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SIMULATION OF MULTIREGIONAL POPULATION CHANGE: AN APPLICATION TO THE GERMAN DEMOCRATIC REPUBLIC

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FOREWORD

During the summer of 1982, Sergei Scherbov (USSR) and Hartmut Usbeck (GDR) came to IIASA as members of the Institute's Young Scientists Summer Program to work in the former Human Settlements and Services Area. Together they produced this paper, which uses the multiregional demographic model to simulate to the year 2030 six scenarios of population development in the German Democratic Republic. It extends the work of the Migration and Settlement case study for the GDR by Mohs (1980) by illustrating how the model can be used as a tool for making simulations that are based on changing rates of fertility, mortality, and migration.

Andrei Rogers
Leader
Population Program

CONTENTS

SIMULATION OF MULTIREGIONAL POPULATION CHANGE: AN APPLICATION TO THE GERMAN DEMOCRATIC REPUBLIC

1. INTRODUCTION

This paper describes the application of the multiregional population projection simulation package available at IIASA[1], to the German Democratic Republic (GDR). It is a continuation of previous work on migration and settlement in the GDR, which was one of the comparative studies of recent migration patterns and spatial population dynamics in all of IIASA's 17 National Member Organization countries (Mohs 1980). In these studies, all of which used a common computer program (Willekens and Rogers 1978), the multiregional population projections were based on constant rates of fertility, mortality, and migration. The way these three components can be expected to change the population distribution, growth, and age composition in the future is important for planning purposes. In this paper six scenarios of changes in fertility, mortality, and migration patterns are described, and the impact of these changes on regional population development is simulated.

The study begins with a short description of the methodological background and the main contents of the simulation package. In the second section a review is given of the current pattern of spatial population development in the GDR. The third

section deals with the application of the simulation model for the GDR, and the paper ends with some conclusions and suggestions for further use of the model.

2. POSSIBILITIES OF THE SIMULATION MODEL COMPUTER PACKAGE

Recent developments in the field of demography have made it possible to study the interregional migrations that take place between human settlement systems. A valuable contribution to these analyses was made by Rogers (1975), who extended the standard demographic life table to include multiregional populations. Further elaboration of the multiregional computer package for population projections (Willekens and Rogers 1978) allowed researchers in each IIASA country to study spatial population systems more deeply.

Computational analyses of the alternatives of population growth in the GDR, presented in this paper, were done with the help of a simulation model—an extension of the multiregional population projection model—which allows for the study of the impact of different demographic scenario variables on the population system, including the impact of international migration. Other scenario variables describe regional fertility, mortality, and origin-destination migration.

There are two types of variables in the simulation model. With the first, the sets of age-specific fertility, mortality, and migration rates can be changed. With the second, only the area under the age-specific curve is affected, but the shape of the curve remains unchanged. For fertility, then, the gross reproduction rate (GRR) is used since it is calculated by summarizing age-specific rates over all ages, and in the case of data given for 5-year age intervals, it is multiplied by 5. For mortality and migration the gross death rate and gross migration rate (GMR), which are calculated in the same way as the GRR, are used.

Changes in scenario variables may be instantaneous or may be introduced as linear functions of time.

The necessary data for the simulation model are for an initial year. These data are very close to those required for the projection model but also include the number of in- and emigrants by age and region when international migration (an open population) is considered. Scenario variables can be specified interactively, during the simulation run, as well as prepared in advance and saved in a data file. Examples of initial data and scenario specifications are presented in the Appendix.

It should be mentioned that the simulation model deals with a population not disaggregated by sex; all demographic variables such as fertility, mortality, and migration, therefore, take the total population into account. In the case of the GDR the population system is regarded as being closed.

3. CURRENT PATTERNS OF SPATIAL POPULATION DEVELOPMENT

Patterns of spatial population development are closely connected with the development of the territorial structure, the national economy, and the population policy of a country. In this section only a brief review of this background can be given (for further details, see Lüdemann and Heinzmann (1978) and Mohs (1980)]. The territory of the GDR contains 108,000 km^2 with about 16.7 million inhabitants. In 1980 the divisions were 15 administrative districts (Bezirke), including Berlin as the capital, with 219 counties (Kreise) and 7,553 communities (Gemeinden). The GDR is a highly industrialized and urbanized country with more than 75 percent of the population being urban. The historical economic development pattern has produced sharp regional contrasts between the southern part, which has a high level of industrialization and population density, and the more agrarian northern part. Under the postwar socialistic conditions, however, these discrepancies have been reduced. The industrialization of the former agrarian regions has affected an evident development of material and cultural living conditions. This industrialization changed the regional population

distribution, primarily because of the growing migration flows to the new industrial centers during the 1950s and 1960s. During the 1970s, this interregional migration shifted to shorter distance, local migration. At present the share of migration between districts, between counties within districts, and between communities within counties is nearly the same.

This analysis of current spatial population distribution patterns is based on observed 1975 characteristics. The data were provided by the Directorate of Statistics of the GDR, the central statistical bureau of the government, and are available at IIASA.

3.1 Regional Aggregation

The initial data were calculated for the 15 administrative districts. A regional data aggregation was necessary because of computing technicalities, planning constraints, and comparability with the former migration and settlement study (Mohs 1980).

Thus the 15 districts were aggregated into five regions, which are also used by the State Planning Commission for long-term planning. These are:

1. The *North region*, including the districts of Rostock, Schwerin, and Neubrandenburg
2. *Berlin*, capital of the GDR
3. The *Southwest region*, including the districts of Erfurt, Gera, and Suhl
4. The *South region*, including the districts of Halle, Leipzig, Dresden, and Karl-Marx-Stadt
5. The *Middle region*, including the districts of Magdeburg, Potsdam, Frankfurt, and Cottbus

The North region is more agricultural in structure than the others, although some important industrial centers have developed in the past. Berlin with its surroundings and the South region

are agglomeration areas because of their density of population, cities, infrastructure, and industry. The Southwest and the Middle regions show a mixed economic structure, with the Cottbus district being the prime location of energy production in the GDR and Hagdeburg, Erfurt, Gera, and Frankfurt being important locations of processing industries.

3.2 Components of Multiregional Population Development

Fertility

In 1975, the base year of this study, the total population of the GDR was about 16,820,000. After a relatively constant period of a nearly zero growth rate during the 1960s, the population of the GDR decreased. The main reason was the decline in the fertility rate, brought about by the changing age structure of the population, the legalization of abortion in 1972, and a broad marketing of contraceptives. The lowest level of this development was reached in the middle of the 1970s (Table 1), a fact that must be considered in this study.

Table 1. Number of births and total fertility rates (TFR) in the GDR during the 1970s.

Year	Births	TFR
1970	236,929	2,192.5
1971	234,870	2,131.0
1972	200,443	1,786.0
1973	180,336	1,576.8
1974	179,127	1,539.7
1975	181,798	1,541.7
1976	195,483	1,636.8
1977	223,152	1,850.6
1978	232,151	1,899.0
1979	235,233	1,894.6
1980	245,132	-

SOURCE: Statistical Yearbook of the GDR (1981).

Since 1976, the total number of births, and with that fertility rates, have greatly increased, largely as a result of population and social policy measures. The regional differences in fertility, especially between the North and South regions, have diminished during the last decades (Table 2). The observed population characteristics and age-specific rates of the five regions in 1975 are shown in Appendixes A1 and A2. The gross reproduction rate has the highest level in the Berlin and North regions (0.796, 0.794, respectively) and the lowest in the South region (0.736).

Table 2. Fertility changes in the districts of the GDR.

	Total fertility rate			
District/Region	1964	1971	1974	1979
NORTH				
Rostock	2.854	2.299	1.670	2.039
Schwerin	2.980	2.321	1.650	2.003
Neubrandenburg	3.175	2.367	1.658	2.072
Berlin	2.319	1.997	1.554	1.994
SOUTHWEST				
Erfurt	2.642	2.237	1.569	1.875
Gera	2.445	2.118	1.586	1.855
Suhl	2.546	2.218	1.554	1.824
SOUTH				
Halle	2.474	2.172	1.464	1.813
Leipzig	2.325	2.033	1.442	1.800
Dresden	2.433	2.133	1.618	2.013
Karl-Marx-Stadt	2.222	1.961	1.416	1.792
MIDDLE				
Frankfurt	2.819	2.203	1.579	1.924
Cottbus	2.769	2.351	1.641	2.008
Potsdam	2.668	2.146	1.487	1.808
Magdeburg	2.615	2.226	1.507	1.791
GDR	2.542	2.152	1.540	1.895

SOURCE: Population Statistical Yearbook of the GDR (1966, 1973, 1976), Statistical Yearbook of the GDR (1981).

Figure 1 shows the age-specific fertility rates for the five regions. Above-average values can be seen for the North region in the first childbearing age group (15-19 years) and also in the 20-24-year age group. Berlin's shift to a higher age of childbearing is also evident, with the lowest value being in the first age group and the highest values in the second and third. The other regions show a similar behavior except for the Southwest region, which has an above-average value in the 30-34-year age group.

Mortality

Aggregate levels of mortality are determined to a high degree by the age structure of the population. The crude death rates have been nearly stable over the last two decades (1965, 13.5; 1970, 14.1; 1980, 14.2), although the age-specific rates, especially in the lower and middle age groups, have diminished. In the GDR one can find a very low death rate in the 0-1-year age group, and there exist only small regional differences in mortality levels among the five regions (Appendix A2).

The life expectancy of the 0-1-year age group has increased from 71-74 years during the period 1960-1975 for females and from 66-69 years for males. The average for the entire GDR population was 71.74 years in 1975 with a regional differentiation of 0.7 years. The increase of life expectancy is primarily a result of the considerable decline in infant mortality and improved living conditions in all regions.

