	[24]150,000
Percentage change, 1939-1950..................	+ 9.0

The change in population indicated by these figures appears to be moderate and in the right direction.[25] It may be shown on the basis of statistics on school enrollment and registered voters that the population probably exceeded 145,000,[26] thus lending some support to the estimate cited here. Moreover, there is a suspicion that electoral district data for native, as contrasted with Russian, communities understate the true population.[27] In the light of these relatively vague impressions the estimate of 150,000 appears to be worthy of acceptance. Some years after the estimate was made, the Soviet government published an estimate of 170,000 for Samarkand as of April 1956.[28] This may be compared with an estimate of 160,000 for

1 January 1955 derived by extrapolation from the 1 January 1950 estimate of 150,000 which was based on the electoral data. Had the extrapolation been carried forward to 1 April 1956, the result would have been 165,000. These figures indicate that the 1950 estimate of 150,000, that is the estimate based on electoral district statistics, may have been a trifle low, but not excessively so considering the possible errors inherent in an estimate of this type. Hindsight, therefore, justifies the earlier acceptance of the 1950 estimate of 150,000.

Kokand.--Development between 1939 and 1950--This is an Uzbek city which had some industrial growth as well as an expansion of area after 1939. Because of limited water supply, however, the growth of industry was not very large. It appears to be a stable city in terms of population size, having changed very little between 1879 and 1939. It might be expected that the population would remain about the same in 1950 and 1939, despite some small growth of industry, because the city had a relative abundance of underemployed labor and because of the water supply problem. A moderate increase in population would also be an acceptable possibility, but substantial gains or losses appear to be ruled out.

> 1939 population within 1950 boundaries....... 86,300
> Estimated 1950 population...................... [2]975,000
> Percentage change, 1939-1950.................. - 13.0

Here, the direction and magnitude of the population change implied by the estimate for 1950, which was based on electoral district statistics, are inconsistent with the expectations and should not be accepted.[30] Some indication of the correct population may be had in other ways.

For one thing, the city of Andizhan elected 248 delegates to its city soviet in December 1950,[31] indicating that its population was about 87,000. Andizhan has been described as the largest city in the Fergana valley.[32] Hence, Kokand's population should be smaller than 87,000. For another, the city of Kokand had 5 of the 48 election districts in the Fergana Oblast for the elections to the Supreme Soviet of the Uzbek S.S.R. in January 1951. It should, therefore, have $\frac{5}{48}$ths of the oblast's population, more or less. On the basis of oblast data for the local elections of September or October 1950, Fergana Oblast had a population of about 812,000. Kokand, therefore, had $\frac{5}{48}$ths of this, or a population of about 85,000. This is virtually the same as in 1939 and earlier years and is in accord with the expectation. The decision to reject the estimate of 75,000, which was based on electoral district data from a Republic election in favor of an estimate of 85,000, which was based on electoral district data from a local election is in accord with the basic hypothesis that the local election data give more accurate results.

The two illustrations above deal with situations in which the electoral district data estimates of population indicate population growth or decline which should be checked in the light of other information. The case of no indicated growth should also be considered. This is the obverse of the Kokand illustration in which no growth was expected, but a population decline was implied by the electoral district data estimate. If ever a case is met in which the electoral district data yield a population estimate which is the same as the number of inhabitants at an earlier date, a check should be made to determine whether, for

the election in question, the electoral districts have in fact been adjusted in areas of known or probable population change. There are grounds for believing that there are sectional differences in the degree to which electoral districts have been formed or altered to conform to real changes in population.

Consider, for example, the data on number of electoral districts employed in the Republic elections in February and March of 1955. Leaving aside for the moment the so-called special districts or military electoral districts (of which there were 12 in the R.S.F.S.R., 3 in the Ukrainian S.S.R., 5 in the Byelorussian S.S.R., and perhaps others elsewhere), it is found that the population of the U.S.S.R. implied by the number of electoral districts amounts to 205.78 million. Not much is known about the so-called special districts. These probably represent Soviet military forces outside the country -- as is known to be the case for similar special districts employed in several All-Union elections. In any event, it is not likely that they represent definable geographic areas, for place names such as are customarily associated with each electoral district in press accounts have not been found for these special districts. The minimum estimate of 20 special districts cannot be converted into a precise estimate of population represented, for it is not clear what legal ratio of population to districts applies to these special districts. If each has the legal ratio used for other electoral districts in the same Republic, the population represented amounts to about 2.20 million, which is not an unreasonable figure for Soviet armed forces abroad -- if that is what these constituents really are. Hence, the population of the U.S.S.R. early in 1955 was about 205.78 to 207.98 million, according to the electoral data imputations. From data on total population as of April 1956 and on rates of natural increase for 1955, recently released by the Soviet Government,[33] it would appear that the population at the

beginning of 1955 was approximately 196 million. Over all, therefore, the
electoral district data seem to overstate the population.

This is not always the case for individual Republics. The estimates
for early 1955 based on electoral district data may be compared with the official
estimates for April 1956.[34] In terms of the ratio of the electoral data based
estimate to the official estimate, the central Asiatic Republics rank as follows
(out of 16 Republics): 8, 11, 14, 15, and 16. The rankings of the Transcaucasian
Republics are: 10, 12, and 13. The R.S.F.S.R. and the western Republics monopolize
the ranks from 1 - 7, with Byelorussia ranking ninth. Even if allowance is made
for differentials in the birth and death rates among these three sections of the
U.S.S.R. -- and this can be done only roughly -- it is clear that the electoral
district based estimates tend to overstate population in the R.S.F.S.R. and the
western Republics, and to understate it in Transcaucasia and in Central Asia.
Consequently, a population estimate which is based on electoral district data
and which indicates no change in population since an earlier date, may suffer
from a failure to properly redistrict for electoral purposes, and may be
unacceptable for that reason. It is always worth testing to determine whether
this is likely to be the case.

As a specific demonstration of this point, consider the following
data:

City	Population	
	1939[1]	1950[2]
Tashkent.....................	585,005	600,000
Margelan.....................	44,700	45,000

[1] 1939 Census.
[2] Imputed from Republic election of 1950.

As an initial conclusion it appears that neither city had much of an increase
between 1939 and 1950. Indeed, since the deviation of both 1950 estimates from
their 1939 level is within the 5 percent margin of error claimed for electoral
imputations,[35] the conclusion of no change from 1939 is tenable. Before this
is accepted, however, the possibility of a failure to redistrict must be
considered. In this instance an examination of similar statistics for other
Uzbek cities indicates that redistricting was in fact carried out in preparation
for the 1950 elections. Therefore, unless Tashkent and Margelan were treated
otherwise for some reason, the conclusion that their 1939 and 1950 populations
were approximately the same appears to be warranted.

Upon examination it turns out that there are reasons for accepting
this as roughly correct in the case of Margelan.[36] One would hardly expect,
however, that Tashkent, as the principal city of Uzbekistan, would stagnate during
a period when the urban population of the republic increased by approximately
25 percent. Furthermore, as shown on page 9 , the case of Tashkent is complicated
by boundary changes. Therefore, it is not surprising that calculations based
on somewhat different data indicate the 1950 population of Tashkent within the
1939 boundaries to be closer to seven than to six hundred thousand. The
imputation of 600,000 refers to the central city, the larger total to a larger
metropolitan area which approximates in area the city of 1939.

The illustrations given above do not, of course, exhaust the possibilities
for evaluation of the adequacy of population estimates based on electoral district
data. In other instances there will be other types of data available to facilitate
proper evaluation, and the ingenuity and skill of the evaluator will be an
important determinant of the types of analysis employed.

Comprehensiveness of electoral district based population estimates.

Apart from the problem of how well a population estimate based on electoral district data accords with expected changes in population, there is another type of problem to be considered before accepting such an estimate. This is the problem of comprehensiveness or coverage. Are all the inhabitants of an area comprehended in the population estimate so derived, or are specified or unspecified classes of persons excluded?

A comparison of population estimates based on electoral data of various types with population census figures is possible for the prewar period.

Table 6.--PERCENTAGE DEVIATION OF POPULATION ESTIMATES BASED ON ELECTORAL DISTRICT DATA FROM CENSUS FIGURES, BY TYPE OF ELECTION, FOR SELECTED POPULATION AGGREGATES: 1937 TO 1939

Type of election	Year	Percentage deviation of estimate from Census total	Population aggregate
All-Union[1]	1937	[2]+1.0	U.S.S.R.
Republic[3]	1938	[3]-0.4	Total of 11 Republics
Local:			
City soviet[5] ..	1939	+0.2	Total of 29 large cities[6]
Oblast soviet[5]	1939	+0.6	Total of 42 oblasts, autonomous oblasts, and krays in the R.S.F.S.R.[7]

[1] Election of December 1937.
[2] Comparison with reported population of 169,000,000 for December 1937. See: Pravda, 15 December 1937.
[3] Election of June 1938.
[4] A similar comparison for certain Republics, A.S.S.R.'s, and oblasts can be made against population estimates for 1938 which are given in Planovoye Khozyaystvo, no. 5, 1941, pp. 75-89. The overall difference amounts to less than 0.2 percent.
[5] Election of December 1939.
[6] Aggregate population exceeding 15 million.
[7] Aggregate population exceeding 97 million.

The very close agreement between the estimates of population derived from electoral district data and the census figures is a very persuasive demonstration of the thesis that, at least in the prewar period, the comprehensiveness of the estimates was, for all practical purposes, identical with that of the Soviet census. Such close correspondence between electoral imputations and prewar census figures does not resolve the question of comprehensiveness, for two questions remain: (1) are census figures themselves comprehensive[37], and (2) does the correspondence between estimates and census figures persist after 1939. An affirmative answer to the first question appears to be indicated, although it cannot be decided definitively. With respect to Soviet prewar census figures, the following points suggest that they are relatively comprehensive:

1. The Soviets have striven for complete enumeration in an apparent effort to conceal the large population losses of the thirties and in order also to meet the informational needs of a planned economy.[38]

2. There are no marked abnormalities in the reported or estimated age-sex structures of the U.S.S.R. population such as would result from the suppression of information on selected groups.

3. There is evidence that slave laborers, the group perhaps most likely to be omitted from the census, were actually enumerated.[39]

4. The large gap (six or more million persons) in prewar and postwar estimates between the number of eligible voters and the population of voting age (18 years old and over) is suggestive of the comprehensiveness of the census, since this gap is of a size that can readily accomodate the estimated number of those unable to vote (slave laborers, inmates of prisons, etc.).

POOR ORIGINAL

Inasmuch as there has been no postwar census, it is somewhat misleading
to speak of a persistence during the postwar years in the degree of correspondence
between estimates based on electoral data and census figures. There are varied
population figures for the postwar period, but none purports to be based on a
census, and differences between estimates and official figures may be due as much
to inadequacies in the official estimates as to inadequacies in the basic electoral
district data. A summary of selected population estimates based on All-Union and
Republic electoral district data points up the problem:

Table 7.--DISCREPANCIES BETWEEN POPULATION ESTIMATES OF THE U.S.S.R. BASED
ON ELECTORAL DISTRICT DATA FOR UNION AND REPUBLIC ELECTIONS: 1937/1938
TO 1954/1955

Year	Type of election		All-Union - Republic differences
	All-Union	Republic	
1937/1938..............	170,700,000	169,630,000	1,070,000
1946/1947..............	199,400,000	193,385,000	6,015,000
1950/1951..............	202,000,000	198,610,000	3,390,000
1954/1955..............	210,800,000	205,780,000	5,020,000

The official Soviet estimate of 200.2 million for April 1956, coupled with
official vital rates for the years 1950 to 1955, indicates that the population on
1 January 1951, was about 183.1 million and on 1 January 1955, was about 195.9
million. It may readily be seen that estimates based on electoral district data
greatly exceed the official or officially implied population estimates. The
official figures imply a very great loss of population during World War II, and
it may be that this loss was not taken into account in the formulation of postwar
electoral districts. One hypothesis sometimes advanced in this connection is that
population gains in particular areas were taken into account, but that population

losses were ignored. Another possibility is that the official Soviet figures are incomplete, perhaps excluding armed forces or other population groups. The magnitude of the discrepancies between postwar estimates based on electoral district data and official population figures is disquieting, and creates a substantial doubt about the correctness of each set of figures.

Moreover, as may be seen in table 7, the level of population estimates based on the All-Union electoral districts is much higher than that based on the Republic electoral districts. Still another puzzling feature is the fact that the population increase between 1951 and 1955, as implied by either set of estimates in table 7, is considerably smaller than the increase implied by announced official data on population and vital rates, that is some 7 - 9 million increase in the estimates as compared with almost 13 million increase according to the official data.

Lacking knowledge of the reasons for these discrepancies, the analyst must use considerable caution in dealing with population estimates derived from electoral district data in the postwar period, and particularly since 1950. Unfortunately, other data resources are quite meager, and recourse must often be had to electoral district data despite their deficiencies. The proper course to follow calls for a selective use of electoral district data, judging results in terms of their agreement with other information and in terms of their reasonableness in a given situation. For example, the population of the Azerbaidzhan S.S.R. in 1949 as estimated by electoral district data[40] was 3,100,000. In view of the fact that this republic is one of the Transcaucasian republics in which there seems to be a systematic downward bias in population as estimated by electoral district data, the estimate of 3,100,000 might be considered as an understatement.

Yet, information on the number of doctors in absolute and per capita terms[41] indicates a population of 3,099,000 for 1949. Apparently the same basic population figure was used to prepare the figure on doctors per capita and to determine the number of electoral districts in the republic. That number may have been too low, but low or not, it is the number that was used.

Other ratio devices.

There is virtually no limit to the number of quantities that may be stated in ratio to total population. The problem is of course to discover items that, in addition to being mensurable, can be shown to be reliably related to total population. In the case of electoral district statistics this connection is provided by decree, but for other items such relationships must be established empirically. This becomes a problem in correlation and in the development of estimating equations and is discussed briefly under the heading of Regression analysis (p. 45). In this section, however, we shall give attention to (1) reported ratios that yield relatively accurate approximations of census figures and (2) the use of mixed sets of nonstandardized ratios where the test of validity is the convergence of results.

In connection with informational releases regarding the cultural and welfare achievements of the regime, the Soviets occasionally publish certain useful per capita ratios together with the associated numerator, e.g., the number of doctors per 1,000 of the population and the total number of doctors. Such figures are relatively rare for recent years and even when found are likely to involve a useless combination of prewar ratio with a current absolute number. For the immediate prewar period however, one may obtain for some 120 cities the ratio of school children to total population as well as the number of school children.[42]

This is an especially valuable adjunct to the census since in this group of cities are a number with less than 50,000 inhabitants for which census results have never been published. In general, however, the prospects for extensive reliance on reported ratios of this type are poor.

Empirically standardized ratios on the other hand represent an unexplored area of potentially great usefulness.[43] To date, however, relatively little work along these lines has been carried out although Soviet planning literature -- to cite one possible point of attack -- contains many suggested ratios.[44] An empirically standardized ratio is one which is not explicitly given in a Soviet source, but which is based on empirical information. For example, if there should be available a series of data on the number of school teachers in a given city, the ratio of school teachers to population at an earlier date or in a city of similar attributes might be applied to the given number of teachers in the city being studied to yield an estimate of population. Another illustration might be data on cinemas, with no information available on the average number of persons served by one cinema. If, however, examination of cinema-population ratios in other places, or in the Republic containing the city, indicates a probable central value of a cinema-population ratio, that central value is what is here called, for lack of a better term, an empirically standardized ratio.

In the population estimates program for Soviet cities carried on at the Bureau of the Census, the use of such empirical ratios has been confined largely to cases where there has been a complete absence of direct information on population size and where the objective of the work was merely the determination of approximate magnitudes. Thus, in work done for the relatively new industrial settlement of Chirchik in the Uzbek SSR, the only basis for an estimate of population size and for a quantitative expression of its development lay in the

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use of such empirical ratios. For the most part, the empirical ratios employed

were those which could be computed for the entire Uzbek Republic. The results

of this procedure are set forth in the following table.[45] After the work had

been completed, the 1939 Census figure for Chirchik was found.[46] It proved to

be 14,700, and fits easily into the series of approximate magnitudes based on

empirical ratios.

Table 8.--POPULATION ESTIMATES FOR CHIRCHIK, UZBEK S.S.R.,
BASED UPON SELECTED EMPIRICAL RATIOS: 1935 TO 1950

Year	Estimated population	Type of ratio
1935.........	18,000	School children/population
1936.........	21,000	Labor force/population
1938.........	[1]12,000-22,500	Republic electoral imputation
	14,000-17,000	School children/population
1940.........	25,000	Newspapers/population
	27,000	Cinemas/population
	28,000	Workers' clubs/population
	33,000	School children/population
1946.........	37,500-52,500	Republic electoral imputation
1948.........	43,000	School children/population
1950.........	45,000	School children/population
	37,500-52,500	Republic electoral imputation

[1] Theoretical range is from 7,500-22,500. There were however,
a reported 7,000 workers and employees, making it unlikely that the
total population was as small as 7,500. The lower limit used allows
for less than 1 dependent per worker or employee.

Techniques of extrapolation.

Extrapolation procedures, which are merely the forward projection of

the trends of some known period, have frequently been used for postcensal estimates

of population. These techniques assume the continuation of existing trends and

are sound to the extent that the pertinent conditions affecting population growth

do not change radically. It follows then, that extrapolations are most trust-
worthy where short periods of time are involved. For these reasons, such methods
have not figured prominently in making population estimates for Soviet cities
since the projection periods involved ordinarily have exceeded 10 years. Furthermore,
the dynamics of the five-year plans and the crushing effect of World War II
produced sharp and pervasive alterations in existing trends. If, for example,
either a simple arithmetic projection or a geometric projection had been used to
estimate the 1939 urban population of the U.S.S.R., basing trends upon the period
1914-1926, the 1939 urban population would have been underestimated by around
26 million persons, an amount equivalent to the total urban population in 1926.
On the other hand, these same procedures if used for the period 1939-1950, would
have produced an overestimation of some 10 million persons (without any allowance
for annexed urban areas and newly formed urban settlements). The accuracy of
arithmetic and geometric projections may often be improved by employing them in
connection with subgroups of the population or by combining the use of arithmetic
and geometric projections. For example, it has been advocated that arithmetic
projections be applied in making extrapolations of the number of expected migrants
and that births might be estimated on the basis of geometric projections. Variations
such as these generally have not been attempted for Soviet cities because of the
absence of data on subgroups, migration flows, and vital rates.

An investment of effort in the development of growth trend curves of
a higher order -- which quite possibly would conform to the data more closely
than either an arithmetic or geometric curve -- has been avoided because of a
preference for procedures with an explicit rationale.[47] At the same time,
component techniques of estimation, which give separate consideration to the

individual factors or components of growth, are usually not feasible because of the almost complete absence of information on migration and vital rates.[46]

Although these comments on the subject of extrapolation are generally negative, it should not be concluded that such devices have no place in the making of estimates of Soviet city populations. Extrapolation is a basic technique and is frequently employed in a secondary role as, for example, the projection of ratios or other relationships such as are encountered in connection with ratio techniques or methods of apportionment.

Apportionment techniques.

Procedures included under this heading are those which break down or apportion a larger whole. This might be the total population or perhaps a growth increment of an area larger than a city. For example, the population of City A may be estimated on the assumption that it bears some relationship to the total urban population of its oblast or, again, the assumption might be made that the city received a certain share of the growth estimated for a number of cities over some period of time. Each problem calls for an apportioning of shares of total population on the one hand or growth on the other. Such procedures involve two problems: (1) the estimate of the population of the larger whole, e.g., either the aggregate population of a group of cities or their growth increment and (2) the estimation of what might be called an apportionment fraction.

In the work with Soviet cities generally, two apportionment procedures have been utilized. (1) Estimates of city population have been derived from an expected share of oblast urban population. (2) In the case of cities of sufficient size and importance to be organized into minor civil divisions (city rayons), the problem has consisted of apportioning the estimated population increment, 1939-1950, for cities of this type. Where the problem involves the apportionment of urban

aggregates larger than individual cities, the difficulties encountered in deriving a figure for the aggregate may be as great and involve as much inaccuracy as a direct estimate for a given city. Nevertheless, under special circumstances, data may be available which permit such estimates to be made with an acceptable degree of precision. The establishment of the apportionment fraction in such problems is in most cases a difficult matter. The simple assumption of a constant fraction derived from some earlier period is ordinarily not trustworthy in view of the structural changes that have taken place in the urban population of the U.S.S.R. during the Soviet period. Between 1939 and 1956 the number of cities increased by 70 percent and the number of other urban settlements by 67 percent.[49] Under such dynamic conditions it is not likely that a city would represent a constant proportion of the urban universe over any appreciable span of time.

Problems of a similar nature are met in the attempt to apportion an estimated aggregate urban population increment, although these are somewhat mitigated by working with subgroups of cities for which some homogeneity can be assumed. Consider, for example, the universe of so-called Class I cities. These are cities organized into city rayons. Included in this classification are most of the cities of 100,000 or more inhabitants, as well as a few smaller cities. As of January 1, 1950, there were 64 cities of this class in the U.S.S.R. Designation of these cities as Class I is for convenience of reference; the terminology is not found in Soviet usage. Among Class I cities there is a positive correlation ($r = .76$) between the share of the aggregate increment received in 1926-1939 and in 1939-1950;[50] on the other hand correlation is negligible when computed for all cities. The estimate of the growth increment of Class I cities is based essentially upon data on the number of persons eligible to vote in local elections.

The apportionment fraction customarily used is that computed for a city in the earlier period, in this case, 1926-1939, although an examination of the relationship suggests that some improvement could be obtained through the use of an estimating equation which would take account of the tendency for smaller Class I cities to receive somewhat larger shares in the second than in the first period.

As mentioned above, data on eligible voters for the local elections in 1939 and 1951 have been employed in estimating the growth of Class I cities. Briefly, this procedure involves the assumption that the rate of growth of Class I cities will have been similar to the computed rate of growth of the number of voters, with an allowance being made for changes in age structure.[51] Data on the number of voters, with the necessary classification by type of administrative area, is most often available in the form of summary tabulations by Republics. Typical of the format used is this tabulation published for the R.S.F.S.R. election of 1951:

Administrative division	Total number of voters
Kray.....................................	7,262,140
Oblast...................................	50,414,567
Okrug....................................	428,683
Rayon....................................	40,974,835
City.....................................	26,599,261
City Rayon...............................	15,129,863
Village and Settlement..............	37,418,697

Source: Pravda, Moscow, December 22, 1950.

An easy and direct interpretation of such a tabulation is impossible because of the overlapping character of the administrative categories that are used. Some discussion of this problem is warranted by the usefulness these figures can have when properly understood:

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Voters shown as voting in elections for the soviets of krays, oblasts, and okrugs (total 58,105,390) do not necessarily represent all voters in the Republic. For example, in the R.S.F.S.R. in 1951, 54,800,000 voters were listed as eligible to participate in the Republic elections held in February. It is probable that the difference between this figure and the sum of voters participating in kray, oblast, and okrug elections is represented by voters residing in cities which are not subordinate to any of these administrative units. The fact that such autonomous cities are sometimes districted in connection with oblast elections tends to contradict this explanation, but the internal evidence in the present tabulation suggests that even though the population of autonomous cities may participate in oblast elections, they are not so recorded in tabulations of voters. Another explanation of this difference, for which there is considerably less evidence, is that certain populations at large, having no identification with local administrations and therefore not voting in their elections, do participate in elections on a Republic level, e.g., certain types of forced laborers, work brigades, etc.

Rayon voters represent voters from all cities plus urban and rural villages which are subordinate to rayon direction. This includes virtually all voters except those residing in cities of oblast or Republic subordination.

The category of city voters includes all eligible voters from places classified as cities, including Class I cities, but does not include urban places otherwise classified, e.g., "workers settlements," "settlements of city type."

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Voters listed as city rayon voters are those from Class I cities.
Such cities are generally of either Republic or oblast subordination.

Village and settlement voters include those from either urban settle-
ments not classified as cities, as well as those from rural villages. The
sum of city voters and village and settlement voters (64,017,958) provides
a close approximation of the total number of voters in the Republic.

Finally full use of such tabulations requires that one consult the
official Soviet administrative handbooks,[52] for the number of administrative
units of each type.

Regression analysis.

Ratio techniques, apportionment devices, and extrapolation procedures
all involve the acceptance of certain relationships, e.g., of school children to
total population; of the share of the growth increment during 1926-1939 to the
share during 1939-1950; of the rate of increase in one period to rate of increase
in the next; and so forth. In the case of electoral district imputations, i.e.,
estimates of population derived from such data, the nature of the relationship
is adopted, often from some larger population or perhaps from an analogical model;
sometimes it may be assumed on the basis of information for an earlier period or
for another place.

Still another, and intrinsically more promising approach is the method
of regression analysis, in which, given the data, the relationships between two
or more variables may be statistically ascertained. In essence, regression analyses
seek to formulate, in terms of suitable parameters, functional relationships between
related variables or, more precisely, between variables for which an a priori
interrelationship may reasonably be postulated.

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For example, it seems reasonable on the surfact that the crude birth rate of a population is affected by such factors as the proportion of women of childbearing age, the proportion of women who are married, the proportion of married women who are employed, the number of marriages in the year preceding, the average number of children per existing family, the availability of simple inexpensive contraceptives, the proportion of the population holding religious views opposed to contraception, the average real income per family, and so forth. Consider, therefore, the information that the crude birth rate of a country is 25 per thousand population. How helpful is this in determining an estimate of the crude birth rate of a particular city or rural civil division? The national rate may be a compound of very low rates in some areas and very high rates in others. If, however, it were possible to assemble data on crude birth rates and on n of the other variables believed to affect the crude birth rate for a reasonably large number of diversified areas, thes data could be expressed in a functional relationship of the form:

$$Y = a_o + a_1x_1 + a_2x_2 + \ldots + a_nx_n$$

where Y is the crude birth rate, and each x value is one of the other variables. The coefficients, a_0, a, $\ldots$, a_n, are statistically derived parameters whose magnitudes depend on the data assembled for the analysis. Then, knowing what values x_1, x_2, $\ldots$, x_n have for some other area, these may be substituted in the equation to obtain an estimate of Y which takes into account the myriad interrelationships of these variables. Incidentally, the coefficients themselves have an analytic significance in that each is a measure of the variation in Y attributable to the particular X with which that coefficient is associated, the other factors being held constant.

The particular formulation of a regression equation given above is in linear form, that is, it assumes that Y and each X variable are linearly related. This need not be assumed, however, if the pattern of empirically derived relationships leads to another conclusion. The arithmetic grows more cumbersome, but the nature of the estimating process is the same.

To return to the problem of using a multiple regression analysis for the estimation of city population, consider the following illustration, which is largely hypothetical.

1. Official population estimates are available for the beginning of 1956 for 135 cities of 100,000 or more population. Since population figures are also available for 1939, the percentage of increase may be computed for each city in this class. Let this be designated by y_i, which is a particular value of Y for city i.

2. Let it be assumed that data are also available for each city on the percentage change in population during an earlier period, the percentage change in the number of registered voters, the percentage change in the number of children enrolled in school, the percentage change in the labor force in large-scale industry, and the like. Let each of these variables be designated by x_{ij}, i indicating the city and j the specific independent variable. In this notation x_{ij} is a particular value of x_j for city i.

3. A scatter diagram may then be prepared for Y and X_j. For simplicity of exposition it will be assumed that each scatter diagram indicates a linear relation between Y and X_j.

4. Using well settled standard techniques for determining the parameters of a multiple regression equation (see any elementary text on statistical methods), an equation of the form

$$Y = a_o + a_1 X_1 + a_2 X_2 + \cdots + a_n X_n$$

may be derived.

5. Given values of x_{ij} for city i, Y_i, or the percentage of increase in the population of city I may be estimated.

6. A graphical representation of the elements of this process is given in figure 2, which, it must be emphasized again, is hypothetical. The individual points represent pairs of values of y_i and x_i, x being one of the independent variables. The line marked "mean" is a representation of the average value of y_i for all the cities included in the diagram. The solid regression line is a representation of the line obtained by fitting a least squares straight line to the data. The small dash line (------) is a representation of the error inherent in estimating y_i from the regression line, and the large dash line (-- -- --) is a representation of the error inherent in estimating y_i in terms of the mean for all the cities in the diagram. The illustration has, of course, been drawn to show the case of a real gain in accuracy accruing from a regression analysis. There may be cases in which there is no gain, however.