Migration

Total migration has declined markedly during the last two decades in the GDR. Figure 2 shows the characteristic trends of migration flows between districts in the period 1953-1972. The following districts had a constant migration loss: Schwerin and Neubrandenburg (North Region), Karl-Marx-Stadt and Halle (South Region), and Magdeburg (Middle region). On the other hand there has been growth due to migration in the Potsdam,

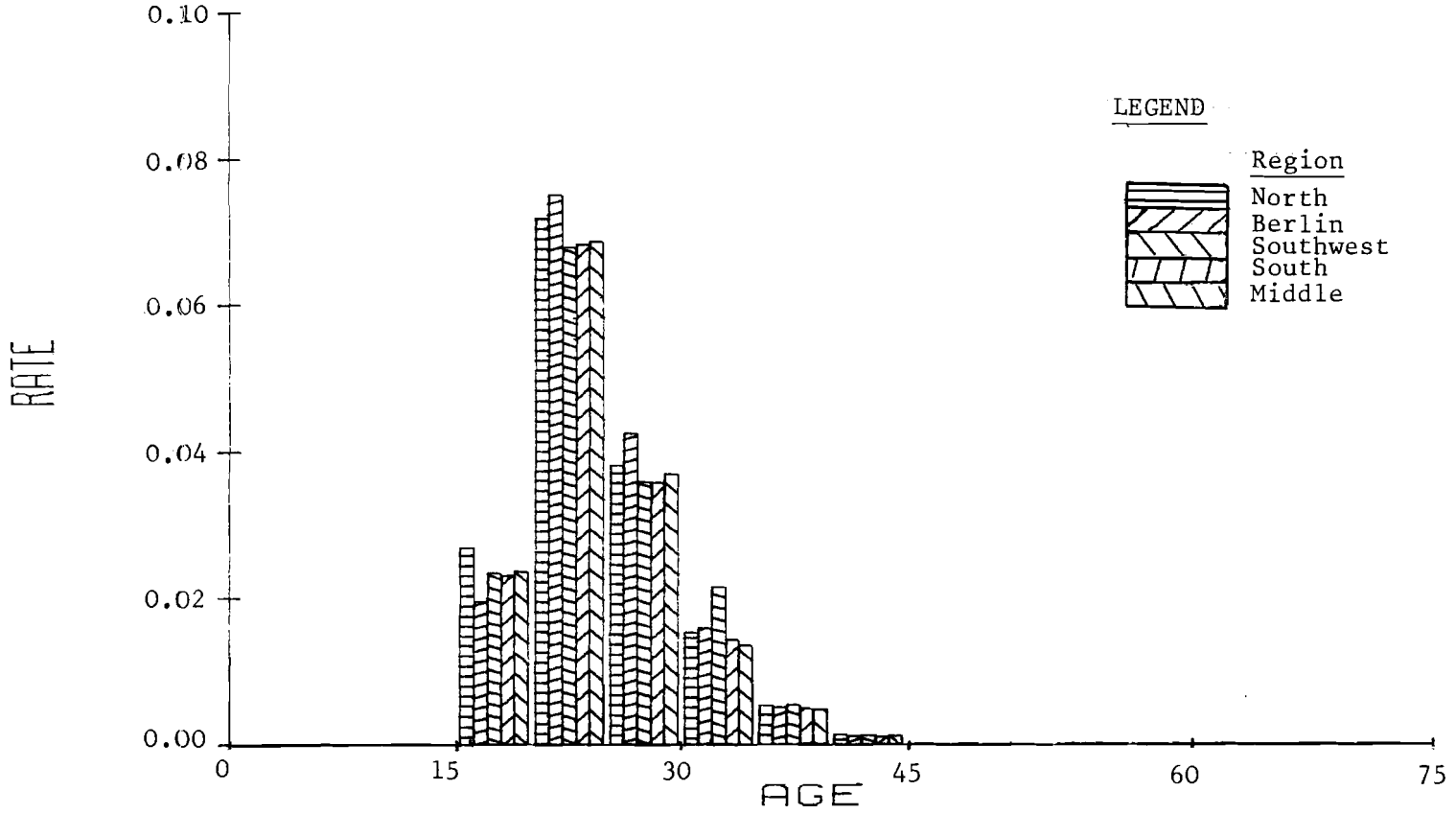

Figure 1. Age-specific fertility rates for five regions of the GDR, 1975.

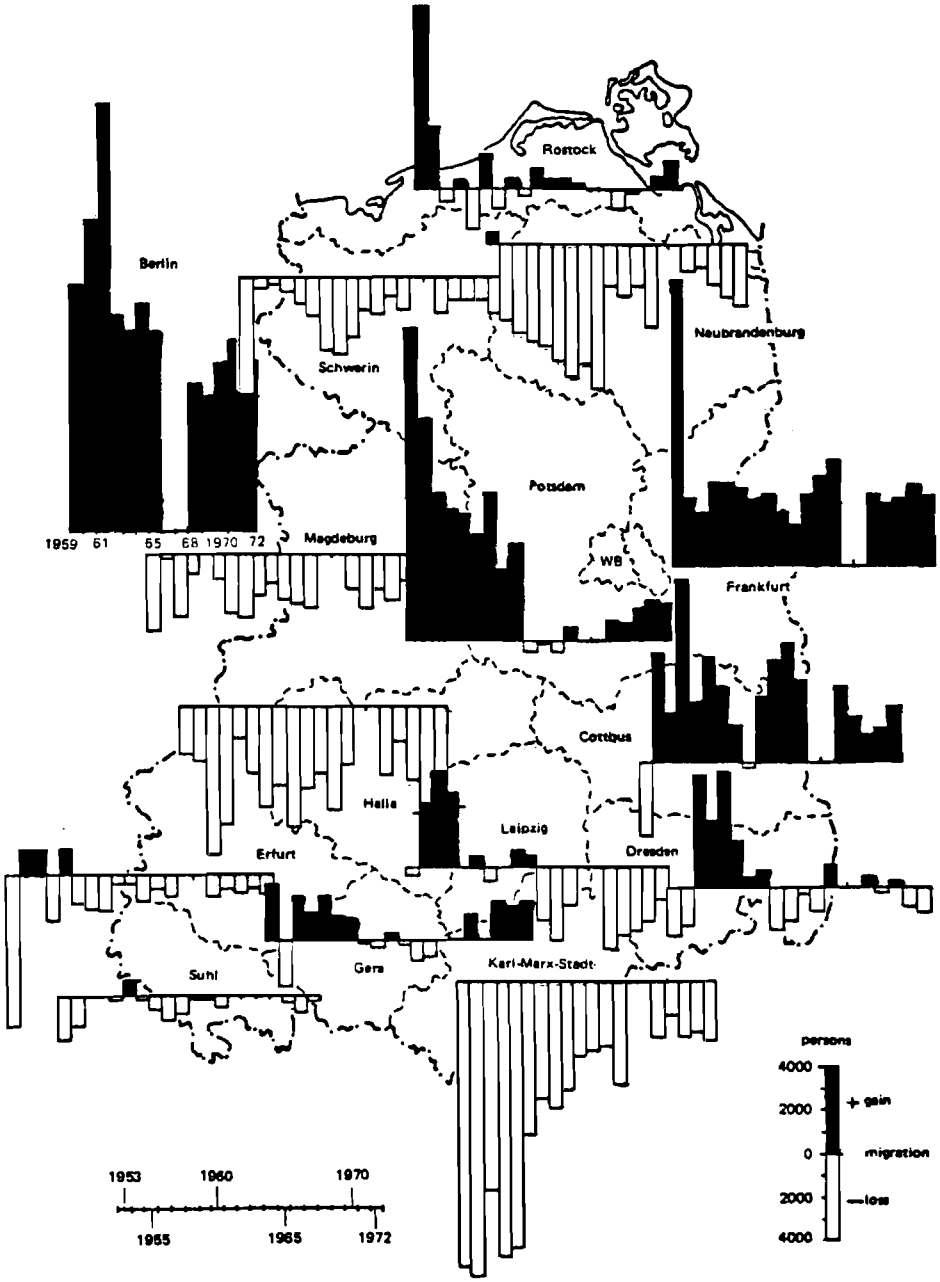

Figure 2. The evolution of migration between the districts of the GDR (all persons) during the period 1953-1972. Migration to Berlin is not included for the period 1953-1958.

SOURCE: Bose (1975, Appendix).

Frankfurt, and Cottbus districts (Middle region) and in the Rostock district (North region) as well as in Berlin, which has had the highest migration gain. It is evident that there is no strong relation between the economic structure of a region and migration balance. Table 3 shows migration flows between the five regions in the 1975 base year.

Table 3. Number of migrants between regions (1975).

To \ From	North	Berlin	Southwest	South	Middle	Arrivals
North	0	1,021	1,670	5,473	5,511	13,675
Berlin	2,897	0	1,790	5,655	9,192	19,534
Southwest	1,929	592	0	9,003	3,210	14,734
South	4,228	1,647	6,655	0	10,071	22,601
Middle	6,773	4,408	3,375	15,069	0	29,265
Departures	15,827	7,308	13,490	35,200	27,984	99,809

In 1975 Berlin, the Middle region, and the Southwest region had a migration gain, whereas the South and the North regions had a migration loss. The analysis of the observed outmigration rates with regard to the crude rates (Table 4) and also to the gross rates (Appendix A2) reflects on the one hand the demonstrated regional differences in migration flows and on the other hand the differences in the general spatial mobility of the population. One can find the highest value in the North region and the lowest value in the South region.

The age profile of the migrants is similar in all regions, with the highest values being in the 15-29-year age groups. This is mainly the well-known young family migration with children (relatively high values in the 0-4 age group) but also migration because of vocational training (15-20 years).