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Figure 2.--HYPOTHETICAL RELATIONSHIP BETWEEN PER-CENTAGE CHANGE IN POPULATION AND PERCENTAGE CHANGE IN THE PROPORTION OF THE LABOR FORCE IN LARGE SCALE INDUSTRY
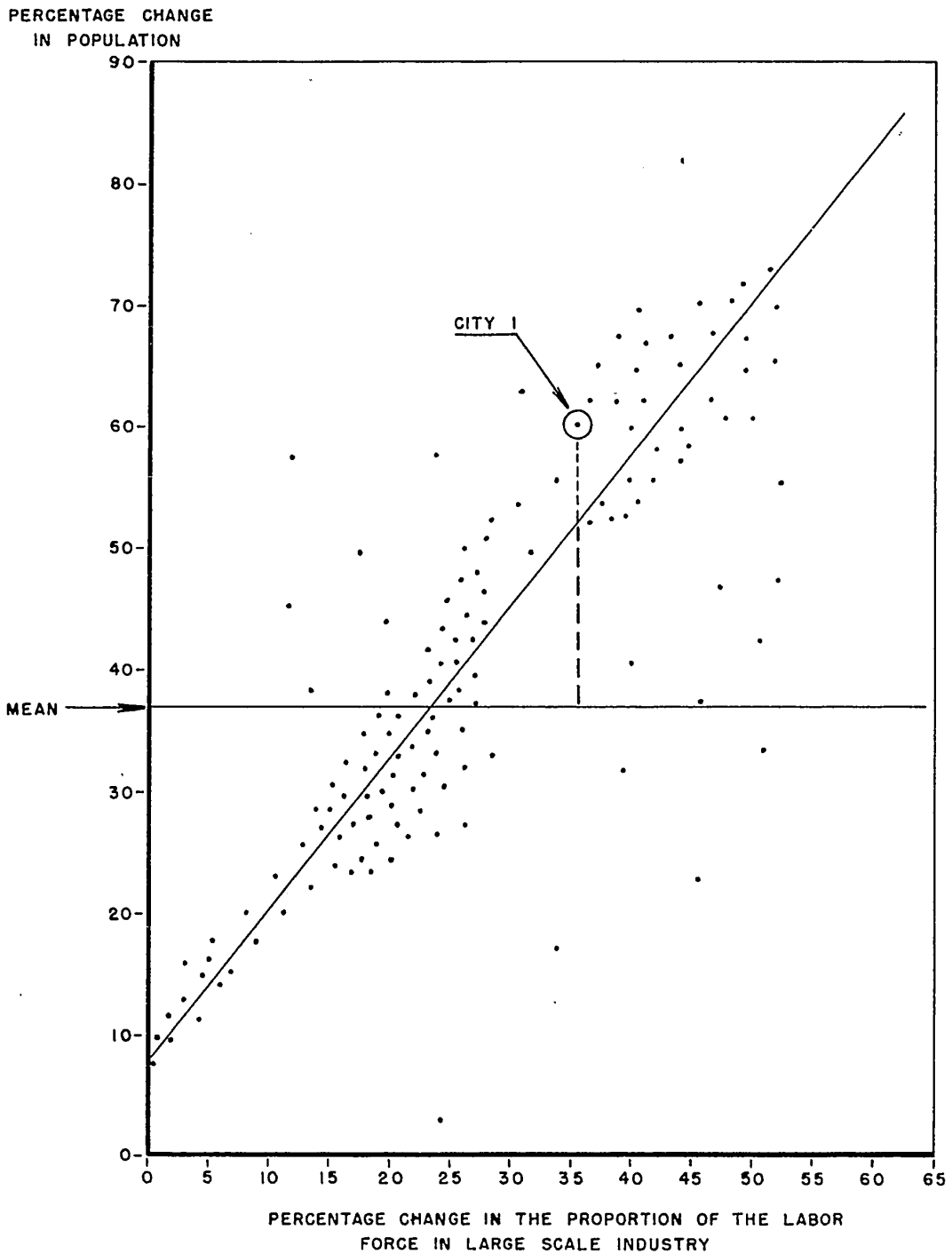
PERCENTAGE CHANGE IN THE PROPORTION OF THE LABOR FORCE IN LARGE SCALE INDUSTRY

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It will be recognized by those familiar with methods of regression analysis that the prediction model discussed here is rather pat. There is little hope, for example, that significant improvements in prediction could be obtained from the use of a single variable such as "percent of change in the proportion of the labor force in large-scale industry."[53]

Moreover, the low level of conceptual and mensurative development in the field of urban research will almost certainly require resort to statistical devices[54] that can deal with nonquantitative attributes. There is little question for example that a careful typology of cities and a sorting of cases by regions would of itself narrow the range of estimation error as contrasted with the practice of basing estimates on the mean value of an undifferentiated universe. The real problem, however, is not the adequacy of statistical devices but rather the lack of both data and hypotheses in this area of research. Results of similar work in the United States[54] have shown a considerable part of the variation in growth rates to be a function of (1) previous rates of growth and (2) regional differences. The nontheoretical nature of such findings, however, in the absence of extensive comparative studies, leaves us without a basis for assessing the likelihood that such a relationship will stand up from sample to sample. In such instances we are dealing merely with refined extrapolations. Hence improved estimates of total population by way of regression analysis must await the necessary preliminary work of both a conceptual and a mensurative sort.

Validation of Estimates

The term validation is used here in the sense of achieving confirmation. Three different types of procedures are proposed in addition to such validation tests as may ordinarily be employed in adopting any method of estimation.

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Therefore, this discussion refers only to the validation of _results_ obtained
by the methods discussed in the earlier portions of this chapter. For convenience
these validating procedures may be referred to as tests of convergence, closure,
and consistency.

Convergence tests.

In view of the very great shortage of validating items it will
ordinarily be advisable to derive a city population estimate by more than one
of the methods that have been presented. An agreement or convergence of results
increases the acceptability of the estimate.   For example, an estimate of
150,000 inhabitants for the city of Samarkand has been made on the basis of
the number of electoral districts formed for the Republic elections of 1951.[56]
In support of this there is an alternative estimate of 145,000[57] based upon
Samarkand's expected share of Kazakhstan's Class I city growth between the years
1939 and 1951. The agreement here is within acceptable limits. As mentioned
in connection with the discussion of ratio techniques, each individual estimate
should be considered also in terms of the reasonableness of the changes it implies
and this should be done before attempts are made to validate it by way of convergence
with other estimates or by any other means.

Closure tests.

This method of validation refers to the requirement that population
estimates of individual city population when added together fit with known or
firmly estimated group or regional totals. Thus, for example, the population
estimates made for the cities of Fergana and Margelan were added to an estimate
previously made for the city of Kokand and the sum of these was compared with an
estimate of the total urban population of Fergana oblast in which all three cities
were located. The totals involved were as follows:

Fergana-Margelan...............................	120,000
Kokand...	85,000
5 settlements of city type....................	35,000
Estimated total urban population of Fergana oblast................................	240,000

The aggregate population of the five settlements of city type in the example

above is a residual and represents a certain degree of looseness in the application

of this particular test. It does, however, yield a reasonable figure for the

average size of such settlements, which would not be true if there were gross

noncompensating errors in the estimates of any one of three cities. Ultimately,

tests of closure should be applied to estimates which have been made for large

numbers of cities by comparing their accumulated total with estimates independently

derived for larger urban aggregates.

Consistency tests.

The tests of validity dealt with heretofore have been primarily

demographic. The consistency of city population estimates with nondemographic

information is another approach to the question of validation. The statistic

that has been used in this way most often is the size of a city's total labor

force. Unfortunately not enough is known of the behavior of crude labor force

participation rates to establish criteria of acceptance or rejection in terms of

given levels of participation. It is not improbable, however, that research in

the future will supply such yardsticks. An examination of labor force participation

rates in the United States in 1940-1950, in postwar Czechoslovakia, and in postwar

Poland, reveals rates averaging from 45 to 50 percent with standard deviations

of 2 to 4 percent. This suggests that under certain conditions the labor force

participation rate is a highly stable statistic. However, the labor force

participation rates[58] of Soviet cities in 1936, the latest period for which

anything like comprehensive data are available, show considerably greater

variation than that observed in the United States, Czechoslovakia, or Poland.

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Cities of the Ukraine and of the Central Industrial Region, where the level of
crude labor force participation rates is comparable with that noted for the United
States and Czechoslovakia, showed over twice as much variation. This is due in
large part to the uneven economic development of Soviet cities up to 1936 as
well as to certain definitional problems of the labor force data in question
which tend to exaggerate real differences. This does not mean that the labor
force estimate is not a useful statistic for validating city population estimates.
It does mean, however, that at the present time such validation must ordinarily
be carried out on the basis of an examination over time of the labor force
participation rates of a given city. (Data for a chronological treatment of
the labor force are discussed in chapter 3.) In other words standardization must
be achieved through comparison with previous levels. Sudden changes in the level
of labor force participation rates, especially declining labor force participation
rates in the case of cities favored by Soviet economic plans, challenge the
validity of a population estimate -- assuming the labor force estimate to have
been previously validated. On the other hand it does not always follow that
one is dealing with an acceptable labor force participation rate if no violent
deviations from trends are observed. In such cases the level of the rate may
still be questioned. Some standardization may be obtained also by an inspection
of the known participation rates of cities of a similar industrial character.
Finally, all consistency tests which concern themselves with the labor force
are complicated by variations in the proportion of nonresident commuting workers
and by variations in the extent to which special types of temporary labor may
have been imported into an area.

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Other types of demographic and labor force comparisons can be made so as to provide secondary tests of the validity of estimates of total population or of growth increments. For example, as is pointed out in chapter 2, the estimation of the age-sex structure of a population depends to an important degree upon the estimate of total population that has been made. Therefore, a comparison of the labor force of a city and the population groups of working age available to carry on the activities of the city will in turn affect the evaluation of the total population estimate.

Data on budget expenditures which are available for some of the larger Soviet cities provide another, apparently rather promising, approach to the problem of validation. Experience with city budget data has been limited, but as shown (figure 3) by the relationship between population growth and growth of budget expenditures (one year lag) in the sixteen oblasts of the Kazakh Republic, these may not be unrelated events. Because of differential and compensatory demographic movements within oblasts, it is likely that the association between over-all population change and over-all change in investment is somewhat attenuated[59] when the oblast is the unit of observation.

The tests that have been proposed do not exhaust the possible methods of validation. Unique items of information are sometimes available and may often provide tests that override any that have been discussed here. As work advances in the field of human ecology as well as in other phases of the social sciences, it is to be expected that many types of relationships will be uncovered that will lead to a greater battery of available tests.

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FIGURE 3. RELATIONSHIP OF POPULATION CHANGE TO CHANGE IN BUDGET EXPENDITURES, OBLASTS OF THE KAZAKH SSR

PERCENT CHANGE IN
POPULATION, 1947–1955

PERCENT CHANGE IN BUDGET EXPENDITURES, 1946–1954
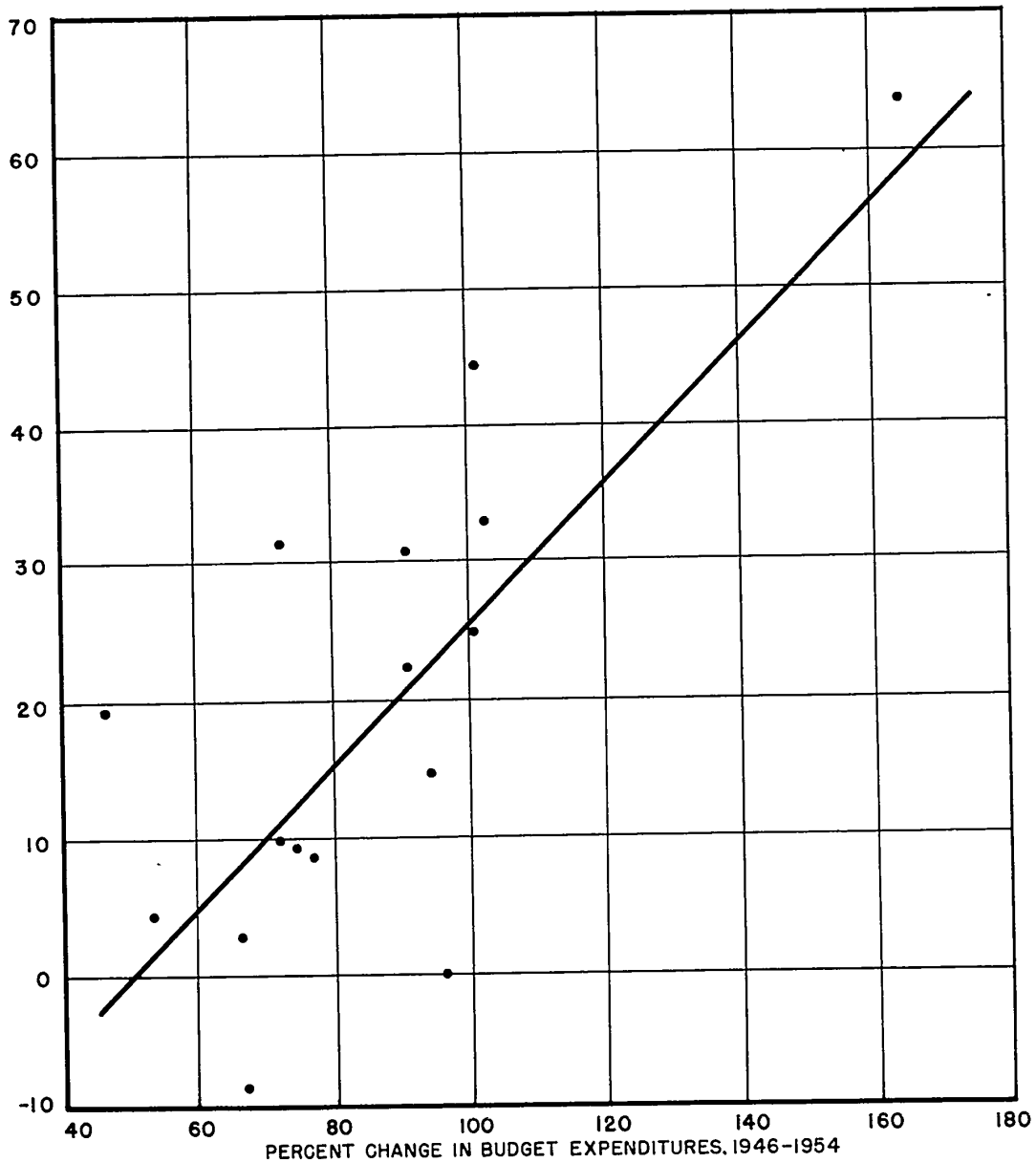
SOURCE: ESTIMATES PREPARED BY THE U.S. BUREAU OF THE CENSUS ON THE BASIS OF INFOR—
MATION IN KAZAKHSTANSKAYA PRAVDA, 19 FEBRUARY 1947; 11 DECEMBER 1950; AND 30 DECEMBER
1954. ALSO BASED IN PART ON DATA IN TSENTRAL'NOYE STATISTICHESKOYE UPRAVLENIYE, SOVIET-
SKAYA TORGOVLYA, MOSCOW, 1956.

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FOOTNOTES

CHAPTER I

[1] Tsentral'noye statisticheskoye upravleniye pri sovete ministrov SSSR. Narodnoye khozyaystvo SSSR, statisticheskii sbornik (The National Economy of the U.S.S.R., A Statistical Compilation), Moscow, 1956; and Statisticheskoye upravleniye RSFSR. Narodnoye khozyaystvo RSFSR, statisticheskii sbornik (The National Economy of the R.S.F.S.R., A Statistical Compilation), Moscow, 1957.

[2] Verkhovnyy sovet SSSR. Informatsionno-statisticheskiy otdel. SSSR Administrativno-territorial'noye deleniye soyuznykh respublik (U.S.S.R. Administrative-Territorial Divisions of the Union Republics), various years.

[3] _____. Vedomosti verkhovnogo soveta SSSR (Journal of the Supreme Soviet of the U.S.S.R.), intermittent.

[4] There may be some disparity in areal coverage among various election statistics. This problem is dealt with below.

[5] Boundaries for 1938 shown on NKVD, USSR. Karta Uzbekskoy SSR (Map of the Uzbek S.S.R.), Scale 1:1,500,000, Tashkent, 1938. For the published list of election districts, see Pravda Vostoka, 24 December 1950.

[6] In part this may be inferred from the fact that there has been no general Soviet census since 1939. Moreover, Soviet delegate Pissarev to the World Population Conference in 1954 admitted that "the polls of electors serve as a basis for calculation of the number of urban and rural (persons) 18 years of age and over....lists (of school children) serve as a source for calculation of the contingent of children." From a paper circulated at the Conference entitled "Organization, notions, and determinations of demographic statistics in the U.S.S.R."

[7] Frequently expressed in terms of election districts rather than elected deputies. The former are preferred since such a list is not affected by the deaths of candidates, and inconclusive contents both of which may reduce the number of elected deputies reported as of a specific date.

[8] Polozheniye o vyborakh v kraevyye, oblastnyye, okrugnyye, raionnyye, gorodskiye, sel'skiye, i poselkovyye sovety deputatov trudyashchikhsya RSFSR (Regulations on elections to krai, oblast, okrug, rayon, city, village and settlement soviets of workers deputies, R.S.F.S.R.), Moscow, 1939; also see Vyshinskiy, A. Ya. Izbiratel'nyy zakon SSSR (Election Law of the U.S.S.R.), Moscow, 1950.

[9] Nemov, N. Vybory v mestnye sovety deputatov trudyashchikhsya (Elections to local soviets of workers deputies), Moscow, 1947; see also Article 26 of the Decree on the Election Law of January 9, 1950.

[10] Republic summaries of election results (deputies elected) by type of local election, viz., to krai, oblast, city, city rayon and village soviets, are available, but because of the variation in the value of $\frac{N}{A}$ within each category these data have little utility. Similar summaries of the number of voters are useful and are discussed under the heading of Apportionment techniques.

[11] With respect to the election of deputies to the Supreme Soviet of the U.S.S.R., Article 135 of the 1936 constitution states that "all citizens of the U.S.S.R. who have reached the age of 18, irrespective of race or nationality, sex, religion, education, domicile, social origin, property status or past activities have the right to vote....with the exception of insane persons and persons who have been convicted

by a court of law and whose sentences include deprivation of electoral rights."
In the revision of the electoral decrees approved in 1950 the word residence was
substituted for domicile. In addition, it is stated (Article 12 of 1950 revision)
that "All citizens who possess the right to vote, who reside (permanently or
temporarily) on the territory of a given soviet at the moment of the compiling of
voters' lists....are included in the voters' lists." In Article 13, it is specified
that no voter may be registered on more than one list. The mechanics for preventing
double counting on voters' lists are given in Article 20.

[12] Polozheniye o vyborakh....op.cit.

[13] This is not invariably true. For example, if election statistics for several
consecutive years are available and if during this period the area for which a
population estimate is desired appears in varying combinations with other adminis-
trative units, it may be possible to derive an acceptable estimate by way of a set
of simultaneous equations. In this connection, see U.S. Department of Commerce,
Bureau of the Census, CONFIDENTIAL, Estimated Population and Labor Force of the
Aleksin Industrial Area: 1 January 1950, Series P-95, No. 35, Washington, D. C.,
10 August 1954, pp. 21-30, CONFIDENTIAL.

[14] Polozheniye o vyborakh....op.cit.

[15] This measure undoubtedly exaggerates the error inherent in an electoral district
ratio estimate of population in instances such as Voronezh and Yaroslavl' in table 2;
in such instances, there is no extraneous territory with which to contend, and
experience indicates that the error is apt to be considerably less than $\pm \frac{R}{2}$. In
general, however, without knowledge of the extent to which the extraneous territory
has been included in election district association with the city, this formula
applies.

If a city or oblast or other area has an integral number of electoral
districts, d_i, and these districts were delineated to conform ideally with a
prescribed population per district, R, the estimate of population by the ratio method
is:

$$P_i = R \cdot d_i$$

with a range of error of $\pm \frac{R}{2}$.

If each district had precisely the prescribed population, there would be
no error in this estimate. In general, however, an area will not be entitled to an
integral number of electoral districts, d_i, but rather to a fractional number,
$D_i = P_i/R$. On the assumption that $(D_i - d_i)$ is rectangularly distributed, i.e., it
is equally likely for $(D_i - d_i)$ to have any value in the range $\pm 1/2$, its variance
will be 1/12 and the variance of P_i will be $R^2/12$.

This result permits the determination of the range of error associated
with electoral district ratio estimates of population for larger areas which
are composed of a finite number of constituent areas for which electoral district
ratio estimates of population may be made. For example, consider the problem of
estimating the total population of a Union Republic with N constituent oblasts each
having d_i electoral districts. The estimated population of each oblast would be:

$$P_i = R \cdot d_i$$

and the estimated population of the Republic would be:

$$P = R \sum^{N} d_i.$$

The variance of P is equal to the sum of the variances of the estimates for each of
the N subareas, there being no correlation between these estimates; that is:

$$\sigma_P^2 = \frac{NR^2}{12}$$

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and the standard deviation is:

$$\sigma_P = R\sqrt{\frac{N}{12}} \; .$$

It may thus be said with virtual certainty that $P = R\sum_1^N d_i \pm 3R\sqrt{\frac{N}{12}}$, and that two times out of three the estimate of P would have a range of error of $\pm R\sqrt{\frac{N}{12}}$. This result conforms with intuition, for if each of the N subarea estimates has a range of error of $\pm R/2$, it would be expected that some of the errors would cancel each other when the N subarea estimates were added together. At the worst, if each of the subarea estimates had an error of $+ R/2$, their sum would have an error of $+ NR/2$ which is $1.7\sqrt{N}$ times as great as the standard error of P.

[16] In drawing up election districts, oblast boundaries are observed. Rayons and cities may be split between several districts and combined with other administrative divisions.

[17] Population approximately 25,000 in 1939.

[18] The discrepancy between the imputations from the oblast and city elections is well within the tolerance limits for work of this kind.

[19] American Russian Institute. Constitution of the RSFSR of January 21, 1937 as Amended Through May 27, 1949 (a translation), April 1950, pp. 18-19. See especially Article 145.

[20] Foreign Broadcast Information Service, Daily Report, Foreign Radio Broadcasts, No. 120, 20 June 1956, pp. DD-4, 5, 6. See also Boyarskiy, A. Ya. and Shusherin, P. P., Demograficheskaya Statistika (Demographic Statistics), Moscow 1955, pp. 224, 225, and 235.

[21] Voprosy Ekonomiki (Questions of Economics), January 1955, No. 1.

[22] No Republic has suffered a decrease in the number of electoral districts for elections to the Supreme Soviet of the U.S.S.R. Electoral districts are abolished, however, in connection with Republic and local elections.

[23] There are also differences between Republics in the norms employed in connection with both Republic and local elections.

[24] For elections of Uzbek S.S.R. Supreme Soviet the legal ratio of population per delegate is 15,000. There were 10 deputies elected from Samarkand (see Pravda Vostoka, December 24, 1950). The theoretical range for this estimate is 142,500 to 157,500.

[25] This involves comparisons with other Uzbek cities which will not be made here. For validation of this conclusion, see U. S. Department of Commerce, Bureau of the Census, CONFIDENTIAL, Estimated Population and Labor Force of the City of Samarkand: 1 January 1950, Series P-95, No. 37, Washington, D. C., 20 January 1955, SECRET.

[26] Ibid., p. 16.

[27] Ibid., pp. 16-17.

[28] Narodnoye khozyaystvo SSSR,....op.cit., p. 25.

[29] Five deputies from Kokand were elected to the Supreme Soviet of the Uzbek S.S.R. in 1950 (see Pravda Vostoka, loc.cit.).

[30] See U. S. Department of Commerce, Bureau of the Census, CONFIDENTIAL, Estimates of the Population and Labor Force of the City of Kokand: 1 January 1950, Series P-95, No. 46, Washington, D. C., November 1955, SECRET.

[31] Pravda Vostoka, 10 October 1950 and 4 November 1950.

[32] Vitkovich, V. Puteshestviye po Sovetskomu Uzbekistann (Travels in Soviet Uzbekistan), Moscow, 1st ed., 1951; 2nd ed., 1953, p. 131.

[33] Narodnoye khozyaystvo SSSR, op.cit., pp. 17, 243.

[34] Ibid., p. 18.

[35] Polozheniye o vyborakh...,op.cit.

[36] See U. S. Department of Commerce, Bureau of the Census, CONFIDENTIAL, Estimated Population and Labor Force of the Fergana-Margelan Metropolitan Area: I January 1950, Series P-95, No. 45, Washington, D. C., November 1955, SECRET.

[37] After making due allowances for underenumeration resulting from technical deficiencies.

[38] For a somewhat one-sided but revealing account of Soviet Census methods see Galin, P. Kak proizvodilis perepisi noseleniia v SSSR (How Population Censuses are Conducted in the U.S.S.R.), Munich, 1951.

[39] Petrov, Vladimir. Soviet Gold, Farrar, Straus and Company, New York, 1949, p. 369.

[40] See Izvestiya, February 9 and 16, 1947 and Pravda, February 22-24 and March 1, 1951.

[41] According to data presented by Boyarskiy and Shusherin, there were 5,902 doctors in Azerbaydzhan in 1949 with a ratio of one per 525 inhabitants.

[42] Tsentral'noye upravleniye narodno-khozyaystvennogo ucheta gosplana SSSR. Kul'turnoye stroitel'stvo SSSR (Cultural Construction of the U.S.S.R.) Moscow, 1940.

[43] Not only is it possible that ratios can be found that will possess greater reliability than those presently available, e.g., election data, but with the development of batteries of such ratios based on a number of different kinds of items, it should become possible to make estimates of total population more quickly and with increased margins of confidence. This would be of special importance under emergency conditions when a large volume of current estimates would be required. It would also serve to sharpen the focus and increase the return from our interrogations of POW's and refugees, as well as of our positive intelligence.

[44] See for example the volume published by Akademiya arkhitektury SSSR, Yezhegodnik arkhitektora (The Architect's Yearbook), 1947, pp. 15ff. The list includes the ratio to total population of such items as hotels, hospital beds, various service groups, areas devoted to various types of land use, cultural facilities and so on.

[45] For fuller treatment of the Chirchik problem see U. S. Department of Commerce, Bureau of the Census, CONFIDENTIAL, Estimated Population and Labor Force of the City and Metropolitan Area of Chirchik: 1 January 1950, Series P-95, No. 24, Washington, D. C., 10 March 1954, SECRET.

[46] Akademiya nauk Uzbekskoy SSR. Institut ekonomiki. Uzbekistan, Ekonomiko-geograficheskaya kharakteristika (Uzbekistan, Economic-geographic Characteristics), Tashkent, 1950, p. 72.

[47] Development of such curves is limited also by the small number and low reliability of the available observations of city size.

[48] In the United States, the migration component of population growth has been estimated from data on school enrollment. Such data are sometimes available for Soviet cities. See: U. S. Department of Commerce, Bureau of the Census. Population, Special Reports, Series P-47, No. 4; U. S. Department of Commerce, Bureau of the Census. Current Population Reports, Population Estimates, Series P-25, No. 12; and Shryock, H. S., Jr. and Lawrence, N. "Current Status of State and Local Population Estimates in the Census Bureau," Journal of the American Statistical Association, v. 44, no. 246, June 1949, p. 157.

[49] Narodnoye khozyaystvo SSSR, ... op.cit., p. 10.

[50] This correlation excludes Moscow, Leningrad, and three other cities that were severely damaged by the war and represent, therefore, marked deviations from the general tendency.

[51] Data on eligible voters can be utilized in connection with ratios of the type discussed in the preceding section. Where such data are reported for specific localities the problem is merely one of estimating the ratio of voters to total population. Somewhat more reliable estimates can be achieved if, in addition, data on school enrollment are utilized.

[52] Verkhovnyy sovet SSSR. Informatsionno-statisticheskiy otdel. SSSR Administrativno-territorial'noye deleniye ..... op.cit.

[53] In fact, there may be virtually no association between the rate of growth of cities and the rate of change in the percentage of the labor force in large-scale industry. An attempt has been made to measure the association between the rate of population growth during 1939-1950 and the percentage of the labor force in large-scale industry in 1936, the last year for which data of this type were available for Soviet cities. There was none. A moderate negative correlation has been found by investigators working with data for the United States. See: Bogue, Donald J. and Harris, Dorothy L. Comparative Population and Urban Research via Multiple Regression and Covariance Analysis. Scripps Foundation for Research in Population Problems, Miami University, and Population Research and Training Center, University of Chicago, 1954, p. 21.

[54] The joint consideration of quantitative and nonquantitative variables is possible through the use of covariance analysis, see, for example, Bogue, Donald J. and Harris, Dorothy L., op.cit., pp. 2-18.

[55] See Bogue, Donald J. and Harris, Dorothy L., op.cit., pp. 40-54.

[56] U. S. Department of Commerce, Bureau of the Census, CONFIDENTIAL, Estimated Population and Labor Force of the City of Samarkand: 1 January 1950, Series P-95, No. 37, Washington, D. C., 20 January 1955, p. 18, SECRET.

[57] Ibid., p. 16.

[58] Strictly speaking these are not labor force participation rates since only members of the labor force carried on the roles of local enterprises and classified as workers and employees are considered.

[59] The coefficient of correlation in this case equals .74, and the coefficient of determination is about .55, indicating that about 55 percent of the variation in population growth is "explained by" changes in budget expenditures. Because of the small number of cases involved in this illustration, all temptation to generalize this relationship should be resisted even though the null hypothesis can be technically rejected.

CHAPTER II.

ESTIMATES OF AGE AND SEX DISTRIBUTION AND OF ETHNIC COMPOSITION
FOR THE POPULATION OF CITIES OF THE U.S.S.R.

The enigmatic character of Soviet demography is once more illustrated by the nature and scope of data available for the preparation of estimates of population by age and sex, or ethnic composition, for Soviet cities. Much of the available material of potential utility is quite out-of-date, great gaps in information must be filled in -- albeit often on a tentative basis, and special adaptations of estimating techniques must be formulated to cope with the severe limitations imposed by the nature of the data. A satisfactory mastery of these problems is worth a considerable expenditure of time and effort, for if it is possible to devise techniques which will adequately reveal at least the main features of the age and sex profile of the population of Soviet cities, a most valuable tool for social and economic analysis will thereby be created.

Significance of Age and Sex Distributions and Ethnic Composition

The distribution of the population of an area by age and sex is a unit of information which has manifold potential analytical applications. It may be used to compute significant age-specific rates; to compute standardized rates by which cities may be meaningfully compared with each other; to establish limits for the size of the labor force and the measurement of the nonresident or commuting labor force; to measure the replacement prospects of crucial cohorts such as males of military age or females of childbearing age; to measure dependency ratios; to measure sex ratios by age; and for many other analytic purposes. Recent history provides good illustrations of the practical importance of demographic factors. Witness the demographic deficiencies of France and their relation to its military defeat during World War II, or the impediments to

France's postwar economic recovery stemming from the increase in the proportion of superannuated workers. Consider also that throughout the industrialized world, and especially in the Soviet Union, demographic influences in the form of lowered sex ratios among adults have contributed to increased levels of female labor force participation. The versatility of the age and sex distribution as an analytic tool is very great, and the range of problems which may be the more readily solved by means of this tool is equally great.

Ethnic characteristics may also be viewed as limiting conditions although somewhat more susceptible to cultural elaboration and, therefore, of variable significance as compared with age and sex. At any one time, however, the interpretations given to ethnic differences will provide one of the central principles of organization by which the success odds of a particular society are set. Where ethnic groups are normatively solidified and coherently organized, i.e., incompletely assimilated, ethnic differences will tend also to be differences in training and education, in loyalties, motivation and morale -- in short, in all of the correlates of differential social status. Stated in terms of patterns of communal action, the degree of ethnic crystalliza- tion to a large extent conditions the general performance standards and energy levels of a population and its resilience in the event of adversity. The analysis of ethnic composition should not end, therefore, with the estimation of a frequency distribution. It achieves full significance only when the ways in which ethnic differences operate in the social system have been revealed.

The implications to be gathered from a study of demographic charac- teristics depend upon the extent to which the situation is one that cannot be immediately altered. This is, in general, the case with large, self-contained units, such as nations, where the influence of migration is limited. On the other

hand, demographic descriptions of small, dependent areas have a high rate of
obsolescence due to the metamorphic effect of migration on age-sex and
ethnic profiles. Thus, for example, we cannot expect to attach the same
significance to a shortage of males or to a preponderance of a given ethnic
group in a local situation as we would if this were found to be true for an
entire nation. It follows from this that a full evaluation of the demographic
structure of any area must make some reference to its degree of stability,
which in turn involves a consideration of such matters as the extent to which
local demand for labor has been met and the demography of potential areas of
population supply.

The utility of estimates of age-sex and ethnic structure is not
confined to what may be inferred from them directly. Going a step beyond the
view of population composition as a limiting factor in communal organization,
it may be hypothesized that for each set of organized activities there is an
appropriate population base, both in terms of size and composition. Thus,
for example, estimates of age and sex composition are useful in attempting to
validate estimates of other communal structures, such as the labor force,
which may have been derived independently. This is perhaps the most frequent
use that is made of age-sex estimates for small areas and it involves the
estimation of the labor force through the application of probable rates of
labor force participation to estimates of population by age and sex. Estimates
of ethnic composition cannot be so used because the relationship of ethnic
structure to the size of the labor force is less direct and less reliable. A
knowledge of ethnic structure will however have a bearing on the evaluation of
a city's regional or interregional role, and the extent of its Sovietization.

Except for the Western border regions of the U.S.S.R. (including the Ukraine and Byelorussia), important Soviet cities have been Russian cities, even when located in non-Russian areas.[1] Conversely, a city without a substantial complement of Russians is likely to display a low degree of industrialization and to be of local importance only. Even though ethnic data for cities are generally lacking, the general truth of these propositions is indicated by the patterns of discrimination in both industrial employment and education revealed by Soviet data. Therefore, estimates of age and sex distribution and ethnic structure provide both a quantitative and a qualitative framework against which the character and significance of a city can be evaluated.

The usefulness of estimates of ethnic composition does not necessarily increase with the number of distinct groups that are identified. The required degree of precision for particular evaluations is frequently difficult to specify, since this depends upon a knowledge of the important symbiotic relationships, such as between Russians and Tatars, that operate in any given community. For an analysis focused on manpower and the associated problems of skill, training and education, it may be sufficient to identify the numerically significant ethnic groups. The purposes of psychological warfare may be better served by somewhat more detailed analysis[2] for it is often true that numerically insignificant groups have a significant influence on the behavior of the larger community.

Closely allied to the question of significance are the problems of accuracy and precision. It is obvious that dependable significant conclusions cannot be derived from grossly inaccurate data, and where, as in studies of the Soviet Union, measures of accuracy may be missing, it is often necessary to state conclusions in the subjunctive. This is a familiar problem and it is generally understood that analyses of Soviet society have many tentative

aspects and are possible at all only through the substitution of assumptions
for unavailable items of information. The point to be made here is that
this imposes limits upon the degree of precision that can be expected in the
final product. For this reason population estimates by age and sex for Soviet
cities have usually been presented in terms of very broad age groupings of
which the following is representative:

> 0 - 14
> 15 - 29
> 30 - 59
> 60 years and over

There is no doubt that the use of such broad gauge class intervals increases
the margin of error that can be tolerated in the various component steps of
the estimating procedure. This advantage is offset, however, by the fact that
the uses for age data presented with this low degree of precision are greatly
restricted. Eliminated in this way is one of the most fruitful approaches to
a validation of labor force estimates, namely through the use of a carefully
derived, detailed set of age- and sex-specific labor force participation rates.
It will be noted also that this set of age intervals, which has been adopted
primarily in connection with manpower analysis, is ill suited for analysis of
other facets of Soviet society, e.g., the educational system,[3] Soviet fertility,
the electoral system and so on.

In summary, the question of significance is a matter of the uses to
which the estimates are put. Although age and sex distributions and ethnic
composition estimates have a high potential for significant implications,
considerable caution is required in their interpretation for small areas where
the population structure may be undergoing a rapid transition. On the other
hand, the estimates of the composition of Soviet cities which our present

methods permit us to make with only a low degree of precision, meet certain
minimum specifications for labor force analysis. For the investigation of
other sectors and problems of Soviet society somewhat modified procedures
and results would be demanded.

Estimation of Population Distribution by Age and Sex

Component projections.

One method very often used for deriving estimates of a city's
population by age and sex is the component projection. This method consists
of three parts, each with many associated minor problems which will be discussed.
The first task is that of estimating the number of persons in the population
at some base date for which data are available who can be expected to survive
to the end of the projection period. To these survivors then are added
separate estimates of the net change in population due to migration and of
the survivors of children born in the community between the base and terminal
dates.[4] In the case of Soviet cities the base date is ordinarily 1926 which
is the last date for which detailed age and sex data are available for small
areas. Current estimates thus involve a projection period of about 30 years,
and unless more recent demographic information is made available by the
Soviet government it will probably become advisable for future work, because
of the length of time involved, to replace component projections based on
the year 1926 with some other method of estimation. An understanding of the
component method as it has been developed in connection with Soviet materials
is, however, a useful background in a search for new methods. Accordingly,
a portion of this chapter is devoted to an exposition of the three principal
estimation problems of the component method: (1) survivors of the base date
population, (2) the survivors of births, and (3) the net change attributable to
migration.

Survivors of the 1926 population.

Of all of the steps involved in a component projection, the
estimate of survivors poses the fewest difficulties. Simply stated, the
task is to estimate the population in the various age and sex groups of
the base population that can be expected to survive over a given period.
There are at least three subsidiary problems to be considered. These are:
(1) an evaluation of the 1926 Census base population, (2) the identification
and removal from the base population of special groups, such as military
garrisons, that are replaced by persons having similar characteristics, and
(3) selection or construction and application of survival factors from an
appropriate life table, and the calculation of mortality modification factors
where these are warranted by changes in mortality conditions subsequent to
the period to which the life table refers.

Evaluation of the 1926 Census base.

A definitive evaluation of the 1926 population census has never been
made, although early steps in this direction were taken contemporaneously by
Soviet demographers and later by outside specialists. Further work on the
evaluation of the 1926 Census is now being carried on by the same U. S.
Bureau of the Census staff that has been concerned with U.S.S.R. city
population estimates. A report on this subject will appear in due course
in this same series of reports. Despite the absence of a definitive evaluation
there is clearly ample evidence of faulty enumeration. Most published
analysis has been devoted to revealing irregularities of profile, -- heaping,
extreme sex ratios, and the like.[5] These defects, coupled with the tendency
for variations in sex ratios by age to be associated with the differences
in ethnic character, strongly suggest underenumeration. Therefore, it is
advisable to begin a projection with a careful examination of the base

population as presented in the 1926 Census and to incorporate necessary

manipulations of the data to correct whatever unacceptable features may

have been revealed. The principal kinds of manipulation that are likely to

be required are allowances for differential underenumeration of female

infants and children and graduation of the distribution by age to eliminate

irregularities likely to have been caused by inadequacies of enumeration.

It is likely that an adjustment to allow for differential underenumeration

of female infants and children will not fully allow for all infant and child

underenumeration and it will often be useful further to allow for under-

enumeration in these age classes on the hypothesis that completeness of

enumeration is no better than in some other area for which data are available,

such as the United States.

Abnormalities in the trend of the sex ratio of the population by age

for the adult population do not necessarily imply faulty enumeration; they

may be unique results of the demographic history of particular places. Yet,

if it is found that such abnormalities occur only among certain ethnic groups

it is a suspicious sign of incompleteness of enumeration. In such cases it

would be preferable to adjust the data so that they conform to a more plausible

function of the sex ratio by age, rather than to accept the abnormalities.

Other types of manipulation may be called for in specific instances;

the recognition of the need for adjustment and the formulation of an appropriate

device for adjustment will depend on the virtuosity of the analyst.

Replacement populations.

This term is used, for want of a better expression, to designate

special population groups for which it would be improper to compute survivors

because of special circumstances. For example, a university may contribute

1,000 persons to the population of a city at the base date and at a date many
years later. It would be incorrect to assume that the survivors of the base
date population would include the survivors of the 1,000 university students.
The latter would have been replaced by others of equally young age, and there
would have been no aging of this base date population of university students
to take into account. Other illustrations of so-called replacement populations
include military garrisons, the inmates of certain types of institutions such
as orphan asylums and homes for the aged, and other nonpermanent population
elements which are continually being replaced by others of like age composition
rather than growing older as residents of the area.

Because of the urban location of Soviet military formations in 1926
and the underdeveloped state of Soviet higher education at this time, military
personnel and their dependents are apt to be the most conspicuous of these
replacement groups. For large cities, the distribution by age and sex of
military personnel and their dependents is given in the 1926 Census volumes
which deal with occupations. In the case of smaller cities, for which detailed
occupational distributions are not available, the military population may some-
times be estimated satisfactorily by allotting to the city in question some
part of the known military formations reported for a larger administrative area.
This has sometimes been accomplished through an analysis of sex ratios leading
to an estimate of excess males who are assumed to be military personnel.[6] The
military population that has been removed must be replaced as a final step in
the projection, and in this connection one is forced to depend almost completely
upon order of battle materials assembled by military intelligence. Since order
of battle information refers only to troops without their dependents, an
estimate of the combined number of military and dependents must be made by

assuming some relationship between these two groups. This relationship has

often been computed from the 1926 Census data for the area in question,

since better figures were not at hand.

<u>Modification of survival rates</u>.

      Life tables of recent date are not available for the Soviet Union.

For the period around 1926 complete life tables are available for the European

part of the R.S.F.S.R., for the Republics of Byelorussia and the Ukraine, and

for certain other subregions of the U.S.S.R. Moreover, from handbooks published

by local statistical agencies throughout the Soviet Union in this period, age-

specific death rates are provided from which either abridged or complete life

tables can be constructed. In general, great refinements in life table construction

are not warranted, since variations in survival rates are among the less signifi-

cant sources of error with which one must contend. However, in view of the

very long projection period, and in view of the calamitous events of World War

II, certain modifications of the survival rates computed from life tables for

the period around 1926 must be considered. Accordingly, depending upon the

region involved, survival rates have sometimes been altered to allow for

improved mortality conditions after 1926. This has been done by assuming a

constant annual percentage decline in the mortality rate of each age-sex

group throughout the 23-year projection period. To implement this assumption

a set of multipliers were developed which were applied to the complements of

the age- and sex-specific survival rates. These multipliers represent average

improvement in age-sex specific survival rates as revealed by Polish life

tables for 1931-32 and 1948, by the slopes of curves representing trends in

age-specific mortality presented by Notestein, et.al.[7] and by U. S. experience

from 1910 to 1930.[8] Whether or not improvement in mortality is to be assumed

will depend upon an individual evaluation of conditions in the area for which

the projection is to be made.

Survival rates have been modified also to take account of war losses, especially among males serving in the armed forces in World War II. The procedure adopted here requires the estimation of the age pattern of war losses among males in the Soviet Union and incorporates these directly into the survival rates. Two assumptions are involved in this method: (1) that the age pattern of war losses for the U.S.S.R. is applicable to any subarea and (2) that the losses to urban areas are not erased by compensatory rural to urban migration. The reasons for the latter assumption will become clear as the entire projection procedure is reviewed. It represents, however, one of the primary defects of the method in its present form.

In addition to problems raised by these assumptions, the data from which estimates of war losses are made are far from ideal. Questions exist both as to total number of casualties and to their distribution by age. Seven million war casualties have been admitted by the Soviets, but it is generally felt that this figure does not include all military deaths that are directly attributable to the war. It is likely that due to the invasion of the Soviet Union and the resulting administrative confusion, the Soviets themselves do not have completely adequate records of their war losses.[9] Several estimated age distributions of war losses are available and are presented below expressed in absolute numbers and a percentage of each cohort affected (age as of 1950).

Table 9.--ESTIMATED U.S.S.R. MALE MILITARY LOSSES[1] IN WORLD WAR II

(Figures in thousands)

Age in 1950	Pattern I[2]	Pattern II[3]	Pattern III[4]
	Losses		
Total...........	9,619	9,619	9,619
20 to 24 years..............	502	276	514
25 to 29 years..............	1,579	1,982	2,143
30 to 34 years..............	2,776	2,583	2,830
35 to 39 years..............	2,289	2,797	2,118
40 to 44 years..............	1,515	1,483	1,304
45 to 49 years..............	701	258	489
50 to 54 years..............	218	166	221
55 to 59 years..............	39	61	...
60 to 64 years..............	...	13	...
	Percent of age group[5]		
20 to 24 years..............	4.4	2.4	4.5
25 to 29 years..............	17.9	22.5	24.3
30 to 34 years..............	35.9	33.4	36.6
35 to 39 years..............	26.8	32.7	24.8
40 to 44 years..............	21.7	21.2	18.7
45 to 49 years..............	12.6	4.6	8.8
50 to 54 years..............	5.7	4.4	5.8
55 to 59 years..............	1.4	2.1	...
60 to 64 years..............	...	0.5	...

[1] Each distribution has been adjusted to total 9,619,000. See Intelligence Research Project no. 2898, Military Intelligence Service WDGS, The Effect of War on Soviet Population and Manpower, 4 March 1946.
[2] Based on estimates presented by Air Research Division, Library of Congress Social Relations Technical Paper No. I-3, An Estimate of the Developments in USSR Population Structure from January 17, 1939 to January 1, 1952.
[3] Intelligence Research Project no. 2898, op. cit.
[4] Lorimer, Frank, The Population of the Soviet Union, League of Nations, Geneva, 1945, pp. 181-182.
[5] Base population estimated by Lorimer, op. cit., pp. 254-255, without adjustment of age cohorts for war losses, but increased uniformly by the ratio of the postannexation to the preannexation population.

The differences between these war loss patterns are slight, especially in view of the widely different bases from which they are derived. Pattern I was developed from data on German war losses in World War I with some consideration of fragmentary data of French and German losses in World War II. Pattern III is admittedly an arbitrary approximation. Pattern II on the other hand was based upon a careful analysis of World War II data relating to the Soviet cohort mobilization schedule, ages of Soviet PW's captured by the Germans and passbooks taken from Soviet casualties. Inasmuch as there was universal conscription and no significant deferment policy, it was possible to estimate the period of exposure for each mobilized age class, the latter, taken together with estimates of the chances of survival, provided estimates of war losses for each age (mobilization) class. The chance of survival factor is not a linear function of time, but is based upon reported rates of kill (more or less constant) and capture (highly variable).

Survivors of births.

The second important component of a population distribution by age and sex, derived by the component projection method, is the survivors of births which occurred between the base date and the estimate date. If data were available, the straightforward solution would be to subtract actual mortality by age or to apply suitable life table survival rates to reported or estimated annual numbers of births during the estimation period. In actual practice this solution of the problem is rarely possible, principally because reliable data on births are rarely available for Soviet cities. There are scattered crude birth rates for the U.S.S.R. and some of its major cities for dates prior to 1939, and of course, the U.S.S.R. series for 1950-1955 recently

published in Narodnoye khozyaystvo, but in general, sufficient data on births
to be used in this approach are simply not to be found. Moreover, there
are legitimate doubts about the completeness of vital registration which
render suspicious even the few published figures on births.

There are, however, other types of data that may be used. One of
these is information for the late 'twenties on age-specific fertility rates,
which is available for a small number of cities. It is possible to project
these rates by analogy to trends observed in similar rates for other countries,
and to apply the projected rates to estimates of the female population, by
age, during the years following the base date. The results would be estimates
of the annual number of births, which could then be used together with
appropriate life table survival rates to obtain estimates of survivors of
births at the end of the estimation period. There are several objections to
this procedure, however:

1. Age-specific fertility rates are available for relatively few cities.

2. The few rates which are available are quite out of date and must be
   projected in accordance with trends observed elsewhere, which may or
   may not adequately represent the situation in particular Soviet cities.

3. The method requires the computation of annual female age distributions,
   a very laborious computation process.

4. There is some circularity of reasoning involved in the method, for the
   annual female age distributions required depend to some extent on the
   gross number of births. The cumulative effect of this circularity can
   be very damaging to estimates for cities which have grown considerably
   by migration. The reason for this is that the annual female age

distributions must include in-migrant females and exclude out-migrant females. Yet, as will be seen below, the estimate of net migration for the entire period of estimation depends in some measure on the number of births during the period.

5. The component projection method calls for the estimation of the net number of survivors of migrants over the entire period. This number would have to be distributed into year of migration cohorts, and each such cohort "revived," that is augmented by an estimate of deaths to the cohort, to each year for which a female age distribution is required. This is a very time-consuming process, and is fraught with many risks of error that are entirely beyond control.

Still another approach to the estimation of survivors of births is by the use of child-woman ratios. These can be computed for every city from 1926 Census data and can be projected without excessive labor. Although not an ideal solution,[10] it has the advantages of simplicity of application, employment of basic data which reflect local conditions, availability of basic data for all cities, and avoidance of circular reasoning.[11]

The steps followed in the use of the child-woman ratio technique are:

1. The ratio of children to women aged 20-54 years is computed from data for the very city being studied, using 1926 Census information. The term children refers to persons whose age is less than the number of years between the base date and the estimate date.

2. The corresponding ratio is then computed for the U.S.S.R. as a whole, for 1926, 1939, and 1950.[12] As will be seen below, it is desirable to accomplish the projection by stages, namely from 1926 to 1939,

and from 1939 to 1950. It happens that 1950 was the terminal date
for the estimates of city population by age and sex prepared by the
U.S. Bureau of the Census. The terminal date could, however, have been
selected as some other year; but this is immaterial to the description
of the method.

3. It is assumed that the child-woman ratio for the city being studied
changed with time in proportion to the change in the corresponding
ratio for the U.S.S.R. as a whole. The projected child-woman ratio
is then applied to the number of survivors of the base date population
to yield an estimate of surviving offspring of this population on the
terminal date. It should be noted that this estimate does not include
all children of the age-group in question. The surviving offspring
of migrants must be separately calculated.

Nature of the migration component.

Once estimates of the numbers of survivors of the base date population
and of births have been computed, they may be used together with estimates of
total population to obtain a measure of migration. Thus, if P_o represents
the total population at the base date, S the number included in P_o who are
expected to survive to the estimate date, P_1 the total population on the
estimate date, B the survivors of offspring of the base date population, and
M a residual, we find:

$$P_1 = S + B + M.$$

The residual, M, may be readily computed from the values of the other terms
of the equation, which have already been computed. What, precisely does M
represent?

In computing the S component of the above equation, it has been
assumed -- in effect -- that no individual included in the base population
moved away. They either died or remained alive in the area to be included
in S. In actual fact, this is a most unlikely situation. As a result, S
overstates the number of survivors of the base population still in the area
on the estimate date by an amount equal to the number of out-migrants
minus the expected number of deaths among out-migrants, assuming the same
age- and sex-specific death rates and the same percentage distribution of
population by age and sex for both nonmigrants and out-migrants. Similarly,
the B component of the above equation is an overstatement of births among
the base population, because it allows for births among out-migrants. The
residual M, therefore, is an understatement of the net change in population
attributable to migration. The amount of this understatement is precisely
the same as the overstatement in the S and B components, namely: out-migrants
minus expected deaths among out-migrants plus expected births among out-
migrants, or more simply, the expected net survivors and surviving offspring
of out-migrants.

It appears, therefore, that the component projection method
designedly overestimates two components and underestimates the third. The
residual M does not represent the true net change in population attributable
to migration; its true meaning is the net survivors and surviving offspring
of in-migrants minus the net survivors and surviving offspring of out-migrants.

To take a simple illustration, suppose that a city had a total
population of 100,000, a constant annual death rate of 20 per thousand, and

a constant annual birth rate of 30 per thousand. Assume also that 10,000

people per year moved away, that 12,000 per year in-migrated, and that

these had the same crude birth and death rates as the nonmigrant population.

In general, if P represents the population at the beginning of a year, B

the births, b the birth rate, D the deaths, d the death rate, and M the

migration, we have:

$$B = \frac{2\,b}{2 + d - b} \quad (P - 1/2\ M)$$

$$\text{and} \quad D = \frac{2\,d}{2 + d - b} \quad (P - 1/2\ M).$$

Applying these formulae to the data of this illustration, we find that after

5 years the original population of 100,000 has shrunk to 53,800, including

the surviving offspring of these inhabitants. On the other hand, the annual

input of 12,000 in-migrants results in a total of 61,500 persons who moved

into the area since the base date and their surviving offspring. Thus, in a

total population of 115,300, only 47 percent are survivors or descendents

of the base population.

Had the population change in this illustration been measured by a

component projection technique, with the assumptions of no out-migration

from the base population and an annual net in-migration of 2,000 per year,

there would be after 5 years about 105,000 survivors or descendents of the

base population and 10,300 survivors or descendents of net in-migrants. Again,

the total population is 115,300, but in this case 91 percent represents

survivors or descendents of the base population.

This illustration exaggerates somewhat the nature of the difficulty created by the use of a component projection technique. If it had been assumed that a portion of the annual out-migration of 10,000 had come from among in-migrants in years following the base date, the discrepancy noted above would have been smaller, but still appreciable.

The significance of this characteristic of the component projection method is that, although it does not affect adversely estimates of net survivors and surviving offspring of migrants, it does have a profound effect on the estimated composition of the population by age and sex, particularly when the distribution by age and sex of nonmigrants is much different from that of in-migrants. Unfortunately, experience indicates that this condition usually prevails.

Inasmuch as the characteristics of migrants have so important an effect on the composition of the population by age and sex, and, inasmuch as the data employed are for years past, a brief historical outline of urban migration in the U.S.S.R. provides a desirable background against which to assess the quality of such estimates.

Historical outline of U.S.S.R. urban migration.

For all practical purposes internal migration and particularly urban-ward migration in the U.S.S.R. assumes greater importance as the date of migration approaches the present, for the proportion of surviving migrants declines as the duration of their residence at their destination grows longer. Yet even the migratory movements of the pre-revolutionary era have some interest because these are reflected in the data of the 1926 Census and are useful in analysis for subsequent periods. This brief survey begins therefore with 1897, the date of the first Russian census.

Phase 1: 1897-1914. Between the time of the first Russian census in 1897 and the Revolution there had been a steady increase in the urban population, compounded almost equally of natural increase and rural to urban migration. During this 16-year period approximately four million persons settled in urban areas. Virtually nothing is known about the characteristics of this migration since at this time the government kept no migration statistics. Furthermore, the civil disruptions that occurred toward the end of this phase precluded a satisfactory count of the population from which something of the characteristics of migrants could have been learned.

Phase 2: 1914-1917. During the war years the urban population increased by some 1.4 million, to reach a total of 26.3 million, or about the same as in 1926. Again our knowledge of the characteristics of the migrants is limited.

Phase 3: 1917-1920. This period was characterized by an urban exodus of large proportions. It is the losses of these years that account for the apparent stagnation of the urban population from the Revolution to 1926, the year of the first major census of the Soviet Union. The magnitude of the over-all decline is not known but its significance is suggested by the case of Leningrad, the center of much revolutionary activity, in which the population declined by 580 thousand in 1917, 837 thousand in 1918 and 320 thousand in 1919; Leningrad changed from a city of over two million to one of slightly more than one-half million during these few years.

Phase 4: 1921-1926. The restoration of order augmented by rural distress brought about a renewal of urban growth based, as in the past, largely upon rural to urban migration. This was the period of the New Economic Policy (N.E.P.); it was a time of consolidation and recuperation for the U.S.S.R. and for the most part the result of the net urban migration was to bring the urban population back to its pre-revolutionary level.

Phase 5: 1926-1939. This period, bracketed by the two census years, is one of greatly accelerated urban migration resulting from the industrial developments of the early Five-Year Plans and the collectivization drive in agriculture. Urban growth during this time coincided closely with the development of the industrial and extra-active centers of the country. The gradation in the rates of increases by type of city[15] confirms the hypothesis of a general association between industrialization and urban growth:

Table 10.—MEAN PERCENTAGE INCREASE OF POPULATION, IN SELECTED TYPES OF SOVIET CITIES:[1] 1925-1939

Type of city	Number of cities	Mean percentage increase
Industrial.....................	34	350
Transportation.................	20	189
Trade..........................	17	153
Diversified....................	9	86

[1] Cities of 100,000 or more inhabitants in 1939.

The expellent force of collectivization is shown in figure 4, which, although based on a limited number of cases, leaves little doubt as to one effect of collectivization upon the rural population. Altogether, more than 18 million persons moved cityward during this period, with low oscillations in frequency at the beginning of each five-year plan and peaks occurring midway in each planning period.

Phase 6: 1939-1950. In general pattern, but not in amplitude, urban migration during this period resembles that of phases 2, 3, and 4 taken together. The war-time evacuation of urban centers was less pronounced than in phase 3, and in addition, the immediate postwar period was characterized by the Fourth Five-Year Plan, which was oriented toward national reconstruction and characterized by economic expansion rather than by the uncertainties and economic paralysis of the N.E.P. of phase 4. During phase 6 the urban population grew by approximately 10 million persons largely as the result of in-migration.

Phase 7: 1950-1955. National reconstruction under Plan IV, was followed by Plan V, which was adopted in 1952 but which covered the years 1951-1956. The industrial emphasis of Plan V resembles that of the early plans. Replacing the collectivization drive of the thirties was the continued mechanization of agriculture and a dramatic program of kolkhoz consolidation. In this five-year span the urban population grew by 17 million persons, 9 million of whom came from rural areas.[14]

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FIGURE 4. COLLECTIVIZATION AND OUT-MIGRATION, FOR SELECTED AREAS IN THE U.S.S.R.: 1928-1931
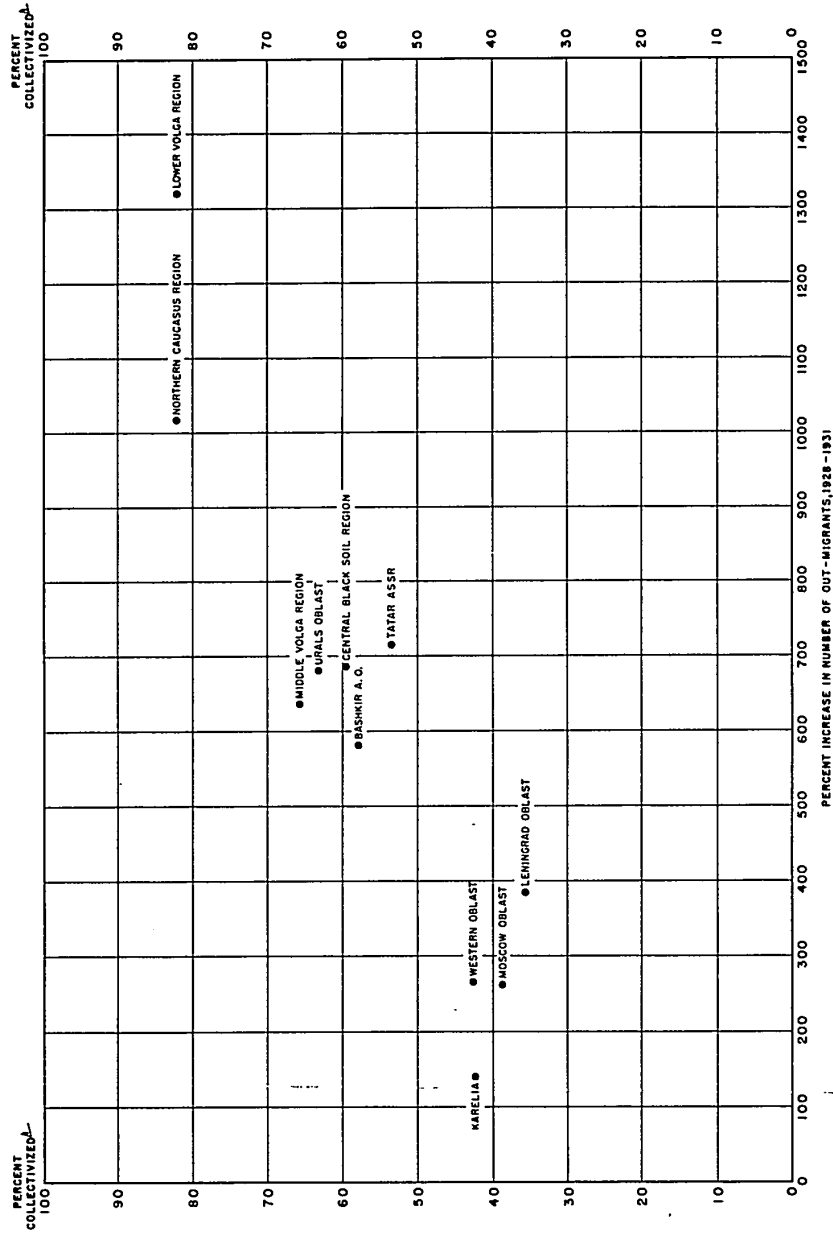
SOURCE: S.S. KLIVANSKIY, "SEASONAL MIGRATION IN THE U.S.S.R. IN 1928 1929-1931," VOPROSY TRUDA, VOL. 10, NO. 10, OCT. 1932, pp. 66-73.
1/ CITED THUS IN SOURCE. PRESUMABLE REFERS TO PERCENTAGE OF PEASANT HOUSEHOLDS THAT WERE COLLECTIVIZED.