Table 4. Crude rates of outmigration for the five regions, 1975.

To \ From	Crude rate of outmigration				
	North	Berlin	Southwest	South	Middle
North	0.	0.000930	0.000660	0.000767	0.001387
Berlin	0.001389	0.	0.000708	0.000793	0.002314
Southwest	0.000925	0.000539	0.	0.001262	0.000808
South	0.002027	0.001500	0.002631	0.	0.002535
Middle	0.003248	0.003686	0.001334	0.002112	0.
Total	0.007589	0.006655	0.005332	0.004934	0.007045

It should be mentioned that migration between the five regions reflects only a small share of the total migration. The main migration flows occur inside districts and counties and are mainly oriented to the district- and county-towns and to other important industrial centers. These short-distance flows influence, to an increasing degree the redistribution of the population to concentrated areas [for further details see Neumann (1978) and Usbeck (1982)].

Age Structure of the Population

As previously mentioned by Mohs (1980), for the GDR analysis it was necessary to adjust the age group structure, which is used in the official statistics of the GDR, to 5-year age groups. In the Statistical Yearbook, the age groups are 0-1,1-3,3-6,6-10, 10-15,15-18,18-21, and 21-25, followed by the 5-year age groups 25-30, and so on. These age groups were chosen for economic reasons, which are explained by Mohs (1980). A description of the adjustment procedure used is contained in Appendix A of that study.

For economic planning, a differentiation of the population in the pre-labor force age, labor force age, and post-labor force age is important. In the GDR these main age groups are the following:

Pre-labor force age - 0-15 years
Labor force age - 15-60 years (female)
15-65 years (male)
Post-labor force age - more than 60 or 65 years

Table 5 demonstrates the changes in the percentage distribution between these age groups during the last two decades.

Table 5. Age structure of the population of the GDR (in percent).

Year	Pre-labor force age	Labor force age	Post-labor force age
1960	21.0	61.3	17.6
1970	22.6	57.9	19.5
1975	20.6	59.7	19.6
1977	19.7	61.4	18.9
1980	18.9	63.2	17.9

SOURCE: Statistical Yearbook of the GDR (1981).

There was a remarkable decline in the labor force age during the 1960s. Since the middle of the 1970s, there has been an increase in this age group, a result of the higher number of people who were born in the second half of the 1950s and the early 1960s and are now coming into the labor force age. This development will reverse after the mid-1980s. Table 5 reflects the unfavorable age structure of the GDR population because of one of the highest shares of 65 years and older persons of the world and a mean age in 1975 of 37 years.

Significant regional differences exist in the age structure of the population (Table 6). A detailed age composition by 5-year age groups is given in Figure 3.

Table 6. Age structure of the population in the GDR by region, 1975 (in percent).[a]

Age group	Region					
	Total	North	Berlin	Southwest	South	Middle
0-14	21.34	23.96	21.30	21.56	19.96	22.36
15-64	62.35	62.52	62.55	62.55	62.10	62.35
65+	16.29	13.53	16.14	15.57	17.94	15.29
Mean age (years)	37.03	34.56	37.12	36.69	38.36	36.15

[a]The deviation from Table 5 results from different age group boundaries. For this study, the age groups of Table 6 were used.

The high share of the population in the post-labor force ages and the below-average share of the other two age groups in the South region are particularly evident, accentuating the contrast that exists in the North region. There are difficult problems in solving the shortage of manpower in the highly industrialized South region, which has many employment possibilities. Mohs (1980) points out that a planned production policy must be accompanied by a planned, temporary inmigration of people to the South. In the following six scenarios fertility, mortality, and migration rate alternatives will be simulated in order to show the reorientation of migration necessary to change the present situation.

4. MULTIREGIONAL POPULATION PROJECTIONS WITH DIFFERENT SCENARIOS

The projections carried out in this study are for 55 years—1975-2030—for the total population of the GDR by age. (Sex-distribution data were not available.)

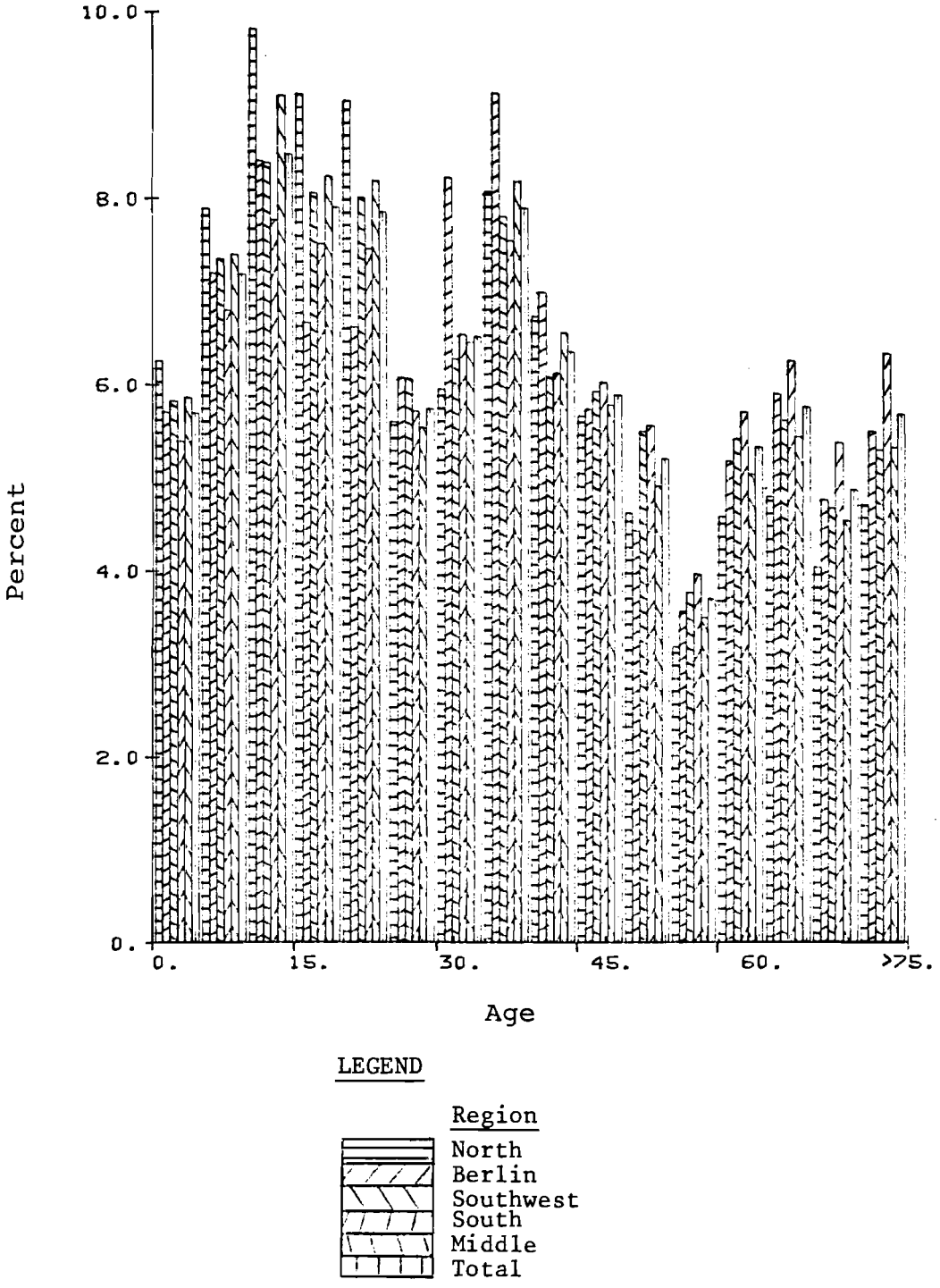

Figure 3. Population age structure of the GDR, 1975.

4.1 Scenarios

The following multiregional population projections are made with changing rates of fertility, mortality, and migration for the total GDR population and for the five regions:

Base run:

Fertility - stable rates
Mortality - stable rates
Migration - stable rates

Scenario 1:

Fertility - increasing rates until 1980 and then stable
Mortality - stable rates
Migration - stable rates

Scenario 2:

Fertility - stable rates
Mortality - declining rates until 2030
Migration - stable rates

Scenario 3:

Fertility - stable rates
Mortality - stable rates
Migration - 1. declining gross migraproduction rates in all regions until 2000 and then stable
2. stable inmigration rates to Berlin

Scenario 4:

Fertility - increasing rates until 1980 and then stable
Mortality - declining rates until 2000 and then stable
Migration - stable rates

Scenario 5:

Fertility - increasing rates until 1980 and then stable
Mortality - decreasing rates until 2030

Migration - 1. stable inmigration rates to Berlin until 1990 and then decreasing rates

2. increasing inmigration rates to the South region since 1985

3. declining gross migraproduction rates in all regions until 2000 and then stable

Scenario 6:

Fertility - increasing rates until 1980 in the North, Berlin, and Southwest regions; increasing rates until 1990 in the South and Middle regions

Mortality - decreasing rates until 2030

Migration - 1. stable inmigration rates to Berlin until 1990 and then decreasing rates

2. increasing inmigration rates to the South region since 1985 until 2000 and then stable

3. decreasing outmigration rates from the South since 1985 until 2000

4.2 Analysis and Interpretation

In the following, the results of the base run and of the six scenarios will be analyzed and interpreted with special attention given to population development until the year 2000 and in the second half of the projection period, focusing on the population development of the base run and scenarios 5 and 6. The reasons for this are:

1. Stable rates (base run) of the components of population change provide insight into the course of population development.