U.S. DEPARTMENT OF COMMERCE

U.S. BUREAU OF THE CENSUS

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A major development in Soviet urban migration has been the gradual extension of governmental control over the process of industrial migration, that is migration to meet the labor requirements of the country's expanding industrial system. Contrary to popular belief the movement of population under the Soviet regime has been and still is, to an important extent, a voluntary movement.[15] Before the advent of the Five-Year Plans it was unplanned as well. The recruiting of industrial labor during the First and Second Five-Year Plans was left largely to individual enterprises with the national, regional or local governments having no immediate role. Mobilization of the economy and the advent of the war forced the national government to assume more direct control, which it did by identifying areas of surplus population,[16] extending financial and other aid to migrants, carrying out planned evacuations, and in a few instances, by resort to forced deportation. One gets the impression, however, that urban migration during the decade prior to World War II was less organized than the planned resettlement of agricultural workers to new agricultural areas. Following the war the Soviet government continued to facilitate the flow of population to areas of labor shortage both through organized recruitment of volunteers and the provision of incentives. The role of the central government in this area was emphasized and implemented in 1947 by the establishment of republic administrations for labor recruitment.

Age and sex distribution of the migration component.

The term "migration component" is used here so as to make it clear that the component projection method deals with an artificial entity corresponding to the needs of the method rather than with actual migrants. This distinction

has been developed and expounded above in the discussion of "The Nature
of the Migration Component." As explained there, the migration component
is a residual obtained by subtracting an estimate of survivors of the
base population and survivors of their offspring from the total population
at the estimate date. It is not a measure of the number of surviving
in-migrants and surviving offspring of in-migrants. It is a legitimate
criticism of the component projection method that the residual must be
used in lieu of a figure representing surviving in-migrants and their
offspring, because the two figures are generally not the same and because
the age and sex distribution of nonmigrants is usually different from that
of in-migrants. But the component projection method requires that this be
done because too many people have been accounted for in the estimates of
the survivors of the base population and their surviving offspring. In
general, migrants include a higher proportion of males than do nonmigrants,
and also a higher proportion of young adults. The component projection
method, therefore, tends to yield a population distribution by age and sex
which understates these two population categories.

Although other methods of estimating migration have been devised,
they are not appropriate for use with the component projection method unless
they have incorporated an understatement of the net change in population
attributable to migration which exactly balances the overstatement inherent
in the other two components, i.e., survivors of the base population and
survivors of offspring of the base population. For example, a method has
been devised for use with data for states and cities of the United States

which involves the use of school enrollment data.[17] By a comparison

between expected and actual school enrollment, a measure of the percentage

of the school-age population cohort comprising migrants may be obtained

and converted into a measure of the rate of migration for the total popula-

tion. This migration rate is then applied to the base population plus

half the births to yield an estimate of net migration at all ages. Even

if the data were available so that this method could be employed for

U.S.S.R. cities, it would be conceptually incorrect to employ the result

in a component projection method, because the result does not have precisely

the inadequacies called for by the method. It would, however, be possible

to modify the procedures used to compute survivors of the base date popula-

tion and of their offspring so that the three components would be conceptually

in accord with one another.

The problem, therefore, is to devise a method for distributing the

residual migration component by age and sex, keeping in mind that its

composition by age and sex must reflect not only the patterns of age and

sex composition peculiar to migrants, and prevailing mortality trends, but

also the cumulative effect of annual increments of migration which more

likely than not resemble each other closely. The meaning of the latter

stipulation may be illustrated simply by considering the ultimate age

distribution of in-migrants to a population which receives a constant annual

input for 10 years. To simplify the case, let it be assumed that the

distribution by age of each annual cohort of migrants is rectangular between

ages 20 and 29 at time of arrival, and that there is no mortality. The

migrants at the close of the period will be distributed as follows:

	Percent distribution	
	Age at arrival	Ultimate age
Total........	100	100
20-24 years............	50	10
25-29 years............	50	35
30-34 years............	-	40
35-39 years............	-	15

Thus, even though migrants may be relatively young on arrival in an area
they do grow older, and successive annual layers of migration produce a
distribution with a markedly different contour than is found in any annual
cohort of migrants. If mortality is taken into account, as it should be, the
ultimate distribution varies somewhat differently, since the distribution
becomes skewed towards the younger ages.

Fortunately, the 1926 Census of the Soviet Union provides data
on the age and sex distribution of in-migrants by period of arrival.[18] These
incorporate the specific migration experience of each area prior to 1926,
the mortality rates then prevailing and the cumulative effect of successive
migratory inputs. It is possible, therefore, to compute the 1926 age and sex
distribution of in-migrants during the preceding 12 years, so that this might
be used for migrants arriving during the 12 years between the 1926 and 1939
Censuses. The same can be done for any period of years, as required. In
fact, this was done in the city population studies for the U.S.S.R. conducted
by the Bureau of the Census. Another method, which was used for Rumanian
cities, began at the other extreme. The distribution by age and sex at time
of migration for internal migrants in Czechoslovakia was cumulated over a

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19-year period, adjusted for mortality in accordance with age- and sex-
specific death rates applicable to Rumania, and the results converted
into a percentage distribution which was applied to the residual migration
component.[19]

Either of these two approaches will yield distributions appropriate
to survivors of migrants over varying periods of time, but it must be under-
stood that neither affords a precise representation of the age and sex
distribution of survivors of migrants in particular cities. The first approach
imparts to the migrants of the estimation period the characteristics represent-
ing the net effect of: (1) annual numbers of arriving migrants proportional
to the migration cohorts of years prior to 1926 for the same city; (2)
distribution of annual migration increments by age and sex proportional to
the distribution for years prior to 1926 for the same city; and (3) age- and
sex-specific mortality rates among migrants equal to those for years prior
to 1926 for the same city. The second approach, that is the one developed in
connection with Rumanian city estimates, embodies a somewhat different set of
postulates, namely: (1) there are equal annual increments of migrants; (2)
the age and sex distribution of migrants at time of arrival is held to be
constant from year to year, and equivalent to a distribution for a relatively
recent date determined for another area; and (3) age- and sex-specific
mortality rates for migrants applicable to the estimation period rather than
to a prior period are employed. Each approach has theortical justifications,
and each provides a result in keeping with the hypothesis involved, but
neither assures literal reproduction of the true age and sex distribution
involved.

In the application of either of these approaches it is necessary
first to isolate the surviving offspring of migrants. This may be done
most readily by employing the same child-woman ratio used for survivors
of the base population. Some bias will be introduced, for the child-woman
ratio among the migrants is likely to be higher than among nonmigrants
simply because the migrants generally comprise a younger population with
a far higher proportion of its members in the child-bearing ages. A bias
in the other direction is also introduced because of the tendency of the
residual migration component to overstate the female migrants. The extent
to which these biases counteract each other cannot be determined.

Once the estimated surviving offspring of migrants have been
subtracted from the residual migration component the remainder represents
survivors of in-migrants minus survivors of out-migrants, as explained
above. The distribution by age and sex of this remainder is the next goal
in this process. Two approaches to this goal have been discussed above.
A third approach, based also on the 1926 Census data on surviving in-migrants
by age, calls for the computation of migrant to nonmigrant ratios for each
age and sex group in 1926, and the application of these ratios to the final
estimates of survivors of the base population on the estimate date. The
results are estimates of surviving in-migrants by age and sex which may be
adjusted linearly to equal the predetermined remainder representing survivors
of in-migrants minus survivors of out-migrants. The effect of this procedure
is equivalent to the effect of the assumption of identical distributions by
age and sex for in-migrants and out-migrants. This relationship has not been
adequately explored, but it is likely not to be an identity, at least in the
circumstances operative in Soviet cities.

Although the first approach mentioned, that is the method of applying to the residual migration component the age and sex distribution of 1926 surviving in-migrants over a period of equal length, was used in the Bureau of the Census studies for Soviet cities, it was not used without a full understanding of the conceptual difficulties involved. An attempt was made to determine pragmatically the importance of a fundamental caveat to the method, namely the frailty of the assumption that the pattern of distribution of migrants by age and sex was the same for pre-1926 migrants and migrants of the 'thirties and 'forties. It was found that there was relatively little variation in the composition by age and sex of surviving migrants to urban areas during years prior to 1926, except for migrants, arriving during the period of the war and the Revolution.[20] For the period after 1926 however, there is evidence of some change in the age structure of U.S.S.R. urban migrants as the table below shows:

Table 11.--AGE DISTRIBUTION OF U.S.S.R. INTERNAL MIGRANTS,
FOR SELECTED YEARS: 1926 TO 1934

Age	Year of migration			
	1926	1932	1933	1934
0-15 years............................	24.7	13.2	15.1	12.9
16-59 years...........................	71.7	83.0	80.9	83.7
60 years and over.....................	3.6	3.8	4.0	3.4

Source: 1926: All-Union Census, vol. LI, Table IV-A.
1932, 1933, 1934: Besher Ia, Problemy naseleniia v narodno-khoziaystvennom planirovanii (Problems of Population in National Economic Planning), Moskva, 1937, p. 38.

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Whether these differences are real or due to differences between census
and registration procedures is not clear. The greater concentration in
the prime adult ages and the somewhat smaller proportion of persons
0 to 15 years among the migrants of the 'thirties are changes of the type
that one would anticipate from what is known of the declining birth rate
and the nature of the demand for migrants at that time.[21]

Whether or not there was a real change in the characteristics
of migrants after 1926, there is little question that 1926 migration
patterns are quite inappropriate in many instances since this was a period
of significant change for many Soviet cities. Consideration might be given,
therefore, to generating families of migration patterns appropriate to cities
of a given type. The selection of an appropriate migration pattern then
would be made on the basis of typological considerations rather than in
terms of the character of the city's previous migration, which very likely
will have changed with changes in the economic structure of the city.

Another shortcoming of the body of 1926 migration data is its
unavailability for small cities. When dealing with such places, often the
only guide to an appropriate migration pattern is that of the larger adminis-
trative area in which the city is located. For example, in estimating the
age and sex distribution of migrants to cities of the Uzbek Republic, the
distribution of persons migrating to all urban places within the Uzbek S.S.R.
was used. This procedure creates certain problems in connection with the
treatment of military personnel, since in calculating a migration pattern

military personnel and their dependents are excluded. Military personnel
and their dependents, however, cannot be divided into migrant and nonmigrant
subgroups on the basis of information in the census and therefore, out of
convenience, military personnel and their dependents have been treated as if
they were all migrants. Removing all of the military personnel from among
the migrants actually reduces the number of bona fide migrants since some
of the military are nonmigrant. This does not create any serious problems
in cases where equal or greater numbers of military dependents are restored
to the population on the terminal date. On the other hand, in cases where
the military have been removed in toto from the migrant distribution and not
restored, deflation in certain age groups will result. This problem is most
likely to be encountered in the case of cities having no military garrison
but for which the migration pattern of a larger administrative area, from
which military forces will generally have been deleted, has been assumed.
In situations of this kind it is recommended that an attempt be made to
distinguish between migrant and nonmigrant military personnel in 1926 and
to eliminate only the former from the civilian migrants.

To summarize, the procedures adopted for estimating the age and
sex characteristics of migrants have been dictated primarily by the character
of available data. In view of Soviet criticisms of their own migration data
available from population registers, it is unlikely that a completely satis-
factory set of statistics could be made available even with a free exchange
of information. Foremost among the problems with which we are forced to
deal is the assumption that the age and sex characteristics of migrants
have not changed substantially since 1926. This assumption is suspect,

particularly for the postwar period, when both the supply as well as the
demand for migrants was affected by heavy, war produced mortality. The
problem is complicated further by the allowances which are made for war
losses in computing survivors of the base population. The Soviet emphasis
upon the development of heavy industry and the concomitant urbanization
of the population makes it appear likely that heavy urban male war losses
would be compensated for, to some extent, by higher sex ratios among the
migrants. The present projection procedure, however, takes note of excess
war mortality but not of any compensatory migration of males to cities.
Still another difficulty with the present method for handling migrants
is the assumption that in- and out-migrants have similar age and sex
distributions. There is, in fact, some evidence of differences elsewhere
in the composition of in- and out-migration flows by age and sex, although
the degree of disparity by age does not appear to be serious.[22]

Improvement of the procedure for estimating characteristics of
migrants would seem to require a greater understanding, obtained through a
program of comparative research, of the relationship between the character-
istics of migrants and the characteristics of the sending and receiving
communities. More should be learned also of the range of differences in
the age and sex distribution of migrants and of corresponding differences
between in- and out-migrants. Such research would probably have to be
conducted for areas other than the Soviet Union, where data of high quality
would be available either from continuous population registers or from
successive enumerations from which the character of migration could be inferred.

Projection by stages.

Component projection procedures for the U.S.S.R. and for Soviet cities will be improved if conducted in two stages, namely 1926-1939 and 1939-x, where x is the postwar year for which the estimates are desired. It has already been noted that relatively great weight must be placed on data from the 1926 Census because detailed figures for subsequent dates are rarely available for cities. The necessarily lengthy time-span involved in such a component projection procedure creates risks of estimation which should be cut down where possible. One way to do this is to introduce data from the 1939 Census of population. In general, the only useful 1939 figure to be found is the total population of the city. The use of this figure provides a measure of control over variation in the several components of population change, namely mortality, births, and net migration. Thus, it has been found advantageous to estimate the age and sex distribution for particular cities in 1939, and to use that distribution as a base for estimates relating to 1950 or other postwar years.

Evaluation of a component projection.

The component projection method used for selected Soviet cities by the Bureau of the Census is an imperfect instrument. Many of the considerations which lead to this conclusion have been set forth and discussed above. Yet, the method was adopted, despite potential weaknesses because of the absence of current information from which a distribution of the population by age and sex could be fashioned effectively. This very absence of current information prevents an effective pragmatic validation

of the method. It has, however, been possible to employ the component
projection technique to the estimation of the distribution of the urban
population of the U.S.S.R., by age and sex, as of the date of the 1939
Census. The fact that this technique led to acceptable results in this
instance is not to be taken as a general validation of the method. It
represents merely one instance in which the method proved useful in actual
practice.

The reports of the 1939 Census indicated a total urban population
of 55,910,000. This was based on returns which were 99.44 percent complete.
On the assumption that this was the true urban population of the U.S.S.R.
in 1939, the same component projection method described above was invoked
to yield, among other estimates,[23] the following figures which were
susceptible to checking against data from other sources:

Age	Estimate
0-7 years	9,911,000
8-17 years	10,479,000
18 years and over	35,520,000

Consider first the estimate of the population 0-7 years. Accord-
ing to a Soviet source,[24] 18 percent of the urban population was 0-7 years
in 1939. Since the percentage figure cited was a rounded figure, this
must be taken to mean more than 17.5 percent but not as much as 18.5 percent.
If the total urban population was 55,910,000, the population aged 0-7 years
was in the range 9,784,000-10,343,000. The estimate of 9,911,000 produced
by the component projection method falls squarely within this range.

Consider next the estimate of the population 18 years old and

over. The number of city voters in 1939 was reported as 30,312,000.[25]

This figure excluded voters in other urban places. At this time the

population in cities numbered 47.3 million.[26] Thus, in cities, between

64.02 and 64.15 percent of the population comprised registered voters.

In the country as a whole, however, the ratio of registered voters to

total population averaged only 55 percent. Thus, it is clear that in

rural areas the proportion of registered voters in the population was even

lower than 55 percent. Perhaps the best assumption that may be made for

the proportion of registered voters in the population of other urban

places is that it was the same in other urban places of 10,000 or more

as in the cities, and an intermediate value -- let us say the same as the

national average of 54.85 percent -- in other urban places of less than

10,000 inhabitants. On this basis, the total number of registered voters

in other urban places may be estimated at from 5,052,000 to 5,175,000.

The number of urban registered voters is, accordingly, in the range from

35,364,000 to 35,487,000. Before these figures may be compared with

estimates derived by the component projection method, they must be put on

a comparable basis. The component projection method employed an estimate

of 55,910,000 urban population of all ages, whereas the estimated number

of registered voters was based on an urban population figure of 56,100,000,

which was not available until 1956. By a proportionate adjustment, the

estimated number of urban registered voters comparable to the preliminary urban

population total falls in the range from 35,244,000 to 35,367,000, all of

whom are 18 years old and over. The estimated number of urban registered

voters accounts for from 99.2 to 99.6 percent of the population 18 years old and over as estimated by the component projection method. Since there must have been at least a small number of nonvoters aged 18 years and over in the urban population, the component projection method appears to have scored another direct hit, or at worst, a very close near miss. Other assumptions about the number of registered voters in other urban areas in 1939 would yield substantially the same conclusion.

Finally, consider the estimate of the population aged 8-17 years. Inasmuch as the total urban population is fixed and the estimates for the population under 8 and over 17 years accord so well with other evidence, the estimate for ages 8-17 years must be equally close to reality. Another view of the matter may be had in terms of the relationship between the population estimate and the 1939 school enrollment in grades 1-10 in urban areas, reported officially at 9,298,000.[27] Not all of these children fall into the age group 8-17 years, however. It is reported that some 5 percent of the entering class in the school year 1939/1940 were only 7 years of age,[28] and there were undoubtedly some few persons over 17 years who were still in the 10-year school system. In the urban areas there are likely to have been even more below-age and above-age children in the schools. Thus, even though a precise figure cannot be obtained, it is not unreasonable to interpret these figures as meaning that 9,000,000 or slightly fewer children aged 8-17 years were enrolled in grades 1-10 in urban areas in 1939. This would amount to from 85 to 86 percent of the urban population aged 8-17 years, as estimated by the component projection method. Is this figure reasonable? Data for the whole of the U.S.S.R. in 1939 reveal the following enrollment rates:[29]

Age	Rate	Age	Rate
8	76%	12	96%
9	93%	13	91%
10	98%	14	80%
11	99%	15	68%

It is a very good assumption that the rates for urban areas were even higher. Under the circumstances, the estimate of population aged 8-17 years, as computed by the component projection method, seems to be a good estimate.

One swallow does not make a summer, however, and one successful application of the component projection method does not unequivocally demonstrate its general applicability. It may be said that experience with the method has led to the conviction that under certain circumstances it yields acceptable results. There are, however, a number of reasons for developing a substitute procedure. These include:

(1) The length of the projection interval. There is an inverse and no doubt accelerating relationship between the accuracy of a projection and the length of a projection period. There is no real hope at the present time for breaking away from 1926 as a base period.

(2) Certain inherent difficulties in the method. These have already been touched upon and include especially the problem encountered in dealing with war losses and migration.

(3) The inapplicability of the method in cases where data are lacking either with respect to the composition of the base population or one or more of the components.

(4) The laboriousness of the method.

An alternate procedure.

   The component projection procedure described above is one device which may be used to estimate the current age and sex distribution of the population of a city.[30] Concern over its potential shortcomings has stimulated considerable thought on the feasibility of other approaches. One such alternative which appears to have promise involves investigation of the possibility of ascertainable measurable relationships between patterns of economic activity and the distribution of the population by age and sex. This might be termed a _functional_ as opposed to a _longitudinal_ estimation technique.

   In one study, devoted to the estimation and analysis of the population of Chirchik,[21] Uzbek S.S.R., the estimated distribution of the population by age and sex was derived by the use of an analogy to the population in the industrial centers of the Kuzbas and Oak Ridge, Tennessee. Implicit in this procedure was the hypothesis that areas with similar salient industrial features would have populations with similar profiles.

   The _functional_ approach here presented as an alternative to the component projection method contemplates a program of systematic research in the field of urban morphology, rather than the use of hand-picked analogies. The envisioned end-product of this research would most likely consist of an urban typology based upon selected economic, social, industrial, and geographic variables which are found to have the characteristic of being able to discriminate successfully between different types of population distributions by age and sex. The development of useful typologies of urban

areas would rely on data for cities in all parts of the world, and would
feature extensive use of correlation and regression analysis. If
successful, such research would lead to the formulation of quantitatively
expressed ranges measuring the association between the variables incor-
porated into the typology and the distribution of population by age and
sex. These could then be used for prediction as well as for current
estimation.

Although this research approach is presented here as a potential
alternative to existing demographic estimation devices, it may have a
wider usefulness, particularly to those users of demographic information
whose concern is not with demography per se, but rather with problems in
the fields of manpower and industrial structure, for the resolution of which
demographic data are often used. A typology of urban areas such as that
suggested here may, if so designed, shed light directly on these problems.
Research in urban morphology involves a number of collateral problems such
as questions of comparability of raw data used to express the significant
variables and questions of the extent to which findings may be generalized.
As a long-range investment of research energies, however, the field is
promising. It cannot, however, provide an immediately useful substitute
for more direct methods of analysis of population distribution such as that
described above.

Consideration should be given, of course, to improving the
component procedure itself. Work along these lines will be advanced most
effectively if it is accompanied by research in urban morphology and by
serious inquiries into the problem of the distribution and movement of
population in the U.S.S.R. and its subregions. Studies of this nature would
supply sets of aggregate totals, ranges of variation, and other benchmarks

which will help to gauge the effect and validity of variations in projection procedure. Cross fertilization of techniques rather than intensive concentration on a single approach should be the guiding policy of future research and logical inquiry in this area.

Estimation of Ethnic Composition

No thoroughly satisfactory method of measuring the ethnic composition of small areas in the U.S.S.R., short of a census, has as yet been devised. This is due in part to the scarcity of timely data on the subject, in part to conceptual problems in the definition of ethnic classifications, and, in a very practical sense, to the lack of knowledge of the ethnic characteristics of Soviet internal migrants. This bleak generalization about the subject of measurement of ethnic composition is frequently gainsaid by the fact that currently useful information on ethnic composition is often at hand and need not be derived by estimation. This seeming paradox merely reflects the fact that ethnic composition changes very slowly, barring large-scale migratory movements; and in such cases data for earlier periods -- such as data from the 1926 Census -- reflect the situation so well that more timely estimates are not required. Whether data on ethnic composition from the past are used to depict the situation in the present, or whether crude current estimates are derived, it is still important to understand what the figures mean and the limitations that must be placed on interpretations based on such figures.

The concept of ethnic composition.

Ethnic differences within a population are important data for demographic intelligence since they frequently represent fault or cleavage lines in the social structure. An ethnic group, defined as a population having a common set of customs and traditions (an ethos) as well as some degree of communal integration, is difficult to identify and cannot always be distinguished from unorganized strata comprised of individuals having a linguistic similarity or claiming a common ethnic descent. Yet for an accurate appraisal of the action potentials of a population, such discriminations are vital. When dealing with Soviet data, however, even the correct labeling of a stratum may be a difficult task. Nevertheless, two questions should be raised about any set of figures which purport to represent ethnic composition: (1) to what extent do the figures depict an ethnic group rather than a mere collection of individuals homogeneous with respect to some single attribute? (2) by what criteria -- language, nationality, religion, descent, residence, etc. -- has the group or stratum been identified? In isolated, undisturbed, areas, the application of a single criterion may suffice to identify both a stratum and an ethnic group. In urban areas, however, the degree of internal integration (or conversely, assimilation) of an ethnic group cannot ordinarily be measured meaningfully in terms of a single criterion. Here some consideration must be given to the degree of consistency afforded by various criteria. For example, a group homogeneous with respect to both language and religion, and segregated spatially, has a quite different connotation than does a group which is

linguistically similar, of varied religious affiliations and spatially
diffuse. These significant differences would, of course, be obscured
by a procedure which described ethnic composition solely in terms of a
language criterion. Similarly, unrevealing in this instance would be a
treatment of ethnic composition solely in terms of single criteria such
as descent, nationality, or religion. In short, the statistical identi-
fication of an ethnic group -- as apposed to a stratum -- requires a
composite index capable of measuring the extent to which the group has
a unitary organization.

    While it is important to recognize the scope of a full analysis
of ethnic composition, a description of the major strata found in a population
is both useful and feasible. One expects, for example, that a city in Central
Asia made up predominantly of indigenous groups will have a different role
in a larger social and economic structure than one, similar in other
respects, but adulterated by Russians and Ukrainians. This is true even
though the identity of these nonindigenous persons, what they do, and how
they regard the indigenous population, may be known only by conjecture.
Applying a minimum standard of value, one is better off with this information
than without it. For a more complete analysis of ethnic composition, however,
an attempt should be made to discover what criterion was used in defining a
stratum. Are these Russians, for example, persons who call themselves
"Russians," perhaps without legal or genetic support for their claims, are
they persons who habitually speak Russian, or are they persons who consider
themselves to be of Russian descent? And, regardless of how they are defined,

are these persons culturally assimilated or do they form a solidified
out-group with a variant subculture? It may not be possible to answer
any of these or similar relevant questions. They should be raised,
nevertheless, since this is the range of problems implied by the concept
ethnic composition. Otherwise there is some danger that a stratum
analysis may merely provide a springboard for jumping to conclusions.

Data and problems of definition.

Soviet data available for stratum analysis are severely limited,
although relevant items have been regular features of their census
schedules since 1897. Data from the Censuses of 1926 and 1939 may be
summarized as follows:

TERMINOLOGY AND AVAILABLE TABULATION REFERRING TO ETHNIC COMPOSITION: SOVIET CENSUSES OF 1926 AND 1939

Year	Definition		Available tabulations	Where available	Remarks
	Russian	English equivalent			
1926	narodnost	descent	For major administrative division, by urban and rural; for most urban areas.	1926 Soviet Census, Part I.	Determination of narodnost made by respondent, preference being given to that of mother in case of doubt. Instructions explicitly exclude consideration of religion, residence, or citizenship.
	rodnoy yazik	native language	ditto	ditto	Defined as language habitually used or one which respondent speaks best.
1939	natsional-nost	nationality	Distribution for total population of USSR. Fragmentary releases for constituent republics.	Izvestiya April 29, 1940. See also publications of republic administrative and scientific bodies.	Determination of natsionalnost a matter of respondent's own self-identification. Date not comparable with 1926 classification by narodnost.
	rodnoy yazik	native language	Data not released	Not available	Concept same as in 1926.

In addition, there are for 8 republics and 16 ASSR's in 1938/39, data on
the distribution of students according to the language in which they were
instructed.[32] Also for this period and for later years, cartographic
materials[33] are available which give a nonquantitative impression of
changes in the distribution of the peoples (narody) of the U.S.S.R.

For the purposes of a stratum analysis for any year later than
1926, the data described above are of insufficient detail when the focus
is a given city or urban area. In the face of such a problem, analyses
suggestive of possible developments may be made by adopting -- for a given
city -- certain assumptions about the ethnic composition of its in- and
out-migrants and the ethnic composition of its natural increase since the
base period (1926). Note again that this approach, which is essentially an
abridged component projection procedure applied to ethnic rather than age
groups, can only suggest the limits of possible changes and does not provide
valid estimates of the number, size, and type of ethnic stratum of a given
population aggregate. Standardized procedures for this purpose do not exist
at present.

It has sometimes been suggested that estimates of ethnic composition
can be made from an analysis of surnames taken from published lists of
political candidates and award winners. The validity of this device depends
upon the representativeness of the process whereby persons on these lists
are selected. Indeed, the assumption of unbiased selection is often unwarranted
because of the characteristically disproportionate numbers of Party members
and government workers, and the underrepresentation of peasants and industrial

workers, in many of these lists, especially lists of political candidates.
There is at present no thoroughly satisfactory method for dealing with
the ethnic composition of small areas. It would appear desirable as a
first step in attempting to break through this problem to learn as much
as possible in quantitative terms about migration in the Soviet Union
since 1926. Such knowledge, gained possibly from a detailed analysis of
election data for small areas, would provide a means for approximating
the orders of magnitude of the ethnic shifts which up till now have been
revealed only in nonquantitative terms by comparisons of Soviet carto-
graphic materials.

FOOTNOTES

CHAPTER II

[1] For example in the Uzbek S.S.R. in 1939, Russians comprised less than 12 percent of the population of the Republic but more than one-third of the urban population. This disproportion is much more pronounced if only the industrialized cities of Uzbekistan are considered.

[2] Certain "ethnic" differences are trivial such as those between Slavs and Greek Orthodox Finno-Ugrians in North Russia. The suggestion should be resisted therefore that the best ethnic analysis is necessarily the most detailed.

[3] For planning and administrative purposes the following age groupings have been advocated by some Soviet writers:

0 - 3	("infants")
4 - 7	("preschool")
8 - 17	("school age")
18 - 54 - Female	("adults")
18 - 59 - Male	("adults")
55 and over - Female	("elderly")
60 and over - Male	("elderly")

[4] Reference is to the All-Union Census of 1926. A city census conducted in 1931 provides age and sex data for the largest cities (Moscow and Leningrad) and for the urban population of the U.S.S.R.

[5] For analysis of this type see Babynin, B., "Perspektivy rosta naseleniya SSSR v 1927/28 - 1932/33" ("Prospects for the Growth of the Population of the U.S.S.R. 1927/28 - 1932/33"), Planovoye khozyaystvo, v. 9-10, 1928, pp. 320-338; Ptoukha, M. "La Population de l'Ukraine jusqu'en 1960" ("Population of the Ukraine until 1960"), Bulletin de l'Institut International de Statistique, v. XXV, part 3, 1930, Appendix I, pp. 77-79; and Lorimer, Frank, The Population of the Soviet Union, League of Nations, Geneva, 1945, Appendix 6, pp. 231-235. These authors are in agreement as to the fact of defects of enumeration, but differ as to their diagnosis and recommendations. In general, the disclosures of Babynin and Ptoukha relative to the enumeration of the youngest cohorts are in line with investigations of the quality of enumeration carried out in connection with the U. S. Censuses of 1940 and 1950.