2. Scenarios 5 and 6 assume considerable changes in the migration patterns of Berlin and the South regions. Thus population changes in Berlin, the present capital and the main center of investment activity, as well as in the South region, the economic center of the country, are of high political and economic importance.

Base Run

In the base run a development of the multiregional population structure of the GDR with 1975 stable rates is projected. This projection was already made by Mohs (1980), but unfortunately in his study an important computing error was made, which greatly influenced the results of the long-term projection. There was a shift of fertility rates in the Berlin, Southwest, and South regions by one age group (Mohs 1980:47-49,51). Because this mistake directly influenced such values as the gross reproduction rate and the mean age of childbearing as well as migration in the population projection, the base run had to be repeated for this analysis.

In multiregional population projections that use stable rates, the base year structural patterns influence the demographic development during the whole projection period. The situation in 1975 is described in section 3.

With the assumption of stable rates the total population of the GDR is expected to decline by -6.5 percent to the year 2000 and by -24.0 percent to the end of the projection period (Table 7). According to this development, the regional shares of the total population will change in the following way (Table 8).

From this base-run scenario it is evident that Berlin will be the main "winner" and the South region the main "loser" of this change. Since the rates of the components of change are stable, the changing age structure will mainly influence the regional differentiation. This is reflected by the patterns of births and deaths during the projection period (Figures 4 and 5). After a low increase to 1985, caused by the higher number of persons in the childbearing age groups, the number of births declines markedly, especially in the South region. This is an expression of the high percentage of persons in the older age groups. The only exception is Berlin, which has a nearly stable number of births because of the high inmigration of younger people.

Table 7. Total population change by regions, 1975-2030, base run.

Region	Total population (in thousands)			Absolute change (in thousands)		Change (in percent)	
	1975	2000	2030	1975-2000	1975-2030	1975-2000	1975-2030
North	2,085	2,051	1,710	-34	-375	-1.7	-18.0
Berlin	1,098	1,337	1,359	+239	+261	+21.8	+23.8
Southwest	2,530	2,433	2,030	-97	-500	-3.9	-19.8
South	7,135	6,107	4,571	-1,028	-2,564	-14.5	-35.9
Middle	3,972	3,802	3,128	-170	-844	-4.3	-21.3
GDR	16,820	15,730	12,798	-1,090	-4,022	-6.5	-24.0

Table 8. Regional shares of the total population, 1975-2030, base run (in percent).

Year	North	Berlin	Southwest	South	Middle
1975	12.4	6.6	15.0	42.4	23.6
2000	13.0	8.5	15.1	38.8	24.2
2030	13.4	10.6	15.9	35.7	24.4

The total number of deaths decreases until 1995 in all regions because the rates refer to persons born in the period between the two world wars who suffered high losses during World War II and therefore make up age groups that now have a minimum number of persons. The following increase in the number of deaths, along with the decrease of births, leads to the fast population decline in the second half of the projection period.

In the base run, the mean age of the total GDR population is expected to increase by seven years by 2030 (1975, 37.03 years; 2030, 44.14 years) with the lowest growth being in Berlin (+4 years). This higher mean age will also influence the volume of migration. There will be a decrease in the total number of migrants from about 100,000 (1975) to nearly 63,000 (2030) (Figure 6). The decrease is highest in the South region, which has the oldest population; outmigration from Berlin tends to be stable.

The change of proportions between the labor force age groups and the pre- and post-labor force age groups is important for economic planning. Despite the continued decline of total population the share of persons in the labor force age group will be increasing until 1995 and then a large drop will occur, according to the base run. The regional shares of the three main age groups are given in Table 9.

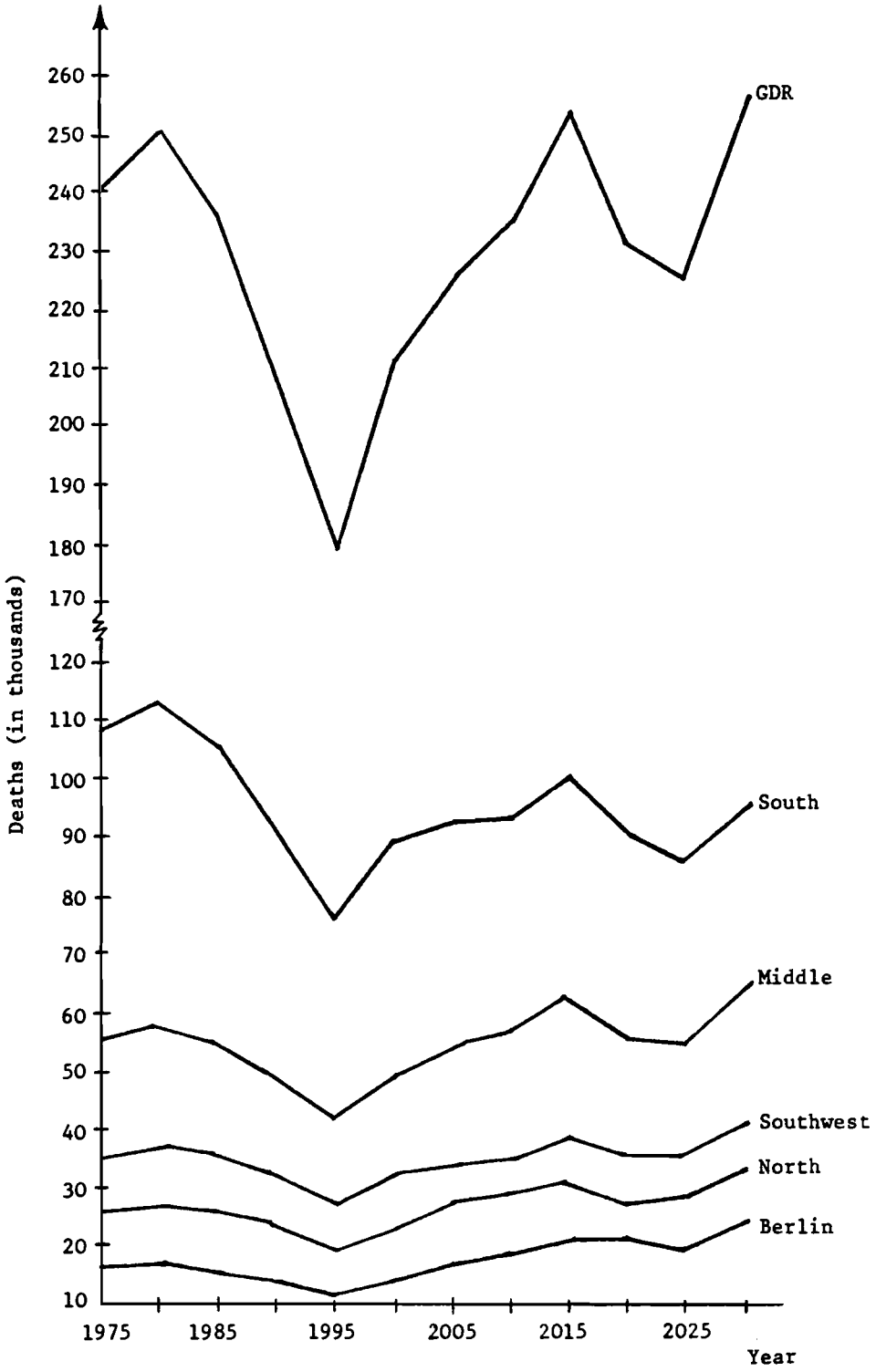

Figure 4. Evolution of total deaths (base run).