[6] For an illustration of this procedure, see: U. S. Bureau of the Census, CONFIDENTIAL, Estimated Population and Labor Force of the City and Metropolitan Area of Andizhan: 1 January 1950, Series P-95, No. 34, 30 August 1954, SECRET.

[7] Notestein, Frank W. et. al., The Future Population of Europe and the Soviet Union, Geneva, Columbia University Press, 1944.

[8] For further discussion of the modification procedure, see U. S. Bureau of the Census, CONFIDENTIAL, Estimates of the Population and Labor Force of Selected Cities of the U.S.S.R., Series P-95, Nos. 18-23, 10 December 1953, pp. 60-63, SECRET.

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[9] The problem is intensified by the relative decentralization of record keeping in the Soviet armed forces.

[10] It would appear in the light of recent cohort fertility analysis that even schedules of age-specific fertility rates adjusted for marital status, for fecundity, and parity are less than ideal for such purposes. The deficiencies of such rates will depend upon the extent to which conditions influencing fertility change and the extent to which efficient techniques of family limitation are available to the population. The more underdeveloped the area, therefore, the more likely that simple age-specific rates will be adequate as indicators of fertility.

[11] The Bureau of the Census in its work on Soviet cities has experimented with more complicated methods of estimating births. The procedure in brief involves (1) an estimate of the annual number of births to survivors of the base population obtained by the use of age-specific fertility rates reported for Moscow in 1926 and (2) an estimate of the annual number of births to migrants based upon a crude birth rate for migrants developed from the application of age-specific birth rates to female migrants arriving in a given city between 1921 and 1926. Both series of annual estimates of births are adjusted by the relationship in 1926 between the crude birth rate of Moscow and the crude birth rate of the city in question. A full discussion of this procedure is contained in U. S. Bureau of the Census, CONFIDENTIAL, Estimates of the Population and Labor Force of Selected Cities of the U.S.S.R., 1 January 1950, Series P-95, Nos. 18-23, 10 December 1953, pp. 65-69, SECRET. This method was abandoned because it was excessively laborious, because the adoption of age-specific birth rates of another city, in this case Moscow, failed to take account adequately of local influences on fertility, and because simpler methods appear to be equally valid.

[12] To compute the child-woman ratio for the U.S.S.R. in 1939 and 1950 it is necessary to have a distribution of the population of the U.S.S.R. by age and sex for these dates. One such distribution for 1939 is given in Lorimer, Frank, The Population of the Soviet Union: History and Prospects, League of Nations, Geneva, 1946, p. 143. A similar distribution for 1950, which has been used extensively in the Bureau of the Census work on estimates of Soviet city population by age and sex is that of Dr. Eugene Kuliecher. See Social Relations Section, Air Research Division, Library of Congress, An Estimate of the Developments in U.S.S.R. Population Structure from January 17, 1939 to January 1, 1952, Social Relations Technical Paper No. 1-3, undated, p. 43, SECRET. This distribution was prepared before the release of current Soviet demographic data in Narodnoye khozyaystvo, and suffers from not having had the advantage of these data. Nonetheless it represents an excellent imaginative reconstruction of the demographic profile of the U.S.S.R. on the basis of very scanty raw data. It is not recommended for future use, however. The Bureau of the Census has prepared new population distributions by age and sex for 1955 and 1956, and projected distributions for 1960, 1961, 1965, 1966, 1970, 1971, 1975 and 1976, which embody information not available prior to 1956. These distributions and projections will be published in the near future.

[13] The typology employed here is that developed by Chauncey Harris in his article on "The Cities of the Soviet Union," Geographical Review, v. XXXV, no. 1, January 1945, pp. 107-121.

[14] Voprosy ekonomiki, v. 1, January 1955.

[15] Throughout the period of Soviet power there have been, of course, planned deportations of dissident and suspect groups, but such deportations generally removed the unfortunate victims from urban areas rather than the reverse.

[16] The Third Five-Year Plan listed 10 areas of the U.S.S.R. with nearly two million "able-bodied collective farmers who can be utilized for work in nonagricultural branches of the national economy and for migration" from which it was planned to call up yearly more than a half million workers in "an organized recruitment." See Sonin, M., "Voprosy pereseleniia v tretei piatiletke" ("Migration Problems of the Third Five-Year Plan"), Problemy ekonomiki, no. 3, 1940.

[17] Lawrence, N., and Greenberg, B., "Illustrative Examples of Two Methods of Estimating the Current Population of Counties," in U. S. Department of Commerce, Bureau of the Census, Current Population Reports, Population Estimates, Series P-25, No. 20, May 6, 1949, Washington, D. C.

[18] Data on migrants to Soviet cities, classified by age, sex, resident status and time of arrival are available in part III, table 4 of the All-Union Census of 1926.

[19] U. S. Department of Commerce, Bureau of the Census, CONFIDENTIAL, Estimated Population and Labor Force of Rumania, Urban and Rural: 1 January 1950, Series P-95, No. 39, December 1955, pp. I-37 to I-38, SECRET. Released as Technical Memorandum OERL-TM-55-21, Officer Education Research Laboratory, Air Force Personnel and Training Research Center, Air Research and Development Command, Maxwell Air Force Base, Alabama.

[20] A test of this involved the application of revival factors obtained from a 1926 life table to the survivors of migrants reported in the 1926 Census. The validity of this procedure rests upon the untested and possibly incorrect assumption of no differential age-sex selectivity of out-migrants as compared with in-migrants.

[21] Sonin, M., "Voprosy pereseleniia n tretei piatiletke," Problemy ekonomiki, no. 3, 1940, pp. 80-90. "Migration of the first and second Five-Year Plans was primarily an industrial migration." In connection with such migration a demand for unattached adults might be expected.

[22] See Thomas, Dorothy Swaine, Research Memorandum on Migration Differentials, Social Science Research Council, New York, pp. 11-69.

[23] The derivation of this estimated distribution will be presented in a subsequent report, along with an analysis of certain implications it has for such problems as the character of urban migrations, the territorial distribution of military personnel and disenfranchised elements of the population.

[24] Marzeyev, A. N., Kommunal'naya gigiyena (Communal Hygiene), Moscow, 1951, p. 42.

[25] Izvestiya, 5 January 1940.

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[26] Narodnoye khozyaystvo, op. cit., p. 26.

[27] Tsentralnoye upravleniye narodno khozyaystvennogo ucheta gosplana SSSR, Kul'turnoye stroitel'stvo SSSR (Cultural Construction of the U.S.S.R.), Moscow, 1940, p. 51.

[28] Bogdanov, I. M., Ocherki po statistike vsoobshchego shkol'nogo obucheniya (Outline of Statistics on General School Education), Moscow, 1948, p. 8.

[29] Bogdanov, op. cit., p. 84.

[30] A modified procedure, which might be called a "controlled component projection" has been used experimentally. See: U. S. Department of Commerce, Bureau of the Census, CONFIDENTIAL, Estimated Population and Economically Active Population of the City and Metropolitan Area of Tula: 1 January 1950, Series P-95, No. 25, Washington, D. C., 10 May 1954, Appendix II, CONFIDENTIAL; and U. S. Department of Commerce, Bureau of the Census, CONFIDENTIAL, Estimated Population and Labor Force of the Ordzhonikidze Metropolitan Area: 1 January 1950, Series P-95, No. 36, Washington, D. C., 30 September 1954, pp. 14-16, CONFIDENTIAL. The modified method uses information on population subgroups such as school children and voters to improve the alignment of cohorts derived by a component projection technique. Data on other population elements such as "workers and employees," pioneer and komsomol members, etc., may also be helpful in such an approach.

[31] U. S. Department of Commerce, Bureau of the Census, CONFIDENTIAL, Estimated Population and Labor Force of the City and Metropolitan Area of Chirchik: 1 January 1950, Series P-95, No. 24, Washington, D. C., 10 March 1954, p. 34, SECRET. See also: U. S. Department of Commerce, Bureau of the Census, CONFIDENTIAL, Estimated Population and Economically Active Population of the City and Metropolitan Area of Tula: 1 January 1950, Series P-95, No. 25, Washington, D. C., 10 May 1954, pp. 49-52, CONFIDENTIAL, where the assumption is made that the age and sex distribution of Tula in 1950 would resemble that of 1939 within the limits set by the general demographic situation in 1950. This procedure was selected because of the similarity of the economic base in 1939 and 1950, and because the estimated age and sex distribution for 1939 was based upon a greater amount of information than was available for any subsequent year.

[32] Tsentral'noye upravleniye narodno-khozyaystvennogo ucheta gosplana SSSR, Kul'turnoye stroitel'stvo SSSR. Statisticheskiy sbornik (Cultural Construction of the U.S.S.R. A Statistical Compilation), Moscow, 1940, table 15.

[33] Especially valuable in this regard are the plates prepared under the auspices of the MVD by Glavnoye upravleniye geodezii i kortegrafii entitled Karta narodov SSSR (Maps of the Peoples of the U.S.S.R.), Moscow, 1953.

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CHAPTER III

ESTIMATES OF THE SIZE AND INDUSTRIAL COMPOSITION OF THE LABOR FORCE FOR
CITIES OF THE U.S.S.R.

This chapter is devoted to problems of labor force definition insofar
as they relate to the development of efficient estimation techniques, to an
exposition of the types of data used in such techniques, and to the description
of the important details of the methodology that has been used by the Bureau of
the Census to estimate the labor force of Soviet cities and its industrial
composition. Little attention will be given to alternative methods or to the
evaluation of the quality of the basic data used in this type of study. It is
planned, however, to incorporate a detailed evaluation of the weaknesses and
potentialities of all available Soviet data on this subject into a subsequent
report in this series (tentative title: Soviet Practise in Collection and Publi-
cation of Data on the Labor Force). An additional reason for the relative brevity
of this chapter is that much of the work done in this area has been of a custom
character, rather than in accordance with standardized procedures; as a result
the emphasis has been placed on the smaller body of topics more or less common
to a number of different procedures and not to any great extent on the custom
variations to which resort was very frequently taken.

Definition of terms.

Broadly defined, the term "labor force" refers to that part of the
population engaged in economic pursuits. It comprises all persons at work or
holding a job as well as the unemployed who are seeking work.[1] This is the rela-
tively unrestrictive definition that should be used in connection with the estimates
of the labor force of Soviet cities prepared by the Bureau of the Census and
presented in this series of reports. The term, or any near equivalent, is rarely

found in current Soviet literature, perhaps because of an unwillingness to concede, on ideological grounds, that the Soviet system can breed unemployment other than fictional unemployment. Most often, Soviet sources refer merely to the employed population. If there were truly no unemployment, the terms "employment" and "labor force" would be close in meaning. But, it must also be noted that the term "employed" refers to information collected at the place of work, as in a census of industrial establishments, and is a measure of economic activity; whereas the term "labor force" has the connotation of a personal characteristic so that a person in the labor force has this as an attribute in much the same way that he has the attribute of being married, or being of a certain age. This is an operational distinction. It follows from the different methods of collecting information, and does not necessarily imply a practical difference in overall estimates, although it is usually true that the two types of measures of the same population yield different results.

In the past, the Soviet literature has used different terms to identify the population engaged in economic pursuits. The 1926 Census, which is of particular interest as the source of much useful information for estimation purposes, featured the term "active population." The definition used was: "... persons who have an independent source of the means of existence (wages, income). Also included as actives are dependents of State and public institutions, unemployed, and military personnel."[2] Except for the inclusion of certain elements which would be more properly classified as other than active, this definition is close in meaning to the customary meaning of the term "gainful worker." Both relate to persons who follow an occupation in which they earn money or a money equivalent, or in which they assist in the production of goods and services. Both automatically exclude very young children, regardless of their actual situation.[3] Both have the connotation of habitual or usual status, rather than status at a particular point in

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time or during a specified time interval. Both terms, when employed for the
collection of information, resulted in operational procedures which tended to
include retired or permanently disabled persons who had not worked or sought work
for long periods of time.

On the other hand, there were some meaningful differences between the
Soviet term "active population" and the more widely used "gainful worker." For
example, the Soviet term included all unemployed and it is noted specifically *
that "students who have finished a course and nonactives who have reached a working
age" were deemed to be unemployed unless actually at work. Such persons were treated
as gainful workers only if they so regarded themselves and so reported themselves
in a census featuring the gainful worker concept. The "labor force" concept also
covers new workers, but only if they seek work. Similarly, the Soviet "active
population" concept included as active such groups as "dependents of State and
public institutions whom the State keeps either in compensation for previous labor
and services for the State (invalids of war and labor), or in expectation of services
from them in the future (scholars, pre-school persons), or as a necessity (prisoners).
.... /Also counted as active are_7.... persons living on their own nonlabor income
from the payment of rent or from interest on securities and deposits .... the
declassed groups of the population (sorcerers, thieves, prostitutes) .... / and /
.... persons living on private charities and .... on alimony."³ None of these
groups, except perhaps those engaged in illegal occupations, are included in the
term "gainful workers" nor in the term "labor force", either in the broad sense in
which it is used in these reports or in the less comprehensive sense in which it
is applied to data for the United States.

The term "labor force," as it is now used in connection with data for
the United States has an operational definition, that is, a definition arising

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from the way information on the subject is collected. It comprehends both the employed and the unemployed, but with the following particular meanings of these terms:

Employed: persons at work, that is, persons who did any work for pay or profit or who worked without pay for 15 hours or more during a specified week on a family farm or business; and persons with a job but not at work, that is, those who did not work or look for work during a specified week, but had a job or business from which they were temporarily absent because of vacation, illness, industrial dispute, bad weather, or layoff with definite instructions to return to work within 30 days of layoff; and persons having new jobs to which they were scheduled to report within 30 days.

Unemployed: persons who did no work at all during a specified week and who were seeking work; and persons not working who would have been looking for work except that they were temporarily ill, or expected to return to a job from which they had been laid off for an indefinite period, or believed no work was available in their line of work or in their community."

It should be clear from what has been said that the labor force estimates for Soviet cities prepared by the Bureau of the Census are not necessarily comparable with "labor force" figures for cities of the United States, nor with "employment" data from Soviet sources, nor even with data from the 1926 Census of the U.S.S.R. on the economically active population. The estimates whose preparation is described below are related conceptually to the data on which they are based and may not be entirely comparable even among themselves because of variations in method and types of basic data employed. In general they come closest to the meaning "employed"

as used in the Soviet sources, and they approach the meaning "labor force," in the unrestrictive sense in which the term was first used above, when unemployment is virtually absent.

The scope of the problem.

In broadest terms the subject of this chapter is the preparation of estimates of total labor force and of the _distribution_ of this total by branch of industry for any Soviet city. This job is not of uniform difficulty due to the fact that employment in certain types of activities is more variable than in others.[7] The greatest absolute variation is encountered in manufacturing, making this significant category the most troublesome to estimate. Service and maintenance activities on the other hand are subject to much smaller absolute variations in size. To pick an extreme example: in Stalingrad in 1926 over 40 percent of the male labor force was in manufacturing as compared with less than 18 percent in the case of Orenburg. Yet the variation between the percentages employed in specific major industry groups in these two cities was only 2.1 for trade and credit, 0.6 percent for government, and 1.8 percent for construction. Compared either with the percentage point variation in manufacturing (more than 22.0) or with the expected estimation error commonly met by the analyst of Soviet labor force data, these differences are small, if not negligible.

Variation in the relative size of various labor force categories occurs in spite of the fact that overall participation ratios appear to be fairly stable. The following table shows this stability for selected cities in a number of countries and for a variety of dates:

Table 12.--TOTAL LABOR FORCE AS A PERCENTAGE OF TOTAL POPULATION FOR
SELECTED CITIES AND DATES

Country	Year	Number of cities	Mean value (percent)	Standard deviation (percent)
United States..................	1940	105	45	2.4
United States..................	1950	105	44	2.8
Austria........................	1939	4	49	1.7
Bulgaria.......................	1934	3	39	1.7
Czechoslovakia.................	1930	5	51	1.6
Denmark........................	1930	2	48	0.8
Ireland........................	1936	2	44	0.8
England and Wales..............	1931	51	48	4.6
Finland........................	1930	4	59	2.1
Germany........................	1933	17	47	3.6
Greece.........................	1928	3	40	1.3
Hungary........................	1930	3	47	1.4
Scotland.......................	1931	4	49	3.0
Spain..........................	1940	4	40	0.8
U.S.S.R. (Central Industrial Region and Ukraine)........	1936	30	45	8.8

Differences in mean values in the table are to some extent a matter of
differences in labor force definition among the countries listed. The
significant fact is the stability of labor force participation ratios within
countries as indicated by the low standard deviations in the final column.[8]
What this means is that, to a considerable degree, variations in the
relative size of the manufacturing component are taken up by or squeezed
out of other labor force categories, rather than being a source of
variation in the size of total labor force.

This general approach to labor force structure indicates in a rough
way, the strategy to be followed in making city labor force estimates: (1)
concentration upon manufacturing as the unique and variable element in urban

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labor force structures, (2) minimal concern with elaborate refinements in estimating nonmanufacturing components except where manufacturing has been found to be insignificant, and (3) evaluation of (1) and (2) in terms of their approximation, when combined, to a reasonable overall labor force participation ratio. Since the latter, in a sense, stands in judgement of the component estimates, it is important to have an independent estimate of the size of the total labor force. One suggested possibility is the use of age- and sex-specific labor force participation ratios applied to an appropriate age and sex distribution of the population.[9] The decision to approach the problem in this manner depends of course upon the quality of the estimated age and sex distribution and upon the extent to which data exist which will permit meaningful sets of rates to be computed. Such rates must obviously be specific for locality, at the very least for urban-rural differences, as well as for age and sex.

One final comment on technique is called for. Because of the very great pitfalls and hazards in work of this kind, it has become standard procedure to work forward from statistical bases twenty to thirty years in the past. Only in this way can the reasonableness of current claims be safely assessed. Without a knowledge of antecedent industrial structure, it is most difficult to know how much confidence to place in figures derived through mechanical manipulation of fragments of elusive Soviet data. This amounts to saying that where all data must be treated as partial or distorted disclosures of actual fact, and where estimating techniques are frequently improvised with insufficient opportunity for establishing their power and aptness, the reasonableness of the implied leap from the past is crucial. Beyond this, for certain sectors of the labor force, the magnitudes and relationships observable in earlier structures are the stuff

out of which current estimates are made. For this reason we begin this account
of estimating procedures with a brief review of Soviet labor force data beginning
with the most inclusive of all Soviet compilations, the 1926 Census.

Soviet labor force data.

Reference has already been made to the practical and conceptual
distinctions between the terms "labor force," "gainful workers," and "economically
active population." Some attention should be given also to an exposition of the
occupational classifications employed in the 1926 Census, since these are so often
used in urban labor force estimation.[10] Both the active and nonactive populations
were classified by occupation. The principal divisions or levels of classification
are as follows:[10]

Class or "position in occupation." This is the principal division of
the classification system, and contains 10 categories:

1. Workers (roughly, wage earners).
2. Employees (roughly, salaried persons).
3. Persons of free professions (doctors, teachers, etc.).
4. Proprietors with hired labor.
5. Proprietors working with members of families and members of
   artels.
6. Individual proprietors.
7. Members of families who assist in the family occupation.
8. Persons not having, or not stating, an occupation.
9. Unemployed.
10. Armed forces.

Branch of the national economy. Within each of the 10 categories
above there is a secondary classification by branch of industry. A
particular principal division may have all, some, or none of the
categories in this secondary division.

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1.   Agriculture.
2.   Large-scale industry.*
3.   Handicraft industry.*
4.   Construction.
5.   Railroad transport.
6.   Other transport.
7.   Trade and credit.
8.   Institutions.*
9.   Other.

* "Large-scale industry" was defined as "all industrial
establishments (factories, plants, mines, pits, peat bogs,
etc.) which usually have not less than 16 workers if the
establishment has mechanical power, or not less than 30
workers in the absence of mechanical power." In general,
the category "handicraft industry" contained all establish-
ments which did not meet the qualification for large-scale
industry. The category "institutions" (uchrezhdeniya)
included persons engaged in governmental activities, as well
as in education, public health, communications, commerce, etc.

Further subclassification of the secondary categories are available

from the 1926 Census by groups of occupation (metalworkers, woodworkers, etc.),

by individual occupations (blacksmith, locksmith, patternmaker, etc.), and, for

the worker occupations, by skill.[10]

Although the 1926 Census is the source of much more detailed labor

force information than any that have been published since, major problems of

comparability are encountered in using these data serially with later information.

Thus, for example, to compare employment in government, education, health,

communications, or commerce, as reported in the employment survey of 1936, with

the numbers in these categories in 1926, involves a very laborious regrouping

of the occupational data in the 1926 Census. Persons so employed in 1926 were

included without differentiation within the category "institutions." The only

way in which 1926 employment in government, for example, can be estimated, is

by gathering together all occupations which by their descriptive titles appear

to belong in that category. Similar problems are met with in attempting
comparisons over time of categories such as steel or textile manufacturing,
food processing, etc. These are the problems which arise inevitably whenever
census data by occupation are compared with figures which have been classified
not by occupation but by industrial affiliation.

One further difficulty to be encountered in using 1926 Census materials
stems from the lack of tabulations for small areas. Detailed distributions of
the labor force are given only for the U.S.S.R., the republics, large economic
regions, each guberniya, and cities with a population of 100,000 and over.
Abridged distributions are presented for the above areas and for uyezds (rayons),
with data for urban and rural subclassifications. Thus, no distribution is
available for cities which had a population of less than 100,000 in 1926. An
estimated distribution for cities of this size may sometimes be derived from
the data reported for the urban part of the uyezd to which the city belonged.
This is done ordinarily by direct proportional allocations, unless there are
items of specific information which indicate a modified procedure.[11]

In the decade following 1926, a great amount of labor force data for
small areas was reported in statistical handbooks published by local statistical
offices and planning commissions. These volumes were generally issued in connection
with territorial and administrative reorganizations, or sometimes as information
relevant to the implementation of the Five-Year Plans. For the most part,
relevant data were concerned with the size and operation of specific industrial
and cooperative establishments rather than with comprehensive coverage of all
branches of the economy. For this reason, the figures on individual establishments

published during the early thirties, are useful chiefly in an auxiliary analytic
way, e.g., in the development or adjustment of industrial productivity ratios.
It was only with the employment survey of 1936 that fairly inclusive figures
on the labor force of a large group of cities became available.[12]

The 1936 survey provides, for most cities and for all oblasts of the
U.S.S.R., the total number of workers and employees (rabochiye and sluzhashchiye,
i.e., wage earners and salaried employees) plus a distribution by industrial
category. This survey was based on reports from establishments, agencies,
offices, etc., of the number of persons "on the rolls." By official admission,
it is deficient in certain sectors and completely ignores others. The deficiencies
occur in the omission of "some enterprises and agencies of the People's
Commissariat of Defense and the People's Commissariat of Internal Affairs."
The sectors which were omitted entirely included collective farms and all
Communist Party and Komsomol organizations.[13] Other categories not covered by
the survey comprised the armed forces, the unemployed, individual farmers,
independent artisans and handicraftsmen (nekooperirovannyy kustar'), servants, and
peddlers, i.e., persons not on the rolls of regular establishments. By far the
most significant of these excluded groups are the members of the armed forces
and persons employed by the Commissariat of Defense. There is no standard
procedure for the estimation of this group. Some of the considerations involved
in their approximation are discussed in the appended illustration. (See
appendix IV .)

One major difficulty in the use of data from the 1936 survey is the
lack of tabulations of total employment in manufacturing by branch of industry.
Such a distribution can be achieved for most cities, however, by use of

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industrial production data (in 1926/1927 rubles) reported in various atlases,
handbooks, etc.[14] When used in conjunction with appropriate reported or
estimated productivity rates, these production figures yield estimates of
employment by branch of industry.

Information relative to the labor force of Soviet cities after 1936
is extremely scarce. It consists largely of a miscellany of newspaper and radio
reports, fragments from encyclopedias, local histories, specialized periodicals,
and the like. In addition, the eyewitness accounts of prisoners of war (now
somewhat obsolete) and of visitors to the Soviet Union, official and otherwise,
are available. These are generally difficult to evaluate, and are useful
primarily as background material.

Out of this melarge it is sometimes possible to gain fairly satisfactory
notions concerning the most significant of recent developments. A demonstration
of such an informational break-through is given with respect to the metallurgical
industry at Tula in the extended illustration in appendix IV. It is extremely
unlikely, however, that more than a limited number of industrial sectors can
be successfully estimated on the basis of current information in any given case.
The approximation of other sectors - especially such nonmanufacturing activities
as government, health, transportation, and commerce - must depend to a considerable
degree upon some kind of a projection of the labor force for a prewar year. As
indicated above, this most often means the period 1935-1936. These problems are
treated in more detail in the section which follows.

Procedural suggestions.

Nothing has yet been developed that can be called a standardized
procedure -- that is one which mechanically applied, will produce an estimate
of total labor force distributed by branch of industry. As previously observed,

each area constitutes a special problem with respect to both available information
and analytical peculiarities. A high proportion of custom work with more than
a little artistic fitting is inevitable. Nevertheless, a core of procedures
has evolved, which, although requiring adjustment and supplementation in
specific cases, is generally applicable to most problems. An outline of an
estimating procedure which would be applicable under ideal conditions of avail-
ability of data is given below. An illustration of its application to a particular
city, Tula, is given in appendix IV.

I. Selection of base.—In view of the data available the base period
will generally be 1935-1936. A detailed labor force estimate as of that
date may be prepared on the basis of the following types of information:

A. Estimates of the total labor force and of the distribution
thereof by major branch of industry may be had from the 1936 employment
survey,[12] subject to such incompleteness of coverage as exists in that
source.

B. The distribution by specific industry branch of employment
in large-scale industry, which is a close equivalent to manufacturing,
may be accomplished by relating data on ruble value of output per
worker (available often for major branches of industry for 1931-1941)
to production in 1935, expressed in rubles.

C. The estimates derived by steps A and B frequently are
incomplete or subject to biases which must be taken into account. For
example, the labor force in agriculture, the self-employed population,
and the armed forces are not adequately covered in step A. Data for
these groups must be sought in other places, such as the reports of

the 1926 Census and the handbooks and statistical compilations of the early and mid-thirties.[15] The needed figures will rarely appear in these sources, but there will usually be additional data on which to base an estimate.

D. The technique noted under step B for the estimation of labor force in specific industrial branches needs amplification. As set forth there, it calls for dividing data on production (in rubles) by data on productivity per worker (in rubles). The result of this computation has one dimension -- workers (rabochiye). This must be converted to total employment. A reasonable value of the ratio of total employment to rabochiye is required for each industrial enterprise; such figures are obtainable by manipulation of certain published data.[16]

E. There is also an element of custom fitting that will often need to be invoked. For example, the estimate of the labor force of a particular branch of industry may have been computed by the use of data on production and productivity, with the production data specific for the time and place, but the productivity data based on the industry branch generally rather than the specific plant in the city being studied. In such cases the local literature must be searched for indications of the product mix in the local plant or any other information that will indicate whether the industry-wide productivity figure applies or must be modified.

II. Estimation of changes since the base date.--There should be separate consideration of manufacturing and nonmanufacturing industries. It cannot be too often asserted that the estimating technique to be followed will

depend on the data available. In the case of certain manufacturing
industries,[17] for which some data on output, production methods, plant
size, installed power, and the like, may be found for different dates,
there are a few general lines of approach which may be stated:

    A. If data on output of a particular plant or set of plants
comprising the industry in the city are available over time, they
may be converted to estimates of employment of _rabochiye_, if productivity
rates are available or can be estimated for the same dates. If no
better measure of productivity is at hand, recourse can always be
had to extrapolations of prewar productivity rates consistent with
national trends. Estimates of _rabochiye_ so computed would have to
be converted to estimates of the total labor force, as described
above.

    B. If there are significant technical and dimensional similarities
between the city being studied and some other city for which more data
are available, estimates may be made by analogy. The acceptance of
an analogical model should be limited to cases for which reliable
data on production cannot be procured or for which suitable produc-
tivity rates cannot be estimated. The most legitimate use of analogy
is as a device for validation of unofficial data on employment.[18]

    C. In a few instances[19] data may be found on the gross value
of output in large-scale industry for a specific city. Such figures
are a mixed blessing since all the problems of the interpretation of
gross output data are complicated many times over by the additional
problem of ascribing a relevant productivity rate where the output

mix is likely to be uncertain. Extrapolation of a known aggregate productivity from some earlier date is likewise precarious because of the differential movement of productivity rates among various industries. In the case of Samarkand, for example, gross industrial output for 1950 was estimated with fair confidence. All that was known of productivity trends for large scale industry, however, referred to the Uzbek Republic as a whole where the production of producers' durables was considerably more important than in Samarkand. Guidance from this source, therefore, had to be rejected and an alternative extrapolation model devised.

D. Postwar estimates of employment in various <u>nonmanufacturing</u> activities have been based almost exclusively upon extrapolations of prewar figures with recourse occasionally to simple ratio techniques. Where the activity appears to be a function of population size, as for example service activities, the extrapolation model generally adopted has been based upon change in total population. This procedure has been followed for all nonmanufacturing categories except transportation and communication in the case of Tula. (See appendix IV.) A more appropriate extrapolation model for transportation and communication appears to be the changes in employment or volume of production in manufacturing. Where structural changes have occurred outside of manufacturing, such as the changes resulting from greater investment of human resources in health or educational activities, extrapolations based on population changes have been abandoned in favor of devices which can reflect these changes. Various types of per capita ratios

are sometimes helpful in these cases, e.g., ratios of students to the number employed in education. In general, however, much greater attention should be given to the development and validation of these ratios. Soviet city planning literature contains other suggestions as to ratios which likewise deserve greater investigation than they have received heretofore.

E. The analogic approach has sometimes been used to obtain an approximate distribution of the nonmanufacturing labor force, by major industry group. Thus, in the case of Chirchik,[20] a small but significant city of the Uzbek, S.S.R., the estimated nonmanufacturing components of the labor force were modeled upon those of the city of Cheremkovo, which as the result of comparative study had been found to resemble Chirchik with respect to: (a) general industrial similarity (chemical industry, machine building), (b) population size class, (c) size of labor force in large scale industry relative to total employment, (d) employment in education, (e) employment in construction. Other adaptations of the analogical method were employed in the studies made of Tula (see appendix IV), Koluga[21], and Ryazan.[22]

Validation of city labor force estimates.

Comments on the subject of validation can be brief. Aside from the inherent reasonableness of the steps which lead to the final estimates, there are no infallible tests of validity at the present time except the requirement that all the pieces should fit together reasonably well. This means not only the component parts of the labor force, but population estimates and general interpretative context as well. At this stage nonquantitative judgements

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inevitably play a large part. The substitution of quantitative measures of validity depends upon progress in systematic input-output analysis, a greater understanding of the structure of Soviet industry and finally, but most important, a greater flow of information from the U.S.S.R.

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FOOTNOTES

CHAPTER XXI

[1] See also: Ducoff, L. J.; and Hagood, M. J. Labor Force Definition and Measurement, Social Science Research Council Bulletin 56, New York, 1947, p. 1.

[2] Tsentral'noye statisticheskoye upravleniye SSSR. Vsesoyuznaya perepis' naseleniya 1926 goda (All-Union Census of Population, 1926), v. XVIII, Moscow, 1929, p. 1.

[3] Children under 10 years were not considered active in the 1926 Census of the U.S.S.R., and were not considered gainful workers in the 1930 Census of the United States.

[4] All-Union Census of Population, 1926, op.cit., v. XVIII, p. 519.

[5] Ibid.

[6] See, for example: U. S. Department of Commerce, Bureau of the Census. "Annual Report on the Labor Force, 1955", Current Population Reports, Labor Force, Series P-50, No. 67, March 1956, Washington, p. 12.

[7] For the United States this has been demonstrated in an article entitled "A Service Classification of American Cities" by Howard J. Nelson. Economic Geography, v. 31, no.3, July 1955, pp. 189-210.

[8] The medium sized standard deviations for England and Wales, Germany, and Scotland are attributable largely to the extreme effect of a small number of textile centers and one (Nürnberg) toy center where extraordinarily large numbers of women are to be found in the labor force. The large standard deviation for the Soviet cities is partly an artifact since the labor force data were subject to arbitrary exclusions which were of greater significance in some cities than in others.

[9] This technique has been used in estimating the labor force of a cluster of Russian textile towns in the Ivanovo region. The chief problem in this approach is to give adequate quantitative recognition to the impressive increases in female labor force participation. Since these had traditionally been high in the old textile centers, data from the Census of 1926 provided a useable base for the necessary computations.

[10] For definitions and a description of the 1926 classification system see Tsentral'noye statisticheskoye upravleniye SSSR, op.cit., pp. VIII-XIII, 1, and 521-540.

[11] Modified procedures are often required in connection with the estimate of military personnel. For a discussion of this problem see pp. 69, 70.

[12] Tsentral'noye upravleniye narodno-khozyaystvennogo ucheta gosplana SSSR. Otdel ucheta truda. Chislennost' i zarabotnaya plata rabochikh i sluzhashchikh v. SSSR. (The Number and Wages of Workers and Employees in the U.S.S.R.), Moscow, 1936.

[13] Op.cit., p. 297.

[14] These production data usually were reported only for large-scale industry, which was defined very similarly to the large-scale industry category in the 1926 Census (see above). The 1926 category, more precisely called "census (tsenzovaya) industry," did not include fisheries, lumbering, and railway repair shops. For an informative discussion of these categories see Hodgman, Donald R., Soviet Industrial Production, 1928-1951, Cambridge, Harvard University Press, 1954, pp. 3, 175.

[15] These are cited in the Tula illustration.

[16] Indications of the value of this ratio for major industrial categories are given in a variety of sources. For specific, technologically homogeneous enterprises the best source has proven to be a 1935 handbook, Tsentral'noye upravleniye narodno-khozyaystvennogo ucheta gosplana SSSR. Trud v SSSR. Statisticheskiy spravochnik (Labor in the U.S.S.R., A Statistical Handbook), Moscow, 1936, pp. 64-67.

[17] Manufacturing enterprises which have been identified unambiguously but for which no other information is available (except sometimes a prewar employment figure) present special difficulties for which there is no general remedy. To state the problem in its most formidable terms, there are in addition (1) enterprises whose separate identity is in doubt, i.e., they may represent merely an alternate designation for a previously identified plant; (2) enterprises whose existence is a near certainty in view of locational factors or expectable input-output relationships, but which cannot be positively identified. Our techniques for handling these cases, whether it be the carry-over or modification of earlier figures, or de novo estimation, are no better than the general state of the arts today in the field of input-output analysis. As our knowledge of interindustrial relationships develops, more exact resolutions of these problems will emerge. At the present time the estimation of industrial matrices is little more than a theoretical possibility. In the work done to date, we have been forced to rely upon a few selected extrapolation models and non-standardized ratio devices.

[18] In this connection see U. S. Department of Commerce, Bureau of the Census, CONFIDENTIAL, Estimated Population and Labor Force of the Aleksin Industrial Area: 1 January 1950, Series P-95, No. 35, Washington, D. C., 10 August 1954, p. 50 ff, CONFIDENTIAL. The problem faced here was the validation of a reported figure for employment at the Aleksin Chemical Combine, the area's chief industry. Data were available relative to production, technology, plant area, work schedule and power supply. With these criteria, a study was made of German chemical plants for which there were, in addition to data of the type mentioned, data on total employment.

[19] See for example, U. S. Department of Commerce, Bureau of the Census, CONFIDENTIAL, Estimates of the Population and Labor Force of Selected Cities of the U.S.S.R.: 1 January 1950, Series P-95, Nos. 18-23, Washington, D. C., 10 December 1953, p. 55, SECRET; also ibid., CONFIDENTIAL, Estimated Population and Labor Force of the City of Samarkand: 1 January 1950, Series P-95, No. 37, Washington, D. C., 20 January 1955, pp. 44-45, SECRET.

[20] U. S. Department of Commerce, Bureau of the Census, CONFIDENTIAL, Estimated Population and Labor Force of the City and Metropolitan Area of Chirchik: 1 January 1950, Series P-95, No. 24, Washington, D. C., 10 March 1954, p. 49, SECRET.

[21] U. S. Department of Commerce, Bureau of the Census, CONFIDENTIAL, Estimated Population and Labor Force of the City of Kaluga: 1 January 1950, Series P-95, No. 38, Washington, D. C., 20 June 1955, SECRET.

[22] U. S. Department of Commerce, Bureau of the Census, CONFIDENTIAL, Estimated Population and Labor Force of the City and Metropolitan Area of Ryazan': 1 January 1950, Series P-95, No. 47, Washington, D. C., December 1955, SECRET.

APPENDIX I

CHRONOLOGICAL LIST OF MAJOR SOURCES FOR U.S.S.R. CITY POPULATION DATA[1]

Year	Source	Remarks
1926	Tsentral'noye statisticheskoye upravleniye SSSR. Vsesoyuznaya perepis' naseleniya 1926 goda (All-Union Census of Population, 1926, vols. I-XVII, Moscow, 1928, 1929.	Last complete published census covering the entire U.S.S.R. For many small cities this source provides the most recent published population figure. Special tabulations based on the 1926 Census but presenting data not found in the regular census publications may sometimes be found for local areas. These are compiled by local statistical agencies.
1931	Tsentral'noye upravleniye narodno-khozyaystvennogo ucheta gosplana SSSR. Trud v SSSR (Labor in the U.S.S.R.), Moscow, 1935, p. 6.	This source presents population totals for 1926, 1931 and 1935 for all cities with a population 100,000 and over in 1935. The 1931 figures are based on city enumerations.
	------. Narodnoye khozyaystvo SSSR (National Economy of the U.S.S.R.), Moscow, 1932, pp. 405-407.	Presents data based on same 1931 city enumeration as above, along with totals for five earlier dates going back to census of 1897. In some cases the figure differ from those in Trud v SSSR. This may be due to variations in the handling of certain population groups.
		As with the 1926 Census, local statistical agencies have sometimes published special tabulations for their areas. These will frequently contain information on cities below 100,000 in population.

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CHRONOLOGICAL LIST OF MAJOR SOURCES FOR CITY POPULATION DATA[1]—Con.

Date	Source	Remarks
1933	Tsentral'nyy ispolnitel'nyy komitet soyuza SSSR. Administrativno-territorialnoye deleniye soyuza SSR (Administrative Divisions of the U.S.S.R.), Moscow, 1934.	A comprehensive list of official Soviet estimates for cities and smaller settlements. These estimates frequently appear to be invalid; possibly they are the result of an unrefined projection of earlier census materials. This source also contains aggregate data on rural and urban population. The definitions of rural and urban territory employed here (those of the Central Administration for Economic Accounting of Tsentral'nyy ispolnitel'nyy komitet soyuza SSSR) differ from those of the Central Administration of Economic and Social Statistics, Tsentral'noye upravleniye narodno-khozyaystvennogo ucheta gosplana SSSR, the agency charged with conducting the census.
1935	Trud v SSSR ... loc.cit. also Tsentral'noye upravleniye narodno-khozyaystvennogo ucheta gosplana SSSR. Sotsialisticheskoye stroitel'stvo SSSR (Socialist Construction of the U.S.S.R.), Moscow, 1936.	Official Soviet estimates for cities of 100,000 or more inhabitants plus estimates for a number of selected new cities.
1936	Besher, R. Ya. Problemy naseleniya v narodnokhozyaystvennom planirovanii (Problems of Population in Economic Planning), Moscow, 1937.	An apparent continuation of the series presented in Sotsialisticheskoye stroitel'stvo SSSR, op. cit.

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CHRONOLOGICAL LIST OF MAJOR SOURCES FOR U.S.S.R. CITY POPULATION DATA[1]--Con.

Year	Source	Remarks
1939	Izvestiya, June 2, 1939.	Results of the Census of 1939 for cities with 50,000 or more inhabitants. Same source provides 1926 populations for 1939 boundaries.
	Tsentral'noye upravleniye narodno-khozyaystvennogo ucheta gosplana SSSR. Kul'turnoye stroitel'stvo SSSR (Cultural Construction of the U.S.S.R.), Moscow, 1940, pp. 26-27.	Educational statistics for a number of cities are presented in percent of the 1939 Census population. This source is especially useful for cities of less than 50,000 population.
1956	------. Narodnoye khozyaystvo SSSR (National Economy of the U.S.S.R.), Moscow, 1956.	Population figures for Republics, and cities of 100,000 or more population for 1956; selected vital statistics; statistics of population distribution for urban and rural residence.
1956	Statisticheskoye upravleniye RSFSR. Narodnoye khozyaystvo RSFSR. Statisticheskii sbornik (National Economy of the R.S.F.S.R. A Statistical Handbook), Moscow, 1957.	Population statistics by oblasts, urban and rural, for cities of 50,000 or more population, and for smaller places which are oblast, kray, okrug, and Republic centers; selected vital statistics.

[1] Soviet encyclopedias often include population figures in articles dealing with particular cities. See Bol'shaya sovetskaya entsiklopediya (Great Soviet Encyclopedia), Moscow, 1st and 2nd editions; also Malaya sovetskaya entsiklopediya (Small Soviet Encyclopedia), Moscow, 1st and 2nd editions.

APPENDIX II

SOVIET ELECTIONS: 1937-1955

Date of election	Type of election[1]	SOURCES FOR DATA ON:		
		Election law	Number of election districts	Election results[2]
December 1937	All-Union	Pravda, 10 July 1937	Pravda, 12 October 1937	Izvestiya, 15 Dec.1937
June 1938	Republic	Pravda, 11 Feb.1938[3]	Pravda, 22 April 1938[3]	Pravda, 15,27-29 June,1938
December 1939	Local	Pravda, 3 Aug.1939[3]	([4])	Izvestiya, 5 Jan.1940[3]
February 1946	All-Union	Pravda, 12 Oct.1945	Pravda, 17 Oct.1945	Izvestiya, 14 Feb.1946
February 1947	Republic	Pravda, 27 Nov.1946[3]	Pravda, 30 Nov.1945[3]	Pravda, 13-19 Feb.1947[3]
December 1947	Local		([4])	Pravda, Ukrayiny, 28 Dec. 1948[3]
March 1950	All-Union	Pravda, 11 Jan.1950	Pravda, 12 Jan.1950	Pravda, 15 Mar.1950
December 1950	Local	Pravda, 30 Oct.1950[3]	([4])	Pravda, 22 Dec.1950[3]
February 1951	Republic	Pravda, 12 Dec.1950[3]	Pravda, 15 Dec.1950[3]	Pravda, 22 Feb.-1 March 1951
Feb.-March 1953	Local	Pravda, 3 Oct.1950[3]	([4])	([4])
March 1954	All-Union	Pravda, 11 Jan.1950	Pravda, 13 Jan.1954	Pravda, 18 March 1954
Feb.-March 1955	Republic	Pravda, 12 Dec.1950[3]	Izvestiya, 25 Dec. 1954[3]	Izvestiya, 3,4,8,10 March 1955[3]
Feb.-March 1955	Local	Pravda, 3 Oct.1950[3]	([4])	([4])

[1] All-Union - Election of deputies to the Supreme Soviet of the U.S.S.R. and to the Soviet of Nationalities of the U.S.S.R.
Republic - Election of deputies to the legislative bodies (Supreme Soviet) of Republics of the U.S.S.R.
Local - Election of deputies to the soviets of kreys, oblast, rayons, cities and villages.

[2] Names of elected deputies, number of ballots cast, percent of votes cast for party candidates.

[3] The sources listed give information primarily for the republic and local elections of the R.S.F.S.R. Since elections of this type are held throughout the Union on approximately the same dates, an examination of the provincial press for a period within several days of the dates given above will provide data for the areas not covered in the sources indicated here.

[4] Comprehensive releases of local election data are seldom found except for republic tabulations of delegates and voters classified and aggregated by major administrative division (kray, oblast, city, etc.). Scattered information may be found in the local press on or about election time.

APPENDIX III

This appendix is devoted to an illustration of the use
that may be made of All-Union and Republic electoral district data
to yield population information about areas so small that they
comprise less than a single electoral district. The electoral
district data by themselves shed little light on the problem, but
if they are used judiciously together with fragments of information
from other sources, they begin to offer useful possibilities.

The case selected for this illustration is Aleksin Rayon,
which lies in Tula Oblast of the R.S.F.S.R. The problem is to
determine, if possible, the population of the rayon and how it has
changed from 1937 to 1954. This rayon has never been large enough
to have an entire electoral district assigned to it; it has always
fallen into electoral districts which contain considerable other
territory as well. A detailed analysis of the Aleksin area is
available in: U. S. Bureau of the Census, CONFIDENTIAL, Estimated
Population and Labor Force of the Aleksin Industrial Area:
1 January 1950, Series P-95, No. 35, Washington, D. C., 10 August
1954, CONFIDENTIAL. It should be noted that the process of

estimation described below deals with estimates of population of the
rayon as a whole, but that this was a matter of secondary importance,
being subsidiary to the main problem of estimating the urban popula-
tion of the rayon.

The electoral district information pertinent to the problem
is summarized in table III-1. To employ this information successfully
it was necessary to use also information for 1936 on the population of
cities and rayons in Moscow Oblast, as it was then constituted. This
information is found in Rayony Moskovskoy Oblasti (Rayons of Moscow Oblast)
Moscow, 1934, pp. 4-19. It was also necessary to use a number of
relationships which had been estimated earlier for Tula Oblast, a
neighboring oblast with a rural population quite similar to that in the
rayons which, together with Aleksin Rayon, formed a single electoral
district. A detailed discussion of the derivation of the estimates for
Tula Oblast is given in: U. S. Bureau of the Census, CONFIDENTIAL,
Estimated Population and Economically Active Population of the City and
Metropolitan Area of Tula: 1 January 1950, Series P-95, No. 25,
Washington, D. C., 10 May 1954, CONFIDENTIAL.

Table III-1.--ELECTORAL DISTRICT INFORMATION RELATING TO
ALEKSIN RAYON: 1937-1954

Date of publication of electoral district lists	Type of election and legal ratio of population per representative	Composition of electoral district to which Aleksin rayon belongs
1937 (October)....	All-Union - 300,000	Aleksin rayon Dugna " Babynin " Kaluga " (including Kaluga city) Tarusa " Detchino "
1938 (April).....	Republic - 150,000	Aleksin rayon Dugna " Kaluga " (excluding Kaluga city)
1945 (October)...	All-Union - 300,000	Aleksin rayon Kosaya Gora rayon Tula city
1946 (November)..	Republic - 150,000	Aleksin rayon (These two areas Tula city comprise two districts)
1950 (January)...	All-Union - 300,000	Same as in 1945.
1950 (December)..	Republic - 150,000	Same as in 1946.
1954 (January)...	All-Union - 300,000	Aleksin rayon Tula " Zaokskoye " Ivan'kovo " Laptevo " Venev " Odoyevo " Leninskiy " Mordves " Dubna " Khanino "

Sources: 1937 - Pravda, Moscow, 12 October 1937.
           1938 - Pravda, Moscow, 22 April 1938.
           1945 - Pravda, Moscow, 17 October 1945.
           1946 - Pravda, Moscow, 30 November 1946.
           1950 - Pravda, Moscow, 12 January 1950.
           1950 - Izvestiya, Moscow, 15 December 1950.
           1954 - Pravda, Moscow, 13 January 1954.

In general, the method used was to strip away from the electoral district estimates of the population of each component area other than Aleksin rayon, leaving the population of the latter as a residual. The details of how this was done for different dates are given below:

1937

1. The population of the electoral district containing Aleksin rayon was estimated at 300,000. The electoral district contained 5 other rayons which were in Moscow oblast.

2. The rural population of these 5 rayons in 1936 was obtained from the work cited above and reduced by 2.7 percent, which was the estimated percentage decline in the rural population of nearby Tula oblast during the same period.

3. Minor adjustments were then made for presumed territorial changes in these 5 rayons, on the basis of the number of sel'soviets.

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4. The resulting estimate of the rural population of the 5 rayons in 1937 was 169,000.

5. The only urban population in these 5 rayons was that in the cities of Kaluga and Tarusa, for which 1936 data were available. The population of Kaluga was also known for 1939, the date of the census, and that of Tarusa was known for 1938. Estimates of the population of each city in 1937 were obtained by linear interpolation. Their combined population was estimated at 74,000.

6. By subtraction of these results (169,000 and 74,000) from the 300,000 total population estimated for the entire electoral district, there was derived an estimate of 57,000 for Aleksin rayon:

Estimated Population of Electoral District ·	300,000
Less· Rural population of Dugna, Babynin, Kaluga, Tarusa, and Petchino rayons·	169,000
Less· Urban population of these rayons, i.e., Kaluga and Tarusa cities :	74,000
Estimated Population of Aleksin rayon (residual) :	57,000

1938

1. The population of the electoral district containing Aleksin rayon was estimated at 150,000.

2. In addition to Aleksin rayon, this electoral district contained the rayons of Dugna and Kaluga, but not Kaluga city.

3. It was assumed that Dugna and Kaluga rayons, excluding Kaluga city, had a decline in population of 5.3 percent between 1936 and 1938. This is the percentage of decline estimated for the rural part of neighboring Tula oblast. The combined 1938 population of these areas was thus estimated at 86,000, leaving an estimate of 64,000 for Aleksin rayon:

Estimated Population of Electoral District: 150,000

Less: Population of Dugna and Kaluga
      rayons, excluding Kaluga city   :   86,000

Estimated Population of Aleksin rayon
              (residual)   :   64,000

1945

1. The population of the electoral district containing Aleksin rayon was estimated at 300,000.

2. In addition to Aleksin rayon, the electoral district contained the city of Tula and Kosaya Gora rayon.

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3. The population of Tula city in 1945 had been estimated at 220,000 in the Bureau of the Census report on that city.

4. The rural population of Kosaya Gora rayon was estimated on the assumption that its 10 selsoviets had the same average size as did all selsoviets in Tula oblast in 1945. The urban population of the rayon, which was in fact the population of Kosaya Gora settlement, the rayon center, was estimated on the assumption that its rate of population change since 1939 was the same as the rate estimated for the urban part of Tula oblast. The total population of the rayon was thus estimated at 28,000.

5. The population of Aleksin rayon was estimated by subtraction, as 52,000:

Estimated Population of the Electoral District:		300,000
Less: Population of Tula city	:	220,000
Less: Population of Kosaya Gora rayon	:	28,000
Estimated Population of Aleksin rayon (residual)	:	52,000

1946

1. The population of 2 electoral districts containing Tula city and Aleksin rayon was estimated at 300,000.

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2. The population of Tula city had been estimated at 236,000 in the Bureau of the Census report on that city.

3. The population of Aleksin rayon was estimated by subtraction, as 64,000:

Estimated Population of 2 Electoral Districts· 300,000

Less: Population of Tula city : 236,000

Estimated Population of Aleksin rayon
(residual) : 64,000

1954

The method of arriving at the population of Aleksin rayon as a residual, which was applied with some success for 1937, 1938, 1945, and 1946, was not particularly useful in connection with the data available for 1954. As is shown below, it was possible to "peel off" figures representing the rural population and the urban population outside of Aleksin rayon, but the residual for the rayon was too small to be creditable. The analysis proceeded as follows:

1. The total population of the electoral district containing Aleksin rayon was estimated at 300,000. There were 10 other rayons in the election district. See table III-1.

2. The rural population of the 10 rayons combined was obtained for 1936 from the work entitled "Rayons of the Moscow

Oblast", and adjusted to 1939 on the assumption that it
changed to the same degree as did the entire rural popula-
tion of neighboring Tula oblast during the same period. There
was also a small adjustment for presumed territorial changes on
the basis of the number of selsoviets. The resulting estimate
was 300,000.

    3. The 1939 estimate of rural population for the 10 rayons
was reduced by about 30 percent, to yield an estimate of 210,000
for 1954. This reduction was made on the assumption that the
rate of population decline in the rural part of the 10 oblasts
between 1939 and 1954 bore the same relationship to the rate of
decline of the rural population of the R.S.F.S.R. during the
same interval, as did the rate of decline of rural population in
Tula oblast to the rate of decline of the R.S.F.S.R. rural popu-
lation during the period 1926-1939.

    4. The urban population of this electoral district, apart
from the urban population in Aleksin rayon, consisted of nine
small urban settlements. One of these, Venev, had a population
of 6,827 in 1936. No data are available for the other eight
settlements. If they had the same average size in 1954 as did

workers settlements in Tula oblast in 1936, their aggregate
population plus that of Venev, would amount to 53,500. This
is clearly too high, for it implies that Aleksin rayon would
have, as a residual, a population of only 36,500 in 1954. It
is very unlikely that the population of the rayon could have
dropped so drastically.

5. It follows that the rural population must have de-
clined more rapidly than was assumed, that the average size of
a worker's settlement was lower in 1954 than in 1936, or
perhaps both to some extent.

6. It is a proper inference from the data that the popu-
lation of Aleksin rayon was no greater in 1954 than in 1948,
but the extent to which it might have declined is not a fact
that can be elicited from the electoral district population
estimate.

An alternative method of estimation placed the popu-
lation of Aleksin rayon in 1954 at about 50,000. If to this is
added the estimates for the urban and rural parts of the electoral
district apart from Aleksin rayon, the total of 313,500 is
attained. This is clearly within the range of error of the
estimated population of 300,000 for the entire electoral district.

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It appears, therefore, that the method discussed here for
estimating the population of a minor component of an
electoral district by reference to other data, may fail when
the degree of error in the estimate of the electoral district
is a considerable fraction of the population of the minor
component. Inasmuch as the error inherent in any population
estimate for an electoral district is undetermined, there is
always the risk that the estimate for the minor component is
wrong. It is only by reference to estimates for other dates
that any feeling of confidence in the results may be justified;
and even if the figures for a series of dates appear to be
reasonable in the light of other information, they may be no
more than crude approximations to the true population.

APPENDIX IV

ILLUSTRATIVE EXAMPLE OF A METHOD OF ESTIMATING THE SIZE AND
INDUSTRIAL COMPOSITION OF A SOVIET CITY -- TULA:
1 JANUARY 1950

I. General Method

Because of the fragmentary nature of the data available on
Tula, the general method used in estimating the economically active
population was an analysis of its development between the census
year, 1926, and the final estimate year, 1950. By this means, the
total economically active population in the terminal year reflected
the expansion (in relation to industrial and population growth) of
base estimates for earlier years on which fuller data could be
developed. Finally, several checks were applied to verify approxi-
mately the results obtained.

Essential data underlying the estimates included the
following:

A. Direct employment data.

1. The 1926 economically active population, taken from returns
    of the All-Union Census of 17 December 1926, is shown in
    table III-A. This table gives the civilian economically
    active population for the city of Tula only.

2. The 1931 employment for certain industries in Tula is
    presented in table III-B.

3. The economically active population reported as of 1 April 1936 for
Tula was 115,243.[1] On the basis of the percentage of total popula-
tion represented by this figure, and of the general practice in
other sources of treating the three areas as an economic unit, it
is believed that this figure includes Tula, Kosaya Gora, and
Novo-Tul'skiy. The economically active comprised 51.5 percent of
the total population of 224,000, estimated as of 1936, for the
aggregate of these communities.

Table III-A.—CIVILIAN ECONOMICALLY ACTIVE POPULATION OF TULA:
17 DECEMBER 1926

Category	Civilian economically active	
	Number	Percent
Total[1]......................................	67,950	100.0
I. Agriculture..................................	2,062	3.0
II. Factory Industry............................	32,428	47.7
III. Handicraft industry........................	7,046	10.4
IV. Construction................................	1,557	2.3
V. Railroad transport..........................	5,612	8.3
VI. Other transport............................	972	1.4
VII. Trade and credit...........................	6,009	8.8
VIII. Institutions..............................	9,832	14.5
IX. Other......................................	2,432	3.6

[1] Branches of the economy "No occupation or unstated occupation," "Unemployed,"
and "Free professions," which are presented separately by the census volume,
have been distributed proportionately among branches II-IX.

Source: Tsentral'noye statisticheskoye upravleniye SSSR. Otdel perepisi.
Vsesoyuznaya perepis' naseleniya 1926 goda (All-Union Census of
Population, 1926), Moscow, v. 19, 1929, p. 128.

Table III-B.--WORKERS (RABOCHIYE) IN SELECTED MANUFACTURING
INDUSTRIES, TULA: 1931

Industry	Number of workers
Apparel[1]	3,598
Food	2,237
Sugar refining	1,620
Distilling	178
Bakeries and factory kitchens	439
Wood and construction materials	1,564
Brickyards	331
Sawmills	233
Furniture and woodworking	1,000
Printing	525

[1] The apparel industry includes employment in clothing, shoes, leather, and furs.

Sources: Ves' SSSR (All of the U.S.S.R.), Moscow, 1931, pp. 351-774, and Tsentral'noye statisticheskoye upravleniye SSSR. Otdel perepisi. Vsesoyuznaya perepis' naseleniya 1926 goda (All-Union Census of Population, 1926), Moscow, v. 19, 1929, p. 128. Where direct information for 1931 was lacking, detailed occupational statistics from the 1926 census were used. An increase of 25 percent (the same as for population growth, 1926-1931) was made for those persons employed in occupations whose products were for use of the local population.

B. Data on industrial production and facilities.

1. Table III-C presents a list -- a partial list, it should be noted -- of the increase in productive facilities in the Tula area between 1931 and 1950. Data from this table provide the basis for estimates of change, by industry, of the economically active in manufacturing.

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Table III-C.—INCREASE IN PRODUCTION FACILITIES, 1931-1950, IN
TULA, KOSAYA GORA, AND NOVO-TUL'SKIY

Industry	Increase in production facilities[1]		
	1931-1935	1936-1939	1940-1950
Ferrous metallurgy			
1. Kosaya Gora	Blast furnace No. 3 put into operation in 1932.		Postwar reconstruction including installation of a turbo-blower.
2. Novo-Tul'skiy	Blast furnace No. 1 put into operation in 1935.	Blast furnace No. 2 put into operation in 1936.	Postwar reconstruction, addition of blast furnace No. 3.
Metal-working and machine building[2]		Expansion of the armaments industry, especially Kalinin 535 and 536, and Plant No. 176, Imeni Lenin.	Wartime employment of Kalinin plants reported at 20,000 or above.[3] Plant No. 176, Imeni Lenin, had an employment of similar magnitude.
		Novaya Tula Armaments and Machinery Plant No. 187 believed to have begun production in this period.	Novaya Tula Plant No. 187 has become a major producer of grain combines in the postwar period.[4]
		New construction at Krylenko Hardware Plant scheduled to begin in 1936 and to be completed in 1937. New annual capacity planned at 30,000,000 rubles.[6]	The Kirov Machine Tool Plant No. 60 has been reconverted since the war and has greater production than prewar.[5] Zars Motor Vehicle Repair Plant newly reported during the war.

(continued)

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Table III-C.—INCREASE IN PRODUCTION FACILITIES, 1931-1950, IN
TULA, KOSAYA GORA, AND NOVO-TUL'SKIY--Con.

Industry	Increase in production facilities[1]		
	1931-1935	1936-1939	1940-1950
Metal-working and machine building[2] (continued)		A railroad repair plant, with a capacity to perform capital repair on 4,800 passenger cars per year was scheduled for completion in 1936.[6]	The Krasnyy Oktyabr' Plant was reconstructed in the postwar period.[7] Postwar plans for the machinery plant Imeni Batischev called for increased production over the prewar level.[9]
Food			
1. Meat	Meat kombinat[10]		
2. Flour milling	Flour mill[10]	Addition to flour mill,[11] macaroni factory,[12] and refrigerator.[13]	
Apparel			
1. Clothing			Sewing factories.[14]
2. Rubber footwear			Rubber plant.[15]

[1] This table presumably does not present a complete list of the expansion of production facilities in the city between 1931 and 1950.