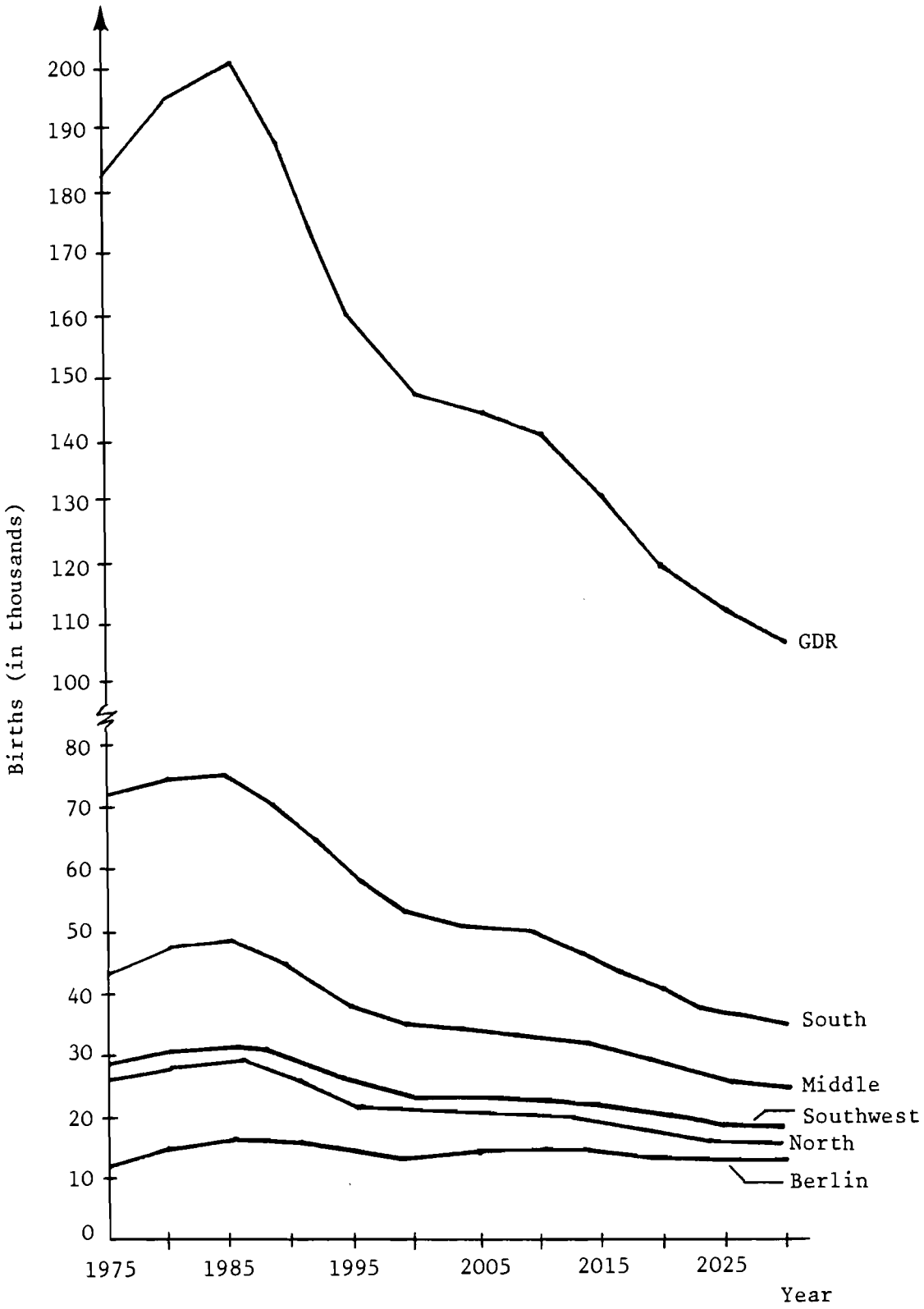

Figure 5. Evolution of total births (base run).

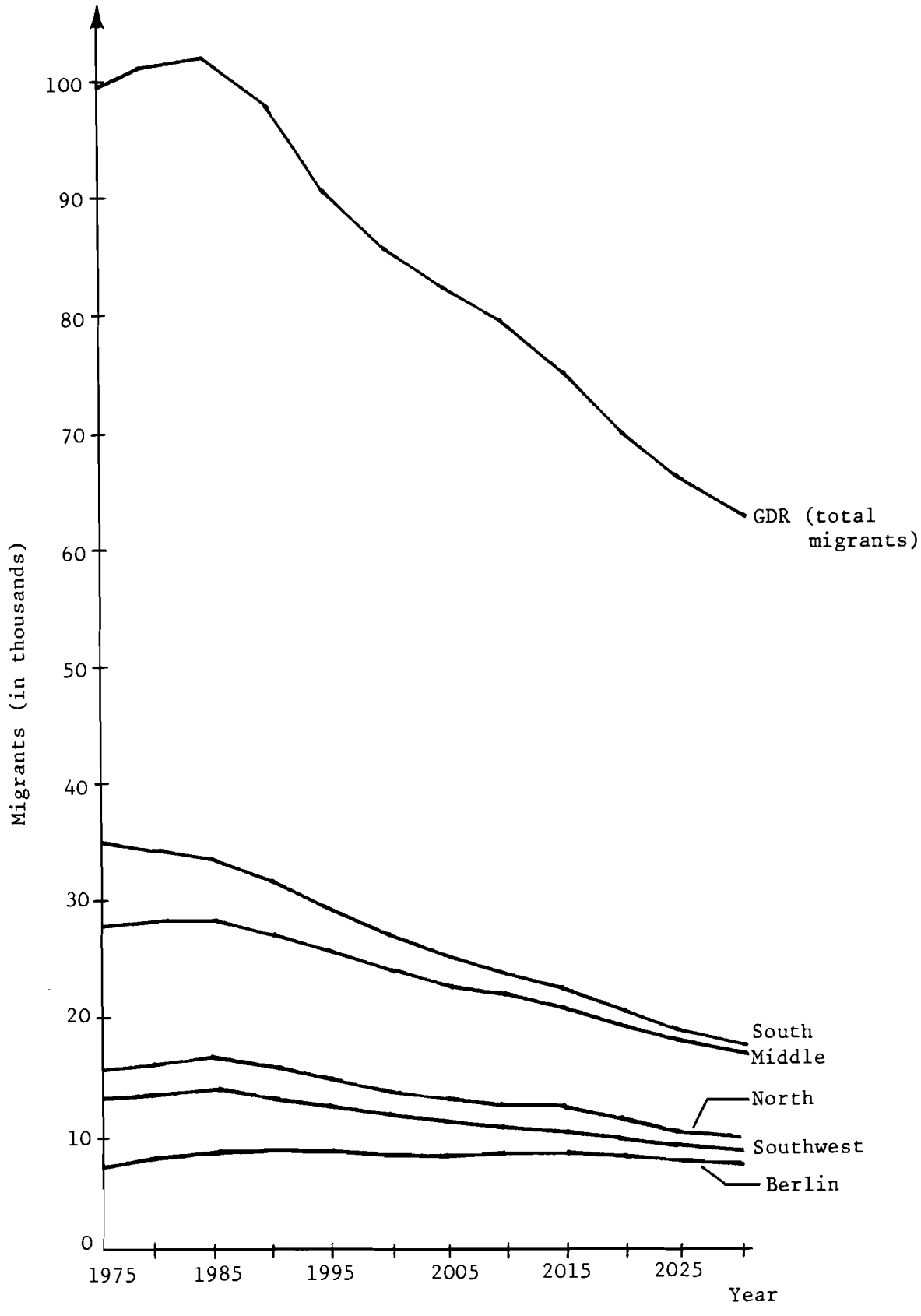

Figure 6. Evolution of the number of outmigrants (base run).

Table 9. Percentage of population in the three main age groups by region, 1975-2030, base run.

Region		Year 1975	2000	2030
NORTH	PrA	24.0	17.5	14.2
	LA	62.5	69.9	63.5
	PoA	13.5	12.6	22.3
BERLIN	PrA	21.3	17.7	15.0
	LA	62.6	71.8	66.7
	PoA	16.1	10.5	18.3
SOUTH-WEST	PrA	21.6	16.8	14.1
	LA	62.9	69.4	63.9
	PoA	15.5	13.8	22.0
SOUTH	PrA	20.0	15.2	12.7
	LA	62.1	68.9	62.8
	PoA	17.9	15.9	24.5
MIDDLE	PrA	22.4	16.3	13.2
	LA	62.3	70.2	63.6
	PoA	15.3	13.5	23.2
TOTAL	PrA	21.3	16.2	13.5
	LA	62.4	69.7	63.7
	PoA	16.3	14.1	22.8

PrA - Pre-labor force age
LA - Labor force age
PoA - Post-labor force age

The low share of the labor force age group especially in the highly industrialized South region will require a changing manpower and population distribution policy, which should include a policy for improving the regional conditions necessary for a higher natural increase.

The resulting age structure of population for the year 2030 if illustrated as a population pyramid would show a form similar to a rectangle, with growing population shares connected with older age groups (Figures 7-12). The present population distribution and growth rate is mainly reflected in the older age groups, thus underlying the idea that if one projects the population with a constant growth rate for a long time period it will become a stable population (Willekens and Rogers 1976).

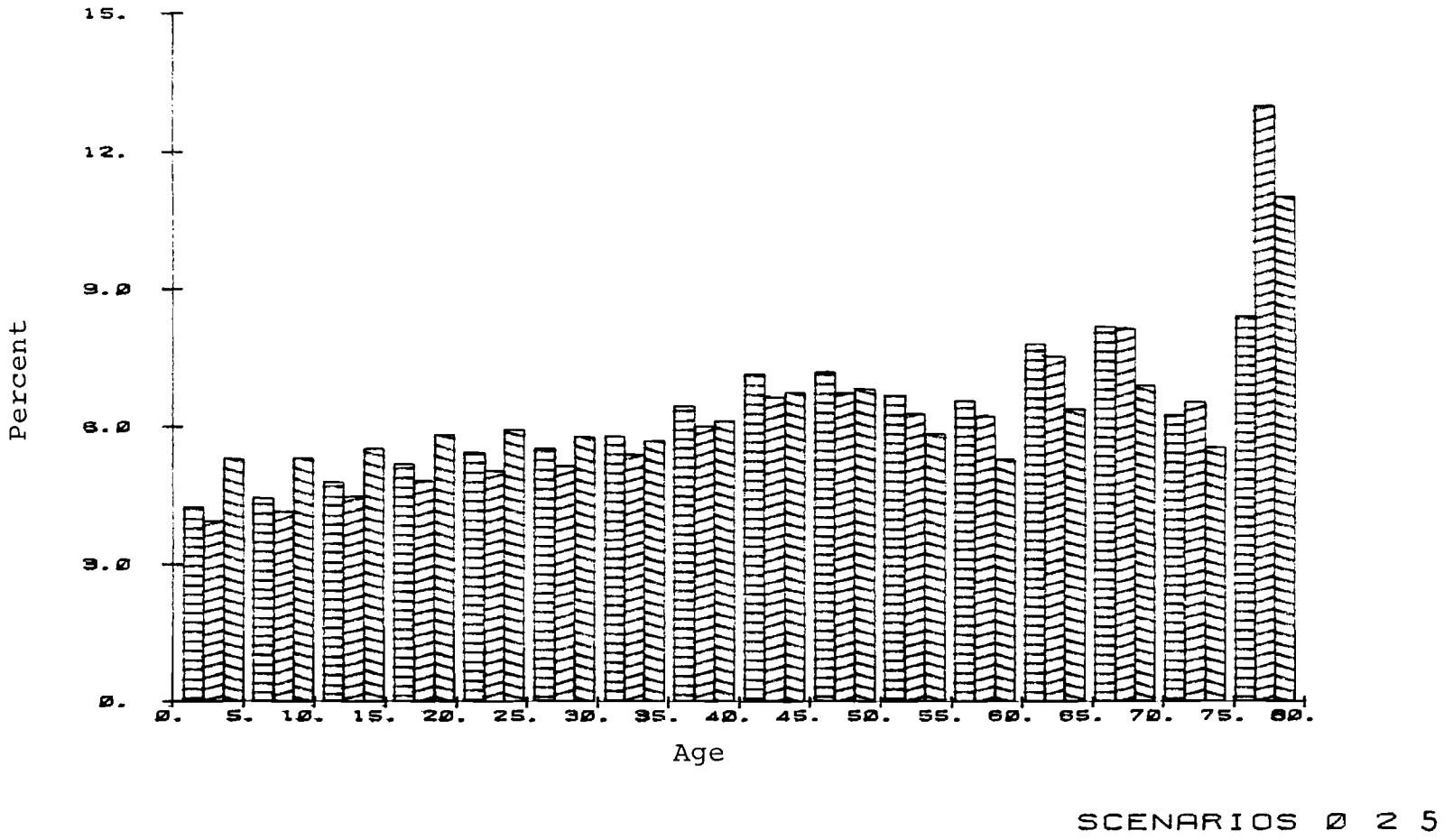

Figure 7. Age structure of the total population of the GDR, 2030.