[2] Information on the metal-working and machine-building industry is very limited. Data presented here on changes in facilities at various plants cannot be considered as complete.

[3] Reichsministerium fur die Besetzten Ostgebiete. Der Generalbezirk Tula, Entwurf, abgeschlossen am 25 November 1941, Reichskommissariat Russland, 1941.

[4] Izvestiya, Moscow, 13 July 1951; Sel'khozmashina (Agricultural Machinery), Moscow, October 1951, no. 10, p. 1.

Footnotes to table III-C.--(continued)

[5] Izvestiya, Moscow, 8 July 1945, 17 January 1948, and 20 January 1950.

[6] Gosplan. Narodnokhozyaystvennyy plan na 1936 god (National Economic Plan for 1936), Moscow, v. 2, 1936, pp. 324-340.

[7] Promyshlennost' stroitel'nykh materialov (The Building Materials Industry), Moscow, 12 March 1950, p. 2.

[8] Gosplan. Narodnokhozyaystvennyy plan na 1936 god, op. cit.

[9] Izvestiya, Moscow, 22 May 1945.

[10] The meat kombinat and flour mill were not mentioned in the 1931 source, but did appear in a 1934 listing of the city's industries. Vysshiy sovet narodnogo khozyaystva SSSR. Spisok promyshlennykh predpriyatiy k atlasu "Promyshlennost' SSSR na nachalo 2-y pyatiletki," (List of Industrial Enterprises for the Atlas "Industry of the U.S.S.R. at the Beginning of the 2nd Five-Year Plan"), Moscow, 1934.

[11] Listed in Gosudarstvennaya planovaya komissiya, Vtoroy pyatiletniy plan razvitiya narodnogo khozyaystva SSSR, 1933-1937gg (Second Five-Year Plan for the Development of the National Economy of the U.S.S.R., 1933-1937), Moscow, v. 2, 1934, p. 368. Scheduled for completion in 1936 with a planned capacity of 100 tons per 24 hours.

[12] Listed in the same source as footnote 11 above. The factory was to be completed in 1937 and have a planned capacity of 11,300 tons.

[13] Listed in the same source as footnote 11 above. Completion date was 1937 and planned capacity 2,000 tons.

[14] Construction of the sewing factories was noted in two sources: Legkaya promyshlennost' (Light Industry), Moscow, v. 7, December 1947, no. 12; and U. S. Army, G-2 Report No. 9008913. The shops were to be completed in 1949, with the following annual production: 75,000 men's suits, 80,000 pairs of trousers, 30,000 women's suits, and 60,000 men's short overcoats.

[15] Mentioned in many sources, this plant was to begin production by the end of 1946, and to produce 1,200,000 pairs of miner's boots per year, as well as other articles such as women's galoshes, insulating tape, rubber hose, shoe soles, oxygen tubes, and fan belts. (Izvestiya, 1 June 1947; Turkmenskaya Iskra, Ashkhabad, 1 June 1947, and Ministerstvo rezinovaya promyshlennost', Zavody rezinovoy promyshlennosti (Plants of the Rubber Industry), Moscow, 1948.)

2. The gross industrial production of Tula, Kosaya Gora, and
   Novo-Tul'skiy in 1935 was shown on a Soviet map to be between
   400 and 500 million 1926-1927 rubles.[2] The distribution of
   this production was 7.8 percent in ferrous metallurgy, 88 percent
   in metal-working and machine-building, and 4.2 percent in all
   others. Since the physical output of ferrous metallurgy in Tula
   in 1935 is known, and its value in 1926-1927 rubles easily
   determined (table III-C), it could be established, by applying
   the calculated value of metallurgy and its percentage of the
   total, that the percentages given refer to a universe of some 317
   million rather than 400 to 500 million rubles. The gap in
   coverage appears to fall in the "other" category, the calculated
   value of which comes to 3.3 million 1926-1927 rubles, as opposed
   to an estimate (built up industry by industry) of 85.8 million
   rubles (table III-G).

3. For 1937, a figure of total production "above 400 million rubles,"
   broken up into 15.1 percent ferrous metallurgy, 47.2 percent
   metal-working, and 37.8 percent food has been published.[3] Here
   again, the universe represented by the percentage is incomplete.
   The values represented by ferrous metallurgy, metal-working, and
   food are 49.8, 156, and 125 million (1926-1927) rubles, respectively,
   with a total of 330 million. It should be noted that the figure

for metal-working is 135 million rubles <u>less</u> than cited for 1935.
Obviously, this represents a difference in coverage; most likely,
the first is a comprehensive figure, while the second covers
selected, presumably exclusively civilian, plants. The figure of
125 million for "food" is far too high, and must be considered as
covering food, clothing, and all other industries except ferrous
metallurgy and metal-working. If this assumption be granted, the
value of output for these residual industries increased by 47
percent between 1935 and 1937. The increase in employment within
these industries is estimated at 19.5 percent. The greater increase
in value of output is accounted for by increased productivity.

4. Production data on the ferrous metallurgy industry are relatively
complete, and have been used as a basis for obtaining the
distribution of the economically active in manufacturing by
industry in all of the estimates (table III-D).

C. Annual productivity rates.

1. The conversion of indirect production data (output in 1926-1927
ruble values) into employment estimates has necessitated the
compilation of an annual productivity series, 1928-1950; and total
economically active to worker ratios. The latter, based on the
1941 Plan, appear to have been fairly stable since the early
1930's (table III-E).

2. The great industrial and population growth of the Tula area between 1935 and 1950 had to be accompanied by a large increase in the quanta of transportation required, and is estimated to have called forth a significant rise in the employment in transportation and communications. The calculations by which this increased labor was estimated are shown in table III-F.

D. Analogical data.

1. In the absence of direct evidence for distributing the economically active in nonmanufacturing by category, the percentage distribution of this group found in the urban parts of the 1936 Moscow Oblast (excluding Moscow city) has been used. Tula city comprised a substantial part of this aggregate. The pattern is as follows:[4]

Category	Percent
Total................................	100.0
Construction...........................	17.9
Transportation and communication............	28.3
Commerce.............................	27.3
Health..............................	8.3
Education............................	9.4
Government administration and party apparatus...........................	7.5
Other (including agriculture)...............	1.3

This pattern was adjusted somewhat in the 1935 and 1939 estimates to account for special circumstances in Tula, e.g., the increase in transportation and communication, and an increase in the government administration category reflecting Tula's becoming an oblast center in 1937. The adjustments are discussed more fully below.

Table III-D.—FERROUS METALLURGY INDUSTRY, TULA METROPOLITAN AREA, 1932-1950
(Values given in 1926-1927 prices)

Year	Production (in metric tons of pig iron)			Value (in thousands of rubles)	Unit value (in rubles per ton)	Blast furnace volume (in cubic meters)		
	Total	Kosaya Gora	Novo-Tul'skiy			Total	Kosaya Gora	Novo-Tul'skiy
1932..	104,600	1104,600	(2)	(3)	(3)	1,410.5	1,410.5	(2)
1933..	165,200	5166,200	(2)	615.1	90.85	(3)	(3)	(2)
1934..	220,400	7220,400	(2)	619.9	90.29	(3)	(3)	(2)
1935..	9285,400	10180,000	11105,400	(3)	1290.57	(3)	(3)	13,930
1936..	9536,000	14171,000	15365,000	(3)	(3)	(3)	(3)	131,860
1937..	16,550,000	(3)	(3)	(3)	(3)	(3)	(3)	(3)
1950..	171,120,000	(3)	(3)	(3)	(3)	3,616.0	1,426.0	2,190

[1] Gosplan, Otdel gornoy metallurgiy i promyshlennosti. Chernaya metallurgiya zhelezorudnaya, margentsevaya i koksovaya promyshlennost' SSSR. Statisticheskiy spravochnik 1926-1934 gg (Ferrous Metallurgy and the Iron Ore, Manganese, and Coke Industry of the U.S.S.R. A Statistical Handbook, 1928-1934), Moscow, 1935, p. 67.

[2] The Novo-Tul'skiy plant was under construction between 1931 and 1935.

[3] Data not available.

[4] Gosplan, Otdel gornoy metallurgiy i promyshlennosti. Chernaya metallurgiya....., p. 22.

[5] Ibid., p. 67.

[6] Ibid., p. 59.

[7] Ibid., p. 67.

[8] Ibid., p. 59.

[9] Gosplan, Narodnokhozyaystvennyy plan na 1936 god (National Economic Plan for 1936), Moscow, v. 2, 1936, p. 324.

[10] Bol'shaya sovetskaya entsiklopediya (Great Soviet Encyclopedia), 1st edition, Moscow, v. 34, 1937, col. 405.

[11] Computed by subtracting Kosaya Gora from the total.

[12] Average of prices for 1933 and 1924.

[13] Malaya sovetskaya entsiklopediya (Small Soviet Encyclopedia), 2nd edition, Moscow, v. 10, 1940, cols. 874-878.

Footnotes to table III-D.—(continued)

14 Geografiya v shkole (Geography in School), Moscow, 1947, no.4

15 Computed by subtracting Kosaya Gora from the total.

16 Malaya sovetskaya entsiklopediya (Small Soviet Encyclopedia), 2nd edition. Moscow, v. 10, 1940, cols. 874-878.

17 Estimate. Total U.S.S.R. production of pig iron and ferroalloys, 1950, was 19.4 million metric tons, of which Central Russia and the Ukraine produced 58 percent, or 11.25 million metric tons. (Shimkin, D.B. Minerals — A Key to Soviet Power, Cambridge, 1953, pp. 36 and 39.) The Tula metallurgical plants produced an estimated 10 percent of this latter figure, or 1.12 million metric tons. This estimate is based upon the percentage of total volumetric capacity of blast furnaces in Central Russia and the Ukraine in 1950 represented by Kosaya Gora and Novo-Tul'skiy.

Table III-E.—ANNUAL PRODUCTIVITY IN RUBLES PER WORKER (RABOCHIY) FOR SELECTED INDUSTRIES OF THE U.S.S.R.

Year	Ferrous metallurgy	Light industry	Rubber articles	Brickyards	Sawmills	Furniture	Woodworking (general)	Printing
1928.........	4,144	8,344	(¹)	(¹)	(¹)	(¹)	4,087	(¹)
1929.........	²4,770	(³)	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)
1930.........	³5,340	(¹)	(¹)	(¹)	(³)	(¹)	(¹)	(¹)
1931.........	⁴5,092	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)
1932.........	5,235	6,584	12,801	1,469	4,994	5,714	4,358	4,518
1933.........	5,623	7,089	13,221	1,438	4,639	6,139	4,531	4,955
1934.........	7,214	7,278	16,391	1,900	5,321	7,542	5,267	5,594
1935.........	⁵9,140	⁶8,395	(¹)	⁷2,116	⁶5,743	⁹8,523	¹⁰6,000	¹¹6,132
1937.........	¹²11,410	¹³10,629	(¹)	(¹)	(¹)	(¹)	¹³7,370	(¹)
1938.........	¹⁴12,545	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)
1940.........	¹⁵13,580	¹⁶13,981	(¹)	(¹)	(¹)	(¹)	¹⁷9,425	(¹)
1941¹⁶	14,938	14,638	(¹)	(¹)	(¹)	(¹)	¹⁰,613	(¹)
1950.........	¹⁹16,147	(¹)	²⁰25,088	(¹)	(¹)	(¹)	(¹)	(¹)
Ratio of economically active worker²¹......	1.53	1.56	²²1.55	²³1.60	²⁴1.57	²⁵1.57	1.57	²⁶1.5

¹ Data not available.
² Tsentral'noye upravleniye narodno-khozyaystva ucheta gosplana SSSR, Sotsialisticheskoye stroitel'stvo soyuza SSR, 1933-1938gg (Socialist Construction of the U.S.S.R., 1933-1938), Moscow, 1939, p. 36, and TsUNKhU, Sotsialisticheskoye stroitel'stvo (Socialist Construction), Moscow, 1935, p. 169.
³ TsUNKhU, Sotsialisticheskoye stroitel'stvo (Socialist Construction), Moscow, 1935, p. 169.
⁴ Ibid.
⁵ Computed as follows:
(a) Increase in employment in ferrous metallurgy, 1934-1935 = 373,600 to 386,200 = 1.0337 (Gosplan, Otdel gornoy metallurgiy i promyshlennosti, Chernaya metallurgiya zhelezorudnaya, margentseveya i koksovaya promyshlennost' SSSR. Statisticheskiy spravochnik 1928-1934 gg (Ferrous Metallurgy and the Iron Ore, Manganese, and Coke Industry of the U.S.S.R. A Statistical Handbook, 1928-1934), Moscow, 1935, p. 117.)

Footnotes to table III-E.--(continued)

Footnote 5 cont'd.

(b) Increase in output, 1934-1935 = 31 percent (Gosplan, Narodnokhozyaystvennyy plan na 1936 god (National Economic Plan for 1936), 2nd edition, Moscow, 1936, p. 107.

(c) Thus, index of productivity, 1934-1935 = $\frac{1.31}{1.0537}$ = 1.2673.

(d) 1935 productivity = 7,214 x 1.2673 = 9,140.

6 Linear interpolation, 1934-1940.
7 Arithmetical extrapolation, 1932-1934.
8 An average of two estimates: an arithmetical extrapolation, 1932-1934; and fitting a curve to rates for general woodworking productivity.
9 An average of two estimates: an arithmetical extrapolation, 1932-1934; and an increase of 13.9 percent, 1935 over 1934, for woodworking general.
10 Interpolated by fitting a curve to data for 1932-1934 and 1940.
11 Arithmetical extrapolation, 1932-1934.
12 Linear interpolation, 1935-1938.
13 Interpolated between 1935 and 1940.
14 Computed. Equal to 223.1 percent of the 1933 rate (TsUNKhU, Sotsialisticheskoye stroitel'stvo soyuza SSR, 1933-1938gg (Socialist Construction of the U.S.S.R., 1933-1938), Moscow, 1939, p. 38).
15 Computed. 1941 = 110.2 percent of 1940 (Gosudarstvennyy plan razvitiya narodnogo khozyaystvo SSSR na 1941 god (State Plan for the Development of the National Economy of the U.S.S.R. in 1941), Reprint No. 30 by the American Council of Learned Societies, Universal Lithographers, Inc., Baltimore, Md., n.d., p. 516).
16 Computed. 1941 = 104.7 percent of 1940. (Ibid., p. 523.)
17 Computed. 1941 = 112.6 percent of 1940. (Ibid., p. 521.)
18 1941 rates are from Gosudarstvennyy plan.....na 1941 god, pp. 512-566.
19 Computed. Index of productivity for Group "A" industries, 1940-1950, excluding machine-building, is estimated at 1.189. Applying this to 1940 productivity in ferrous metallurgy gives the 1950 estimate.
20 Computed. Index of productivity for Group "A" industries, 1932-1950, is estimated at 1.96. Applying this to 1932 productivity gives the 1950 estimate.

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Footnotes to table III-E.--(continued)

21 These ratios are based on tables in Gosudarstvennyy plan......na 1941 gcd, pp. 512-566. The total economically active includes all persons (rabochiye, sluzhashchiye, and engineering-technical personnel engaged both in production and ancillary functions) employed by a specific Commissariat. The term worker refers here to rabochiye engaged solely in production carried on by the Commissaria...

22 An average of the ratios for the Commissariats of Chemicals and of Light Industry.

23 Figure is for the Commissariat of Construction Materials, Republic Industry.

24 Figure is for Commissariat of the Lumber Industry.

25 Ibid.

26 An arbitrary ratio, assumed in the absence of other data.

Source: Unless otherwise noted, rates have been computed from Tsentral'noye upravleniye narodno-khozyaystva ucheta gosplana SSSR, Sotsialisticheskoye stroitel'stvo SSSR (Socialist Construction of the U.S.S.R.), Moscow, 1936, table 2, pp. 3-18).

Table III-E-1.--ANNUAL PRODUCTIVITY IN RUBLES PER WORKER (RABOCHIY) FOR SELECTED METAL-WORKING AND MACHINE-BUILDING INDUSTRIES OF THE U.S.S.R.

Year	Total machine-building (including repair)	Miscellaneous machine-building and metal-working					
		Textile machinery	Transport machinery	Agriculture machinery	Machine tools	Other metal-working	Average
1928	3,615	(1)	(1)	(1)	(1)	(1)	(1)
1932	5,126	5,534	5,653	5,260	5,250	4,736	5,287
1933	6,070	6,101	6,494	6,482	6,082	5,798	6,191
1934	7,085	7,262	7,636	6,625	7,793	6,810	7,225
1935	²8,289	(1)	(1)	(1)	(1)	(1)	²8,453
1937	²10,698	(1)	(1)	(1)	(1)	(1)	(1)
1938	⁴11,909	(1)	(1)	(1)	(1)	(1)	(1)
Ratio of economically active worker	⁵1.56	(1)	(1)	(1)	(1)	(1)	⁶1.56

[1]Data not available.
[2]Interpolated between 1934 and 1938.
[3]Rate of increase, 1934-1935, assumed to be the same as that calculated for total machine-building.
[4]Reported as 196.? percent of 1933. Tsentral'noye upravleniye narodno-khozyaystva ucheta gosplana SSSR, Sotsialisticheskoye stroitel'stvo soyuza SSR, 1933-1938gg (Socialist Construction of the U.S.S.R., 1933-1938), Moscow, 1939, p. 36.
[5]Computed from Gosudarstvennyy plan razvitiya narodnogo khozyaystvo SSSR na 1941 god (State Plan for the Development of the National Economy of the U.S.S.R. in 1941), Reprint No. 30 by the American Council of Learned Societies, Universal Lithographers, Inc., Baltimore, Md., n.d., p. 520. The rate is for the total economically active in the Commissariat of General Machine-Building to the number of workers employed in the industry.
[6]This ratio is assumed to be the same as the ratio for total machine-building.

Source: Unless otherwise noted, rates have been computed from Tsentral'noye upravleniye narodno-khozyaystva ucheta gosplana SSSR, Sotsialisticheskoye stroitel'stvo SSSR (Socialist Construction of the U.S.S.R.), Moscow, 1936, table 2, pp. 3-18.

Table III-E-2.—ANNUAL PRODUCTIVITY IN RUBLES PER WORKER (RABOCHIY) FOR SELECTED FOOD INDUSTRIES OF THE U.S.S.R.

Year	Total industry	Meat	Flour Milling	Bakeries	Sugar refining	Distilleries	Macaroni	Factory kitchens
1928	13,082	(1)	(1)	(1)	(1)	(1)	(1)	(1)
1931	²12,100	(1)	(1)	(1)	(1)	(1)	(1)	(1)
1932	11,773	15,412	28,831	14,306	6,450	41,240	11,148	8,443
1933	11,973	20,730	33,241	13,974	6,726	41,081	12,245	8,715
1934	13,057	24,349	32,059	15,730	7,533	38,000	12,000	10,549
1935	³14,364	⁴28,196	(1)	(1)	(1)	(1)	⁵15,600	(1)
1937	³16,978	(1)	(1)	(1)	(1)	(1)	(1)	(1)
1938	⁶18,283	(1)	(1)	(1)	(1)	(1)	(1)	(1)
1940	⁷22,130	(1)	(1)	(1)	(1)	(1)	(1)	(1)
1941	⁸24,033	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Ratio of economically active/worker.	⁹2.19	(1)					(1)	(1)

1 Data not available.
2 Interpolated between 1928 and 1932.
3 Interpolated between 1934 and 1938.
4 Reported as 15.8 percent increase over 1934. Gosplan, Narodnokhozyaystvennyy plan na 1936 god (National Economic Plan for 1936), 2nd edition, Moscow, 1936, p. 184.
5 Rate of increase, 1934-1937, assumed to be the same as that calculated for total food industry.
6 Reported as 52.7 percent over 1933. Tsentral'noye upravleniye narodno-khozyaystva ucheta gosplana SSSR, Sotsialisticheskoye stroitel'stvo soyuza SSSR, 1933-1938gg. (Socialist Construction of the U.S.S.R.: 1933-1938), Moscow, 1939, p. 38.
7 Computed. 1941 rate reported as 108.6 percent of 1940. Gosudarstvennyy plan razvitiya narodnogo khozyaystvo SSSR na 1941 god (State plan for the Development of the National Economy of the U.S.S.R. in 1941), Reprint No. 30 by the American Council of Learned Societies, Universal Lithographers, Inc., Baltimore, Md., n.d. p. 524.
8 Gosudarstvennyy plan....na 1941 god, p. 524.
9 Ibid. Ratio is that of total economically active of the Commissariat of Food to the number of workers employed in the food industry.

Source: Unless otherwise noted, rates have been computed from Tsentral'noye upravleniye narodno-khozyaystva ucheta gosplana SSSR, Sotsialisticheskoye stroitel'stvo SSSR (Socialist Construction of the U.S.S.R.), Moscow, 1936, table 2, pp.3-18.

Table III-F.—CIVILIAN ECONOMICALLY ACTIVE POPULATION IN TRANSPORTATION
IN TULA, KOSAYA GORA, AND NOVO-TUL'SKIY: 1935-1950

Year	Economically active population		Shipments		Productivity (U.S.S.R.)
	Number[1] (1)	Index[2] (1935 = 100) (2)	Volume[3] (in metric tons) (3)	Index (1935 = 100) (4)	Index (1935 = 100) (5)
1935...	11,000	100	1,927,000	100	100
1937...	14,000	126	3,318,500	172	[4]137
1939...	15,000	135	3,690,100	191	[5]142
1950...	21,000	192	6,327,000	328	[6]171

[1] The figure for 1935 was estimated by analogy from the Moscow urban oblast pattern (table III-G). Figures for the other years were computed by using the indexes in column 2.

[2] These indexes were derived as the quotient between the indexes in columns 4 and 5.

[3] Estimates of the volume of shipments for each year are comprised of two elements: (1) an estimated shipment of five tons of materials for each ton of pig iron produced in the area; and (2) a total of all other shipments for the area based on an estimated 500,000 tons in 1935. This latter figure was increased in direct proportion to the population increase for each of the later periods.

[4] This figure is based on a productivity series computed from employment data (see Lorimer, Frank, The Population of the Soviet Union, Geneva, 1946, pp. 219-221) and production data (see Grossman, G., and Shimkin, D. b., Mineral Consumption and Economic Development in the United States and the Soviet Union (a supplement to Shimkin, D.B., Minerals: A Key to Soviet Power, Harvard University Press, Cambridge, 1953), Russian Research Center, Harvard University, April 1952, p. 58).

[5] Interpolated between 1937 and 1950.

[6] Computed from production data (domestic ton-miles) in Grossman, G. and Shimkin, D. B., loc. cit. and from employment data in Fortune, v. 47, no. 2, February 1953, p. 119; and Shimkin, D. B., "Russia's Strength Today," Automotive Industries, 1 October 1953 and 15 October 1953.

Table III-G.--CIVILIAN ECONOMICALLY ACTIVE POPULATION AND VALUE OF PRODUCTION
BY INDUSTRY FOR TULA, KOSAYA GORA, AND NOVO-TUL'SKIY:
30 JUNE 1935

(Numbers are rounded to the nearest thousand and percentages, computed from
unrounded data, to the nearest tenth, without adjustment to group totals
which are independently rounded)

Category	Economically active		Value of production (in million rubles)
	Number	Percent	
Total......................	113,000	100.0	
Manufacturing...........................	73,000	64.9	402.8
Ferrous metallurgy..............	4,000	3.8	25.8
Metal-working and machine-building.......................	54,000	47.9	291.1
Food...........................	6,000	5.1	37.9
Wood, construction materials..	2,000	2.2	10.5
Apparel........................	5,000	4.6	30.2
Miscellaneous.................	1,000	1.3	7.3
Commerce.........................	11,000	9.3	
Transportation and communication...	11,000	9.7	
Construction......................	7,000	6.1	
Health...........................	3,000	2.8	
Education.........................	4,000	3.2	
Government administration and party apparatus..................	4,000	3.5	
Other............................	1,000	0.5	

Source: See section II-A of this appendix.

II. Detailed Procedure

Estimates of the economically active population, with distribution by industry and category, were made for 1935, 1939, and 1950. Each of these is discussed below.

The area included in the primary estimates consisted of Tula, Kosaya Gora, and Novo-Tul'skiy. This choice was determined by the greater availability of data for the area as an economic unit. These primary estimates were then adjusted to obtain estimates for Tula city and the Tula metropolitan area as a whole.

Throughout this entire analysis it has been assumed that no changes took place in those economic sectors for which evidence of changes, direct or indirect, is lacking.

A. 1935 economically active population (table III-G).

1. Total.

The total economically active for 1935 was obtained by applying the 1 April 1936 ratio of economically active to total population, or 51.5 percent, to the estimated 1935 mid-year population. This gave a total of 112,000, which is increased to 113,000 by the addition of an estimated 1,000 as an approximation of Party and NKVD personnel excluded from the 1936 survey.

2. Manufacturing.

The number of persons employed in manufacturing was estimated by
using direct employment and production data. The procedure, by
industry, was as follows·

a. Ferrous metallurgy. This represents a simple division of
value of output (table III-D) by annual productivity per
rabochiy (table III-E), multiplied by the ratio of total
economically active to rabochiy (table III-E).

b. Metal-working and machine-building. The value of output in
1935 has been calculated in section B-2 above, while data on
productivity and total economically active to rabochiy ratios
are given in table III-E.

c. Food. Changes in the economically active in this industry,
1931-1935, were fairly complicated. Employment in sugar
refining and distilling was left unchanged in the absence of
evidence to the contrary. Employment in the meat kombinat
and flour mill, which were added to the industry during the
period, was calculated on the basis of national urban consumption
levels of the two products,[5] and the 1935 population of the area.
The number of persons employed in bakeries and factory kitchens
was computed by obtaining a rate of increase over employment in
1931 which was based on increases in total population and in

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total employment in manufacturing, respectively, divided by
estimated increases in annual productivity.

d. Apparel, wood and construction materials, and printing.
   No change in employment in these industries has been allowed
   for the period 1931-1935, in the absence of concrete evidence.

e. Miscellaneous. An arbitrary factor was used to cover employ-
   ment in "Miscellaneous" industries. This constituted a
   number equalling five percent of the aggregate estimated
   employment in food, apparel, wood and construction materials,
   and printing.

The total value of industrial production, obtained by summing the
various industries, was 402.8 million rubles. This total was
within the lower limit of the area's production as given in the
Soviet source,[6] or 400-500 million rubles. A value at the lower
limit seemed reasonable, as another source listed the total value
of industrial production in 1937, two years later, as "above 400
million rubles."[7]

3. Nonmanufacturing.

The economically active population in nonmanufacturing categories
was obtained by subtracting employment in manufacturing from the
total. As mentioned previously, this residual was distributed in
accordance with the pattern of employment in the urban part of
Moscow Oblast (excluding Moscow city) in 1936.

B.   1939 economically active population (table III-J).

   1.   Total.

      The total economically active population for 1 January 1939
      was estimated as shown in table III-H. This part of the
      population grew by some 29,000 persons, 1935 to 1939.

   2.   Manufacturing.

      a.   Ferrous metallurgy. Direct information on prewar ferrous
           metallurgical output is available only through 1937; for
           this year, the estimated employment in ferrous metallurgy
           (using the productivity and economically active to worker
           ratios of table III-E) is 7,000. Since the output of pig
           iron in the U.S.S.R. as a whole increased only 3.5 percent
           during the period 1937-1940,[8] and there were no facilities
           known to be added at Tula, it is assumed that neither
           output nor employment showed any measurable increase at
           Tula between 1937 and 1939.

      b.   Metal-working and machine-building. The approach used in
           estimating this component was to gauge the size of the
           residual to the economically active population of Tula, 1935
           to 1939, after all other increases (e.g., ferrous metallurgy
           and transportation) had been subtracted from the total
           increase of the economically active population. This
           resulted in a figure of 64,000, an increase of 10,000 over

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1935 (tables III-G and III-J). An approximate check of this estimate of 64,000 was then made. It was assumed that the value of output in metal-working calculated for 1937 (156 million 1926-1927 rubles) covered nonmilitary plants only. At 1937 productivity rates, this would correspond to an employment of some 22,000 persons. (The 1937 productivity of 10,700 rubles per rabochiy, given in table III-E-1, was multiplied by 1.05 to correspond to the product-mix at Tula.)

A strong indication of the size of employment in military metal-working is provided by data on the workers' club at the "Machine-building Plant" (sic) at Tula in 1939. This club had 45 rooms plus an auditorium with a capacity of 1050, almost exactly the same as in the workers' club in the ZIS plant at Moscow.[9] The latter had an employment of 42,000 persons in 1937, and probably somewhat more in 1939.[10] Thus, it is very likely that at least 40,000 were employed in the integrated complex of ordnance factories denoted by the Soviet term "Machine-building Plant," and that the residual figure for all employment in metal-working, 64,000, appears to be reasonable.

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Table III-H.—CIVILIAN ECONOMICALLY ACTIVE POPULATION OF TULA, KOSAYA GORA, AND NOVO-TUL'SKIY: 1935-1939

Date	Civilian population[1]	Increase	Natural increase[2] .015 x (2)	Migrants		Economically active population	Economically active as percent of civilian population
				Total (3) - (4)	Economically active[3]		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
30 June 1935...	217,125	(4)	(4)	(4)	(4)	[4]112,819	52.0
30 June 1936...	228,474	11,349	3,257	8,092	5,227	118,046	51.7
30 June 1937...	246,924	18,450	3,427	15,023	9,705	127,751	51.7
30 June 1938...	265,374	18,450	3,704	14,746	9,526	137,277	51.7
1 January 1939..	274,600	9,226	1,990	7,236	4,674	141,951	51.7

[1] Mid-year estimates are interpolated from data in table I-A. The estimate for 1 January 1939 is based directly on the census total for 17 January 1939, without adjustment to 1 January.