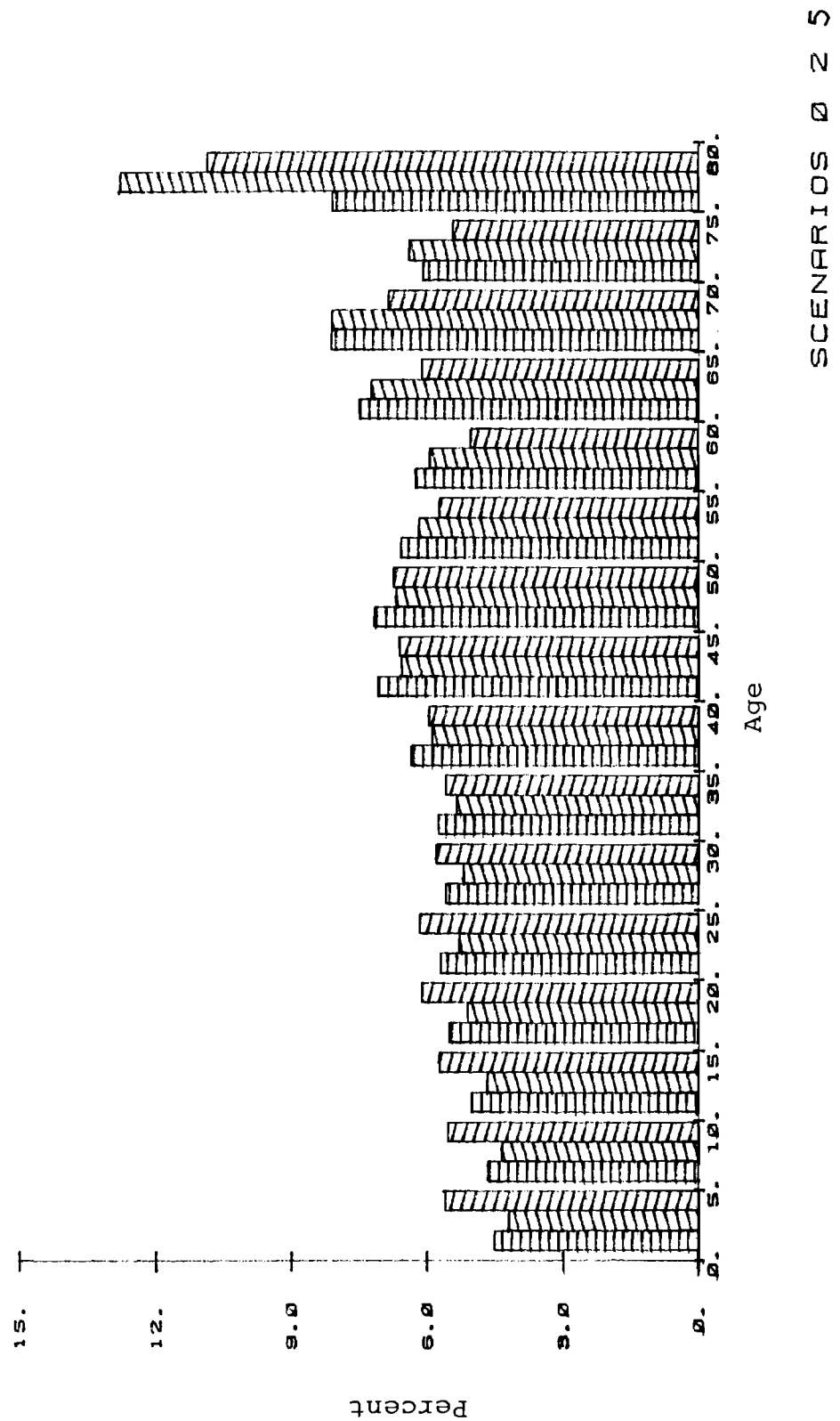

Figure 8. Population age structure of the North region, 2030.

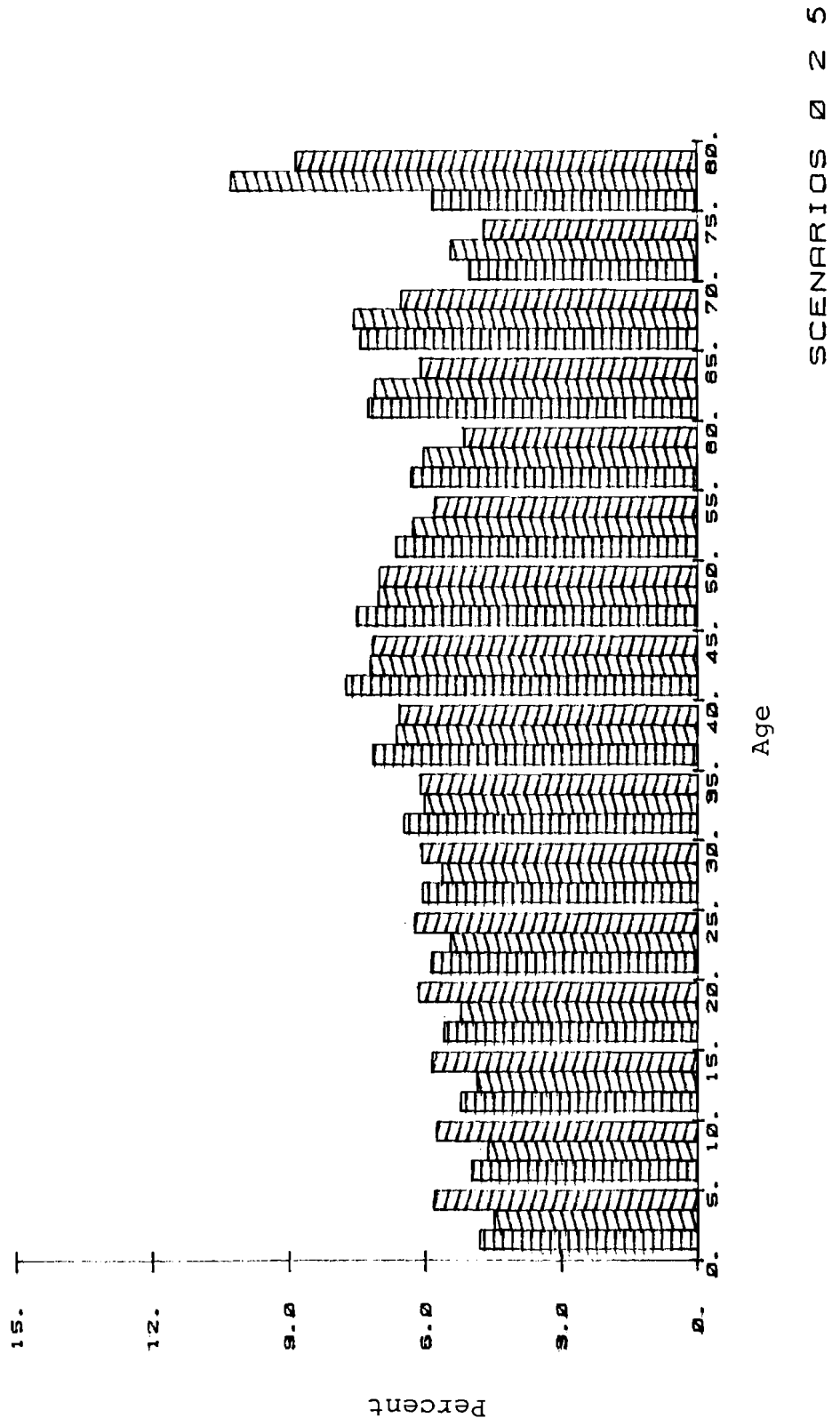

Figure 9. Population age structure of the Berlin region, 2030.

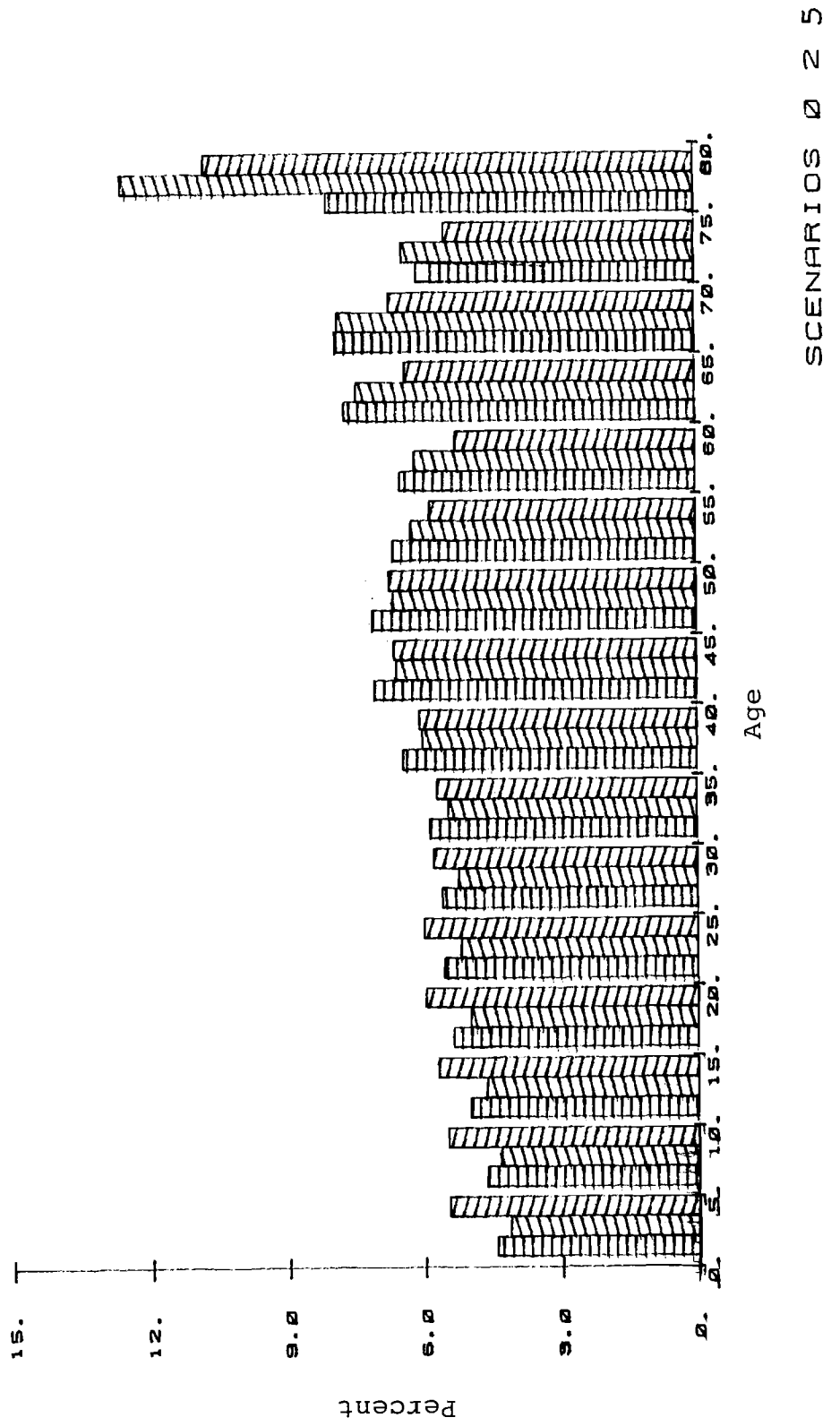

Figure 10. Population age structure of the Southwest region, 2030.

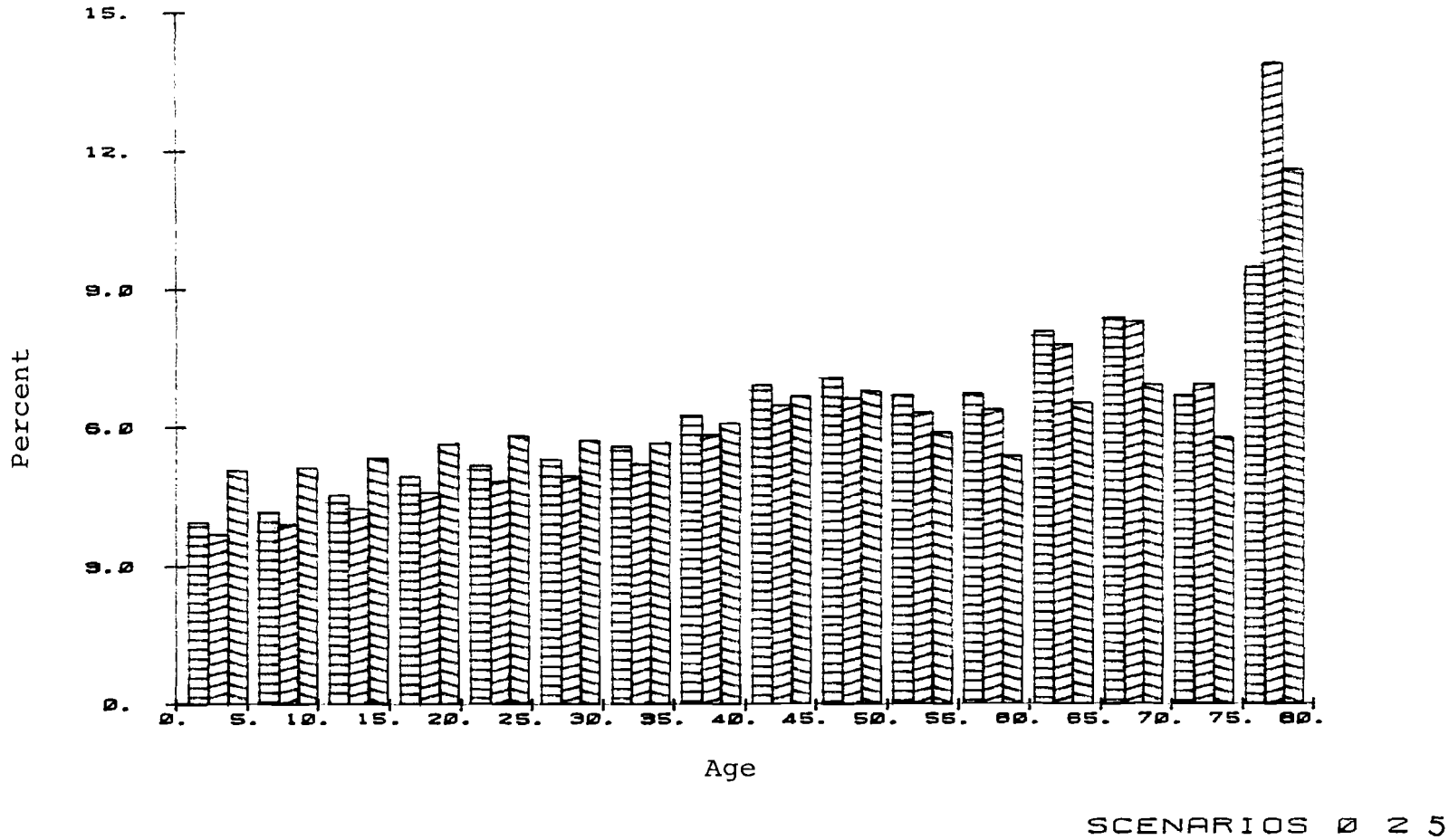

Figure 11. Population age structure of the South region, 2030.

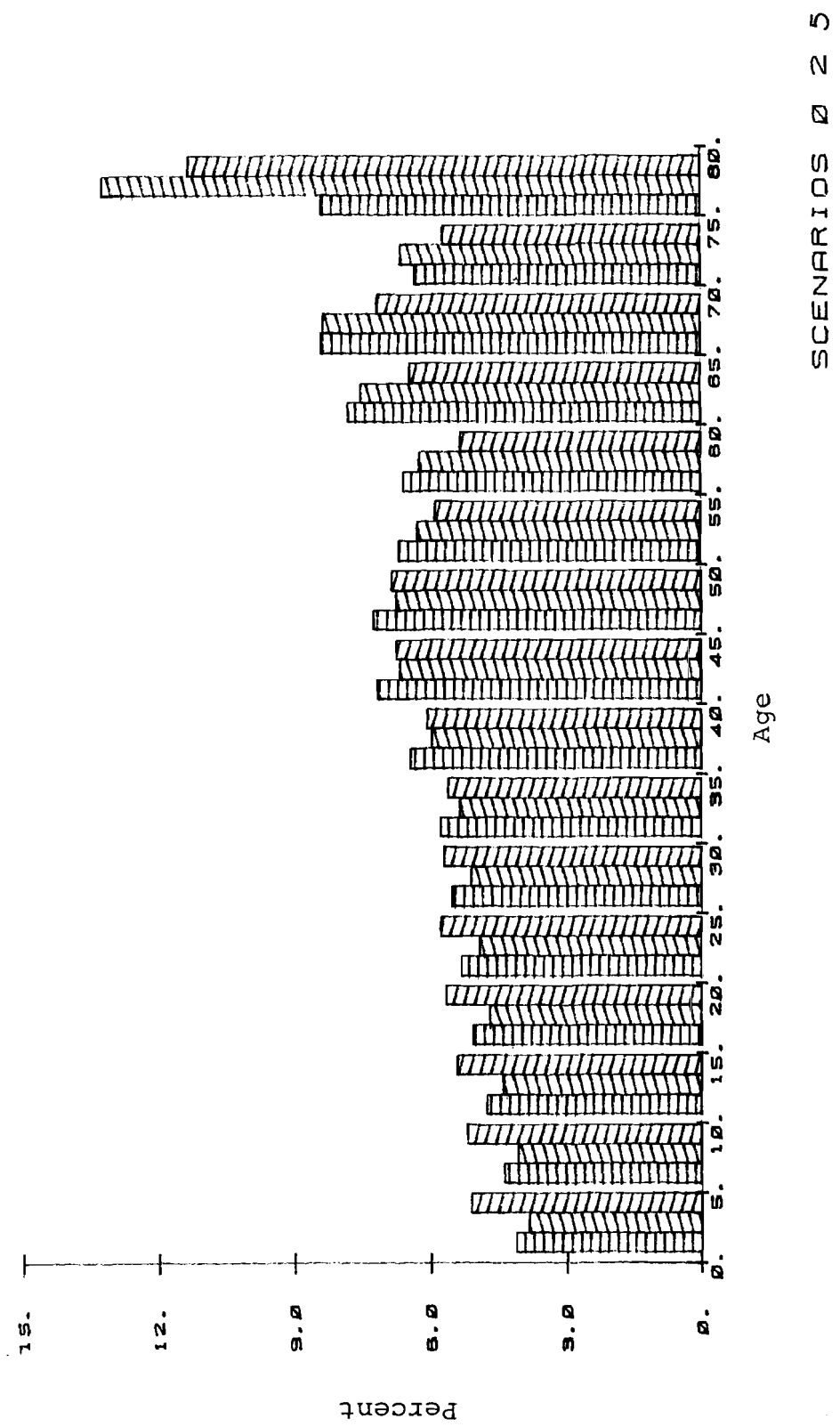

Figure 12. Population age structure of the Middle region, 2030.