[2] The natural increase rate of 1.5 percent per year is assumed. In 1927 the rate for urban areas of the Central Industrial Region was 1.72 percent, (Lorimer, Frank, The Population of the Soviet Union, Geneva, 1946, p. 82) but some decline after that date is assumed.

[3] It is estimated that 64.6 percent of the migrants entered the economically active population each year during this period. The corresponding rate for migrants entering Tula in 1926, or 54.4 percent, was obtained by applying 1926 age-specific participation rates for the civilian nonagricultural economically active population of Tula guberniia to the migrants who entered Tula in 1926. Tsentral'noye statisticheskoye upravleniye SSSR. Otdel perepisi. Vsesoyuznaya perepis' naseleniya 1926 goda (All-Union Census of Population, 1926), Moscow, v. 19, 1929, pp. 256-257, and v. 36, 1930, pp. 208-209.

[4] This rate for 1926 was increased to the 1935-1939 period by assuming the same rate of increase as for the increase in the ratio of the U.S.S.R. urban economically active to U.S.S.R. urban population between 1936 and 1939 (Section II-C below). The rate of 64.6 percent is that estimated for 1937, the mid-year of the 1935-1939 period.

Table III-J.--CIVILIAN ECONOMICALLY ACTIVE POPULATION OF TULA,
KOSAYA GORA, AND NOVO-TUL'SKIY: 1 JANUARY 1939

(Numbers are rounded to the nearest thousand and percentages, computed from
unrounded data, to the nearest tenth, without adjustment to group totals
which are independently rounded)

Category	Economically active	
	Number	Percent
Total...........................	142,000	100.0
Manufacturing..........................	90,000	63.5
Ferrous metallurgy......................	7,000	4.7
Metal-working and machine-building.........	64,000	45.4
Food.................................	8,000	5.5
Wood, construction materials..............	2,000	1.7
Apparel...............................	7,000	5.0
Miscellaneous.........................	2,000	1.2
Commerce.............................	13,000	9.3
Transportation and communication..........	15,000	10.8
Construction...........................	8,000	5.5
Health................................	4,000	2.8
Education.............................	5,000	3.2
Government administration and party apparatus...	6,000	4.4
Other................................	1,000	0.5

Source: See section II-B of this appendix.

4.4 percent for the category, in order to adjust for a
probable increase in employment.

c. All other nonmanufacturing categories were held at the same
percentage of the economically active as in 1935. Thus, in
effect, their estimated size increased at the same rate as
the population.

C. Validation of the 1939 estimate.

Three lines of evidence may be advanced to validate the estimate
detailed above.

An hypothetical economically active population for Tula,
Kosaya Gora, and Novo-Tul'skiy may be constructed by taking the data
for age- and sex-specific civilian labor force participation rates
for the urban part of Tula gubernia in 1926 (data on the city
directly are lacking) and projecting them to 1939. This projection
is based on the following considerations· in 1926, the urban
population of the U.S.S.R. (26,314,114 persons) included 571,102
military personnel or 90.5 percent of the total armed forces strength
of the U.S.S.R.[11] Of the civilian urban population, 17,976,832 were
aged 15 or above; 9,401,C99, or 52.3 percent of the civilian urban
population over 15, were economically active. By 1939, the urban
population of the U.S.S.R. had increased to 55,909,908.[12] Of this
number, at least 3 million (or 85 percent of the total estimated

armed forces strength) were military, leaving 52,900,000 civilians.[13]
The age-structure of the U.S.S.R. changed relatively little between
1926 and 1939, with the percentage 15 and above increasing only from
62.8 to 63.8 percent, or a relative increase of 1.6 percent. Applying
this rate of increase to those above 15 gives an estimated urban
civilian population 15 years of age and older of 37,513,000. The
civilian urban economically active population in 1939 is estimated
to have totalled 23,115,000 (Lorimer's national total of 28,539,000
workers and employees, less a deduction of 7,524,000 for rural persons
in agriculture, handicrafts, trade, education, health and administra-
tion, plus an addition of 10 percent for the probable under-counting
of domestics, casual labor, urban forced labor, etc.).[14] This figure
comprises 61.6 percent of the estimated urban civilian population
15 years of age and older, which represents an increase of 17.8
percent (61.6 ÷ 52.3 = 1.178) in civilian participation in the
economically active population.

In 1926, 61.5 percent of the civilian population 15 years
of age and over in the urban portions of Tula gubernia was economi-
cally active.[15] Adjusting this factor by the coefficient of increase
in participation in the economically active population as calculated
above gives 72.4 percent. The estimated population of Tula, Kosaya
Gora, and Novo-Tul'skiy aged 15 and over in 1939 is 199,700.

This gives an estimated economically active population of 145,000, or 2.0 percent above the figure estimated directly (table III-J).

A second check may be made by adjusting the 1939 economically active participation rates by sex. For the civilian males aged 15 and over, two exclusions may be made: a deduction of 6.6 percent of the total, or 6,460 for disability and old age, and one of 5,847 or 6.0 percent for students.[16] The resulting estimate is a male civilian economically active population of 85,500, or 87.4 percent of all civilian males aged 15 and over. If this total is subtracted from the aggregate of 142,000 (table III-J), the estimate for employed females becomes 56,500, or 55.6 percent of all females aged 15 and over. Against these figures we may set estimates based on the proportions of female employment in each industrial category in the U.S.S.R. in 1938-1940 (table III-K): 85,000 males and 57,000 females -- virtually identical.

A final check may be made by comparison with detailed data on the economically active population of Izhevsk in 1936, which also is a city primarily devoted to the manufacture of munitions. The comparative structures as percentages of total employment are the following.

PERCENTAGE OF TOTAL EMPLOYMENT

Category	Tula, Kosaya Gora, and Novo-Tul'skiy (1939)[1]	Izhevsk (1936)[2]
Total..............	100.0	100.0
Manufacturing.................	63.5	63.5
Commerce.....................	9.3	10.7
Transportation and communication.............	10.8	6.2
Construction.................	5.5	4.9
Health......................	2.8	3.4
Education....................	3.2	6.0
Government administration and party apparatus.......	4.4	3.9
Other.......................	0.5	1.3

[1] See table III-J.

[2] Data from Tsentral'noye upravleniye narodno-khozyayst-vennogo ucheta gosplana SSSR. Otdel ucheta truda. Chislennost' i zarabotnaya plata rabochikh i sluzhashchikh v SSSR (Numbers and Wages of Workers and Employees in the U.S.S.R.), Moscow, 1936, pp. 170-171.

The most notable element in the comparison, of course, is the high percentage of the economically active population in both cities which is occupied in manufacturing. The greater significance of Tula as a transportation center is reflected in the higher percentage in that occupation. Likewise, the relatively small percentage of Tula's economically active population which is engaged in education is shown by the comparison.

Table III-K.--CIVILIAN ECONOMICALLY ACTIVE POPULATION OF
TULA, KOSAYA GORA, AND NOVO-TUL'SKIY, BY SEX:
1 JANUARY 1939

Category	Economically active			Percent female[4]
	Total[1]	Male[2]	Female[3]	
Total..............	142,000	85,000	57,000	[5](39.2)
Manufacturing......................	90,000	57,000	33,000	[5](35.6)
Ferrous metallurgy...........	7,000	5,000	2,000	23.9
Metal-working and machine-building................	64,000	45,000	19,000	29.7
Food.......................	8,000	4,000	4,000	47.2
Wood, construction materials	2,000	1,000	1,000	[6]43.8
Apparel....................	7,000	1,000	6,000	82.4
Miscellaneous..............	2,000	1,000	1,000	42.1
Commerce......................	13,000	6,000	7,000	[7]52.0
Transportation and communication.	15,000	9,000	6,000	[8]36.5
Construction..................	8,000	5,000	3,000	[9]38.0
Health........................	4,000	1,000	3,000	[10]76.0
Education.....................	5,000	2,000	3,000	[10]58.0
Government administration and party apparatus.............	6,000	4,000	2,000	[10]35.0
Other.........................	1,000	1,000	([11])	[10]38.0

[1] Total economically active taken from table III-J.

[2] Male economically active obtained by subtracting female from the total.

[3] Female economically active obtained by applying the percentages from column 4 to unrounded figures for the total.

[4] Figures in this column are from Syssoeff, B., Women's Participation in the Labor Force of the U.S.S.R. (MSS), Russian Research Center, Harvard University, 1950, pp. 13-16. Unless otherwise noted the percentages are for 1 January 1938.

[5] These percentages were computed from unrounded totals obtained by summing the female economically active calculated for the various categories.

[6] An average of silicates and ceramics (43.4), and wood and sawmill (44.2).

[7] This percentage is for 1940, and is an average of municipal services (67.0), and trade (37.0).

[8] This percentage is for 1940, and is an average of railroad transport (25.0), and communication (48.0).

[9] This percentage is for 1940. No rate for construction is given.

[10] These percentages are all for 1940.

[11] Less than 500.

D. 1950 economically active population (table III-L).

The total economically active population for 1950 was obtained by summing the estimates for all the separate categories. It is partially dependent upon the estimate for the total population, for several of the industries and categories were increased in the same ratio with the population, but three-quarters of the total increment was computed from production data independent of population growth.

1. Manufacturing.

   a. Ferrous metallurgy. Once again information on production in this industry served as a basis for estimating a large part of the industrial economically active population. Using the volume of production and productivity rates from tables III-D and -E, and assuming a rate of increase in value of production, 1935-1950, equal to the rate of increase in volume of production for the same period (i.e., a constant price), employment in this industry was computed for 1950.

   b. Metal-working and machine-building. Employment in this industry was estimated by means of the following equation:

$$B_{1939-1950} = A_{1939-1950} \times \frac{B_{1935-1939}}{A_{1935-1939}}$$

   where

   A = increase in employment in ferrous metallurgy

   B = increase in employment in metal-working and machine-building.

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Table III-L.—CIVILIAN ECONOMICALLY ACTIVE POPULATION OF TULA
KOSAYA GORA, AND NOVO-TUL'SKIY: 1 JANUARY 1950

(Numbers are rounded to the nearest thousand and percentages, computed from
unrounded data, to the nearest tenth, without adjustment to group totals
which are independently rounded)

Category	Economically active	
	Number	Percent
Total..............................	170,000	100.0
Manufacturing.....................................	106,000	62.5
Ferrous metallurgy........................	10,000	5.6
Metal-working and machine-building.......	74,000	43.8
Food....................................	8,000	4.8
Wood, construction materials.............	3,000	1.7
Apparel.................................	9,000	5.5
Miscellaneous...........................	2,000	1.1
Commerce....................................	16,000	9.1
Transportation and communication.............	21,000	12.3
Construction.................................	9,000	5.4
Health.......................................	5,000	2.8
Education....................................	5,000	3.1
Government administration and party apparatus.	7,000	4.3
Other..	1,000	0.5

Source: See section II-D of this appendix.

Table III-L.—CIVILIAN ECONOMICALLY ACTIVE POPULATION OF TUL'
KOSAYA GORA, AND NOVO-TUL'SKIY: 1 JANUARY 1950

(Numbers are rounded to the nearest thousand and percentages, computed from
unrounded data, to the nearest tenth, without adjustment to group totals
which are independently rounded)

Category	Economically active	
	Number	Percent
Total..............................	170,000	100.0
Manufacturing.....................................	106,000	62.5
Ferrous metallurgy...........................	10,000	5.6
Metal-working and machine-building.......	74,000	43.8
Food..	8,000	4.8
Wood, construction materials...............	3,000	1.7
Apparel.....................................	9,000	5.5
Miscellaneous...............................	2,000	1.1
Commerce...	16,000	9.1
Transportation and communication..............	21,000	12.3
Construction....................................	9,000	5.4
Health...	5,000	2.8
Education.......................................	5,000	3.1
Government administration and party apparatus.	7,000	4.3
Other...	1,000	0.5

Source: See section II-D of this appendix.

c. <u>All other manufactures</u>. As noted in section I-B-3, it has
been estimated that employees in all categories other than
ferrous metallurgy and machine-building increased 19.5 percent
between 1935 and 1937. This growth was distributed uniformly
by category. For the period, 1937-1939, a period marked by
increasing concentration on ordnance production, it has been
assumed that increases in the consumers' goods sector were
limited to a minimum in food (bakeries and factory kitchens)
and miscellaneous. The figures for 1939 are, therefore, those of
1937, increased by 1,000 each in those two categories.

3. Nonmanufacturing.

Several categories of the nonmanufacturing group underwent
significant changes between 1935 and 1939.

a. <u>Transportation and communication</u>. The greatest change in
the economically active in this category occurred between
1935 and 1937, in connection with the rapid growth of
metallurgical production. The increase in employment
between these years was computed in table III-F. The growth
between 1937 and 1939 was much less because of a leveling
off in metallurgical production (table III-F).

b. <u>Government administration and party apparatus</u>. On 26 September
1937, Tula became the center of the newly-formed Tula Oblast.
The share of the category government administration and party
apparatus in the total economically active population was
arbitrarily increased by one percent of the total, or to

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This gives a figure of 74,000. A qualitative verification of
this figure, i.e., an estimated increase of 10,000 in metal-
working and machine-building employment, is given in many
postwar references to increased production in the Kirov Machine
Tool Plant, the Novaya Tula Machinery Plant No. 187, and the
Zars Motor Vehicle Repair Plant, as well as the large munitions
factories.

c. Wood and construction materials. While direct data on an
expansion in this category are lacking, the sizeable growth
of ferrous and metallurgical output, called for an estimated
increment of 1,000 persons.

d. Apparel. Production in this industry has expanded markedly
in the postwar period. Estimates of the number of persons
employed in sewing factories, based on reported production
(table III-C) were made from U. S. data. An estimate of
employment in the new rubber products plant (which has been
grouped with apparel since the main product is rubber footwear)
was made by use of reported production (table III-C). Prices
obtained from an early Soviet source[13] were applied to obtain
value of production, and the number of persons employed was
then computed by use of annual productivity rates (table III-E).

e. <u>Food and miscellaneous industries</u>. In the absence of data
indicating expansion, no change was made in the 1939 estimate
for employment in food and miscellaneous industries.

2. Nonmanufacturing.

The number of persons occupied in all of these categories, except
transportation and communication, was increased in direct proportion
to the growth of total population for the period 1939-1950.
Transportation and communication was given an increment for this
period based on the growth in both population and production.
Data for this calculation are shown in table III-F.

E. Validation of the 1950 estimate.

In view of the absence of official population figures or
other firm demographic landmarks for 1950, no absolute verification
of the estimates is possible. Nevertheless, it is possible to check
the consistency of the estimate of the economically active population
with the estimates of total population and age-sex structure for Tula,
Kosaya Gora, and Novo-Tul'skiy as an aggregate. For 1950, the
estimated number of civilian males 15 and above in this group of
communities was 111,960, and the number of females 131,317. The
economically active participation rate for civilian males in the Tula
area in 1939 was already close to the maximum possible without a
curtailment in education. Consequently, this rate of 87.4 percent of
civilian males 15 and above may be applied in 1950.

For the female population the 1939 rate of 55.6 percent was also high, although not quite maximum. However, since the character of the city has remained strongly oriented toward industries both requiring considerable physical strength, e.g., metallurgy, and providing high wage rates -- and hence incentives -- it appears unlikely that the proportion of women in employment would have increased markedly. For this reason, the 1939 economically active participation rate has been used for the female population also. The results are the following: the estimated civilian economically active population is 171,000, or 0.6 percent higher than that calculated directly. The proportion of female employment in the total shows a rise from 39.8 percent in 1939 to 42.7 percent in 1950.

F. Expansion and redistribution of the 1950 economically active population for the city and metropolitan area of Tula.

1. Kosaya Gora and Novo-Tul'skiy.

The estimated population of these settlements is 49,000. Assuming conservatively that the percentage of the population which was economically active here was the same as for Tula, Kosaya Gora, and Novo-Tul'skiy combined, gives an estimated economically active population of 26,000. Of this, 10,000 is known to be in ferrous metallurgy. A rough estimate of 500 in metal-working and 500 in all consumers goods industries combined may be added to give a total of 11,000 in manufacturing.

It was assumed that manufacturing occupations comprised
64.9 percent of the economically active population, as was the case
in 1935 (table III-G). Accordingly, the nonmanufacturing
occupations were assumed to comprise 35.1 per cent of the economi-
cally active population, or about 5,000 persons. Use of this
relatively high proportion of the economically active population
in manufacturing for the workers settlements appears justified in
view of the certainty that educational, administrative, and
similar service facilities would be less developed there than in
the central city. This calculation leaves a residual of 10,000,
which is the estimate of workers and employees living in Kosaya
Gora and Novo-Tul"skiy, but working in Tula city.

2. Tula city.

This estimate is a simple arithmetic residual from the combined
Tula, Kosaya Gora, and Novo-Tul'skiy figures after the removal of
the estimate for employment in the two workers settlements.

3. Barsuki, Gorelki, Khrushchevo, and Plekhanovo.

The estimated population of these communities is 15,000 (6,000 of
which is at Plekhanovo, with 3,000 each for the other three
communities) and the economically active population is 8,000.
Of this latter, 55 percent may be ascribed to wage work, the
remainder being collective farmers.

It was assumed that manufacturing occupations comprised 64.9 percent of the economically active population, as was the case in 1935 (table III-G). Accordingly, the nonmanufacturing occupations were assumed to comprise 35.1 per cent of the economically active population, or about 5,000 persons. Use of this relatively high proportion of the economically active population in manufacturing for the workers settlements appears justified in view of the certainty that educational, administrative, and similar service facilities would be less developed there than in the central city. This calculation leaves a residue of 10,000, which is the estimate of workers and employees living in Kosaya Gora and Novo-Tul"skiy, but working in Tula city.

2. Tula city.

This estimate is a simple arithmetic residual from the combined Tula, Kosaya Gora, and Novo-Tul'skiy figures after the removal of the estimate for employment in the two workers settlements.

3. Barsuki, Gorelki, Khrushchevo, and Plekhanovo.

The estimated population of these communities is 15,000 (6,000 of which is at Plekhanovo, with 3,000 each for the other three communities) and the economically active population is 8,000. Of this latter, 55 percent may be ascribed to wage work, the remainder being collective farmers.

These settlements have had the following history:
Plekhanovo has been a workers settlement since 1939; Gorelki became
a city-type settlement in 1948-1949; Barsuki was not a city-type
settlement in January 1950, the date of the estimate, but became
one at the end of the year; Khrushchevo is still classified as
rural. On the basis of the legal definition of a workers settlement
(a minimum of 400 adults, of whom 65 percent are wage earners),[19]
we estimate that in Plekhanovo and Gorelki 65 percent of the labor
force were wage earners. The comparable proportions for Barsuki
and Khrushchevo were estimated at 50 and 30 percent respectively.

Applying the percentages from table III-G gives an
estimate of 3,000 persons employed in manufacturing. As of 1935,
43 percent of the economically active population in manufacturing
was engaged in metal-working.[20] In the absence of later data,
this same percentage has been used for 1950 with the remainder
being allocated to the category "miscellaneous." For nonmanufac-
turing, the percentages in table III-G were used without change.

4. The final step in allocating the economically active population
was to add the estimates for Barsuki, Gorelki, Khrushchevo, and
Plekhanovo to the totals previously estimated (table III-L).

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NOTES

[1] Tsentral'noye upravleniye narodno-khozyaystvennogo ucheta gosplana SSSR. Otdel ucheta truda. Chislennost' i zarabotnaya plata rabochikh i sluzhashchikh v SSSR (Numbers and Wages of Workers and Employees in the U.S.S.R.), Moscow, 1936, p. 184.

[2] Bol'shoy sovetskiy atlas mira (Great Soviet Atlas of the World), Moscow, v. 2, 1939, plate 45.

[3] Malaya sovetskaya entsiklopediya (Small Soviet Encyclopedia), 2nd edition, Moscow, v. 10, 1939, cols. 875-876.

[4] TsUNKhU, Chislennost'...op.cit., pp. 60-65.

[5] The 1935 national urban consumption level of meat was calculated at 14.9 rubles (1926-1927 prices) per capita. This was based on data from TsUNKhU, Sotsialisticheskoye stroitel'stvo SSSR (Socialist Construction of the U.S.S.R.), Moscow, 1936, table 2; Gosplan, Narodnokhozyaystvennyy plan na 1936 god (National Economic Plan for 1936), Moscow, 1936, p. 430; and an estimated urban population of the U.S.S.R. for 1935 of 45 million. The consumption level of flour was estimated at 200 kg. per capita for 1935, and the productivity of flour at 360 tons per rabochiy annually. These estimates were based on data from the three volumes of TsUNKhU, Sotsialisticheskoye stroitel'stvo (1935 volume, p. 279; 1936 volume, table 2; and the 1933-38 volume, p. 77).

[6] Bol'shoy sovetskiy atlas mira, loc. cit.

[7] Malaya sovetskaya entsiklopediya, loc. cit.

[8] Schwartz, Harry, Russia's Soviet Economy, New York, 1950, p. 226.

[9] Facilities of the two clubs were as follows:

Facility	ZIS plant, Moscow	Machine-building plant, Tula
Number of paid workers...............	53	30
Number of "circles"....................	55	20
Number of participants in them....	1,671	946
Number of rooms for club work..........	41	45
Number of auditorium seats.............	1,100	1,050

Source: TsUNKhU, Kul'turnoye stroitel'stvo SSSR. Statisticheskiy sbornik (Cultural Construction of the U.S.S.R. A Statistical Compilation), Moscow, 1940, p. 162.

[10] Employment in the auto industry of the U.S.S.R. was 87,000 in 1937. The ZIS plant in Moscow produced 48.6 percent of the total value of output. Assuming the same productivity in the three major plants, GAZ, ZIS, and YaAZ, employment in the ZIS plant would thus be 48.6 percent of 87,000. (Sources: Shimkin, D. B., "Labor Productivity in the Soviet Automobile Industry," Memorandum on Labor Requirements for Munitions Production in the U.S.S.R., Russian Research Center, Harvard University, Cambridge, Mass., 19 April 1950, (CONFIDENTIAL).

NOTES--(Cont'd)

[11] Tsentral'noye statisticheskoye upravleniye SSSR. Otdel perepisi. Vsesoyuznaya perepis' naseleniya 1926 goda (All-Union Census of Population, 1926), Moscow, v. 34, 1930, p. 3.

[12] Izvestiya, Moscow, 2 June 1939.

[13] The estimate of 85 percent of the military strength enumerated among the urban population in 1939 is based on the percentage of 90.5 in 1926. Total strength of the armed forces was estimated at 3.5 million (appendix IX).

[14] Lorimer, Frank. The Population of the Soviet Union, Geneva, 1946, p. 100. Deductions from this total are based on Lorimer's estimates, applying the following percentages to obtain rural employment:

Occupation	Percent rural	Source
Agriculture and related occupations...	100.0	- - -
Handicrafts...	50.0	Estimate
Trade...	24.8	Equal to percent of total trade turnover in cooperatives. (Gosudarstvennyy plan razvitiya narodnogo khozyaystvo SSSR na 1941 god (State Plan for the Development of the National Economy of the U.S.S.R. in 1941), pp. 591-592.
Education...	63.2	TsUNKhU, Kul'turnoye stroitel'stvo..., pp. 37-38; 107.
Health...	45.8	Gosudarstvennyy plan...1941 god, p. 608.
Administration...	25.0	Estimate.

[15] Tsentral'noye statisticheskoye upravleniye SSSR. Vsesoyuznaya perepis' ....1926 goda, v. 19, 1929, pp. 256-257.

[16] The deduction of 6.6 percent for disability and old age is based on U. S. data. It is equal to the percentage of males, 14 years and over in 1950, who were not in the labor force for these reasons. (U. S. Bureau of the Census. U. S. Census of Population: 1950, v. II, Characteristics of the Population, Part I, U. S. Summary, Washington, 1953, p. 1-247.)

NOTES--(Cont'd)

Footnote 16 cont'd.

The deduction for students is based on data from TsUNKhU,

Kul'turnoye stroitel'stvo SSSR........; pp. 26, 65, and 104.

[17] U. S. Bureau of the Census. Census of Manufactures: 1947, Washington, D. C., v. 2, 1949, pp. 207-221.

[18] Universal'nyy spravochnik tsen (Universal Handbook of Prices), Moscow, 1928.

[19] Tsentral'noye statisticheskoy upravleniye gosplana SSSR. Slovar'-spravochnik po sotsial'no-ekonomicheskoy statistike (Dictionary-Handbook of Social-Economic Statistics), 2nd edition, Moscow, 1948, p. 438.

[20] Sources: Bol'shoy sovetskiy atlas mira, loc. cit.; Rayony moskovskoy oblasti (Rayons of Moscow Oblast), Moscow, 1936, pp. 4-19; TsUNKhU, Chislennost'....op. cit, pp. 60-65; Tsentral'nyy ispolnitel'nyy komitet, Administrativno-territorial'noye deleniye soyuza SSR na 15 iyulya 1934 goda (Administrative-Territorial Divisions of the U.S.S.R. on 15 July 1934), Moscow, 1934, pp. 26-35.

APPENDIX V

URBAN AREA REPORTS OF THE FOREIGN MANPOWER RESEARCH OFFICE
U. S. BUREAU OF THE CENSUS

U. S. Department of Commerce, Bureau of the Census. UNCLASSIFIED, Estimates
of the Population and Labor Force of Major Polish Cities: 1 January 1950,[1]
Series P-95, Nos. 1-17, Washington, D. C., 10 August 1953, UNCLASSIFIED.

——. CONFIDENTIAL, Estimates of the Population and Labor Force of Selected
Cities in the U.S.S.R.: 1 January 1950,[2] Series P-95, Nos. 18-23,
Washington, D. C., 10 December 1953, SECRET.

——. CONFIDENTIAL, Estimated Population and Labor Force of the City and
Metropolitan Area of Chirchik: 1 January 1950, Series P-95, No. 24,
Washington, D. C., 10 March 1954, SECRET.

——. CONFIDENTIAL, Estimated Population and Economically Active Population
of the City and Metropolitan Area of Tula: 1 January 1950, Series P-95,
No. 25, Washington, D. C., 10 May 1954, CONFIDENTIAL.

——. CONFIDENTIAL, Population and Labor Force Estimates for Czechoslovakia:
1 January 1950, Series P-95, No. 26, Washington, D. C., 15 July 1954,
SECRET.

——. CONFIDENTIAL, Population and Labor Force Estimates for Prague City
and the Prague Metropolitan Area: 1 January 1950, Series P-95, No. 27,
Washington, D. C., 1 June 1954, SECRET.

——. CONFIDENTIAL, Population and Labor Force Estimates for the City of
Plzen: 1 January 1950, Series P-95, No. 28, Washington, D. C.,
1 June 1954, SECRET.

——. CONFIDENTIAL, Population and Labor Force Estimates for the City of
Pardubice: 1 January 1950, Series P-95, No. 29, Washington, D. C.,
1 June 1954, SECRET.

——. CONFIDENTIAL, Population and Labor Force Estimates for the City of
Brno: 1 January 1950, Series P-95, No. 30, Washington, D. C.,
1 June 1954, SECRET.

[1] (Warsaw, Lodz, Wroclaw, Szczecin, Bydgoszcz, Chorzow, Sosnowiec, Gliwice,
Poznan, Lublin, Katowice, Krakow, Gdansk, Gdynia, Bytom, Zabrze, and
Czestochowa).
[2] (Ivanovo, Shuya, Kovrov, Kineshma, Kirov, and Kostroma).

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————. CONFIDENTIAL, Population and Labor Force Estimates for Ostrava City and the Ostrava Metropolitan Area: 1 January 1950, Series P-95, No. 31, Washington, D. C., 1 June 1954, SECRET.

————. CONFIDENTIAL, Population and Labor Force Estimates for the City of Bratislava: 1 January 1950, Series P-95, No. 32, Washington, D. C. 1 June 1954, SECRET.

————. CONFIDENTIAL, Estimated Population and Labor Force of the City and Metropolitan Area of Andizhan: 1 January 1950, Series P-95, No. 34, Washington, D. C., 30 August 1954, SECRET.

————. CONFIDENTIAL, Estimated Population and Labor Force of the Aleksin Industrial Area: 1 January 1950, Series P-95, No. 35, Washington, D. C., 10 August 1954, CONFIDENTIAL.

————. CONFIDENTIAL, Estimated Population and Labor Force of the Ordzhonikidze Metropolitan Area: 1 January 1950, Series P-95, No. 36, Washington, D. C., 30 September 1954, CONFIDENTIAL.

————. CONFIDENTIAL, Estimated Population and Labor Force of the City of Samarkand: 1 January 1950, Series P-95, No. 37, Washington, D. C., 20 January 1955, SECRET.

————. CONFIDENTIAL, Estimated Population and Labor Force of the City of Kaluga: 1 January 1950, Series P-95, No. 38, Washington, D. C., 20 June 1955, SECRET.

————. CONFIDENTIAL, Estimated Population and Labor Force of Rumania: 1 January 1950, Series P-95, No. 39, Washington, D. C., December 1955, SECRET.

————. CONFIDENTIAL, Estimated Population and Labor Force of the Metropolitan Area and City of Bucharest: 1 January 1950, Series P-95, No. 40, Washington, D. C., October 1955, SECRET.

————. CONFIDENTIAL, Estimated Population and Labor Force of the City of Cluj: 1 January 1950, Series P-95, No. 41, Washington, D. C., October 1955, SECRET.

————. CONFIDENTIAL, Estimated Population and Labor Force of the City of Constanta: 1 January 1950, Series P-95, No. 42, Washington, D. C., October 1955, SECRET.

————. CONFIDENTIAL, Estimated Population and Labor Force of the City of Iasi: 1 January 1950, Series P-95, No. 43, Washington, D. C., October 1955, SECRET.

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SECRET

------. CONFIDENTIAL, Estimated Population and Labor Force of the City of Timisoara: 1 January 1950, Series P-95, No. 44, Washington, D. C., October 1955, SECRET.

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