The results of the base run are important to see what will happen in the future if the observed rates remain stable. During the second half of the 1970s, however, a large rise in the fertility rate in all regions took place; thus the projected values of the base run are underestimated. This will be seen later in the comparison of the projected and real values for 1980 between all scenarios.

Scenario 1

Here the assumption is that the regional fertility rates will increase to the average of the country in 1980 and then will remain constant during the whole projection period. There will be no change in the mortality and migration rates. The assumption that fertility rates will be nearly stable after the increase in the second half of the 1970s is also made in the population projection of the State Planning Commission (Stempell and Weber 1978).

The increase of fertility rates leads to quite different results when compared with the base run. In Scenario 1, to the year 2000 there is only a small decline of the total GDR population, but in the second half of the projection period it drops to a much lower figure than in the base run (Table 10). This sharp decrease can be explained also by the changing age structure (see above). The regional differentiation is lower, and except for the South region, all other regions are expected to have a population gain until 2000. The population gain of Berlin is higher than in the base run because of the higher fertility rates and a higher number of inmigrants.

The mean age of population is expected to increase by about three years. The regional differences sharply decline (Table 11), but the mean age of Berlin's population will increase only by one year. Because of the continuous migration gain, the capital will have the lowest mean age at the end of the projection period.

Table 10. Total population change by region, 1975-2030, Scenario 1.

Region	Total population (in thousands)			Absolute change (in thousands)		Change (in percent)	
	1975	2000	2030	1975-2000	1975-2030	1975-2000	1975-2030
North	2,085	2,172	2,083	+87	-2	+4.2	-0.1
Berlin	1,098	1,416	1,681	+308	+583	+29.0	+53.1
Southwest	2,530	2,585	2,508	+55	-22	+2.2	-0.9
South	7,135	6,552	5,821	-583	-1314	-8.2	-18.4
Middle	3,972	4,083	3,969	+111	-3	+2.8	-0.1
GDR	16,820	16,809	16,063	-11	-757	-0.1	-4.6

Table 11. Mean age of the population by region, 1975-2030, scenario 1.

Region	Mean age		
	1975	2000	2030
North	34.56	36.78	39.72
Berlin	37.12	36.09	38.08
Southwest	36.69	37.59	39.60
South	38.36	38.90	40.43
Middle	36.15	37.43	39.78
Total	37.03	37.83	39.80

In spite of a higher fertility rate, the share of persons in the pre-labor force age group is decreasing. As in the base run the percentage of persons in the labor force age group is expected to increase until the end of this century and then a large drop will occur. In connection with this, the share of the elderly population (post-labor force ages) can be expected to be higher than at the beginning of the period (Table 12).

Table 12. Percentage of population in the three main age groups of the GDR population, 1975-2030, scenario 1.

Age group	1975	2000	2030
Pre-labor force age	21.3	19.4	18.2
Labor force age	62.4	67.4	63.6
Post-labor force age	16.3	13.2	18.2

Only the values for the South region are below average in the pre- and labor force ages and above average in the elderly group.

Scenario 2

Here a change of the gross death rate is assumed from 1.3 (1975) to 0.9 (2030) and rates of fertility and migration remain stable. Because of the stable fertility rates, scenario 2 generates a remarkable population loss in all regions except Berlin (Table 13). The lower death rates bring about a smaller population loss in all regions than in the base run, however. The expected development causes an average shift of the mean age by nearly 10 years and of the life expectancy by more than 5 years (Table 14).

The age structure of the population, given in Figures 7-12 in comparison with the two other scenarios, shows for scenario 2 the lowest percentage values until the age group 45-50 years and the highest values in the age groups above 65 years. This results in a remarkable shift between the three main age groups during the projection period (Table 15).

The regional differentiation is similar to the base run.

Scenario 3

In this scenario fertility and mortality rates are expected to remain stable, as well as the inmigration rates to Berlin. This is based on the assumption that Berlin will continue to be the main center for investment activities in the future. On the other hand a trend from long distance migration to short distance migration has been evident in the past, and it is assumed that this tendency will also continue in the future. Thus the out-migration rates of all regions are expected to decline by 10 percent until the end of the projection period.

Because fertility and mortality rates will remain stable, scenario 3 leads to a population loss for the whole country by more than 4 million people until 2030, as in the base run (Table 16).

Table 13. Total population change by region, 1975-2030, scenario 2.

Region	Population (in thousands)			Absolute change (in thousands)		Change (in percent)	
	1975	2000	2030	1975-2000	1975-2030	1975-2000	1975-2030
North	2,085	2,084	1,861	-1	-224	-0.05	-10.8
Berlin	1,098	1,359	1,476	+261	+378	+23.8	+34.4
Southwest	2,530	2,474	2,197	-56	-333	-2.3	-13.2
South	7,135	6,213	4,941	-922	-2194	-13.0	-30.8
Middle	3,972	3,867	3,412	-105	-560	-2.7	-14.1
Total	16,820	15,997	13,888	-823	-2932	-4.9	-17.4

Table 14. Mean age of population/life expectancy by region, 1975-2030, scenario 2.

Region	Mean age			Life expectancy		
	1975	2000	2030	1975	2000	2030
North	34.56	38.74	45.65	71.31	73.71	76.87
Berlin	37.12	38.00	43.88	71.13	73.67	77.12
Southwest	36.69	39.74	45.66	71.69	73.98	76.99
South	38.36	41.41	47.22	72.01	74.18	76.98
Middle	36.15	39.85	46.58	71.39	73.77	76.91
Total	37.03	40.14	46.25	71.51	73.86	76.97

Table 15. Percentage of population in the three main age groups of the GDR, 1975-2030, scenario 2.

Age group	1975	2000	2030
Pre-labor force age	21.3	16.0	12.6
Labor force age	62.4	68.8	59.8
Post-labor force age	16.3	15.2	27.7

Table 16. Total population change by region, 1975-2030, scenario 3.

Region	Total population (in thousands)			Absolute change (in thousands)		Change (in percent)	
	1975	2000	2030	1975-2000	1975-2030	1975-2000	1975-2030
North	2,085	1,996	1,558	-89	-527	-4.3	-25.3
Berlin	1,098	1,349	1,398	+251	+300	+22.9	+27.3
Southwest	2,530	2,430	2,022	-100	-508	-4.0	-20.1
South	7,135	6,113	4,582	-1022	-2553	-14.4	-35.8
Middle	3,972	3,842	3,235	-130	-737	-3.3	-18.6
Total	16,820	15,730	12,795	-1090	-4025	-6.5	-24.0

With respect to the population development of the five regions, the North region has a higher population loss in scenario 3 than in the base run. With a general decline of the outmigration rates in all regions the net migration balance of the North region tends to be worse in comparison with the other regions. This is a result of the higher mobility of the younger population of the North region than of the South and Middle regions, which have an older population and the strongest migration ties with the North region (Table 17).

Table 17. Migration flows between the North, South, and Middle regions, 1975 and 2030, scenario 3.

To \ From	1975			2030		
	North	South	Middle	North	South	Middle
North	-	5,473	5,511	-	2,512	317
South	4,228	-	10,071	2,167	-	5,875
Middle	6,773	15,069	-	3,572	7,010	-

Migration change also influences the regional differences of the mean age of the population. It can be seen that the highest mean age increase is expected in the North region and the lowest in Berlin (Table 18), which results in a more equal regional mean age.

The composition of the three main age groups of scenario 3 is similar to that of the base run with a small shift to the older age groups in the North region.

Table 18. Mean age of the population by region, 1975-2030, scenario 3.

Region	Mean age		
	1975	2000	2030
North	34.56	38.53	44.07
Berlin	37.12	37.47	41.48
Southwest	36.69	39.24	43.59
South	38.36	40.90	45.23
Middle	36.15	39.24	44.12
Total	37.03	39.64	44.14

Scenario 4

In scenario 4 fertility is expected to increase to a national average of 0.95 by 1980 in all regions and to be stable in the following period. It should be mentioned that this assumption takes into account the fertility rate of the South region, which was below the national average and those of the North and Berlin regions, which were above the national average. Thus the projected values for the South region might be overestimated.

With respect to mortality a decline of the gross death rate to 1.0 until 2000 is assumed, with the death rate remaining stable in the second half of the projection period. Migration rates remain stable throughout.

The decline of the death rate leads to an increase of the average life expectancy to 75.4 years for the whole country with only low regional differences.

According to this scenario, the GDR will have a low population growth after the year 1980 to a peak in 2015 of 17.6 million people, followed by a decline with the higher share of population being in the older age groups (Table 19).

Table 19. Total population change by region, 1975-2030, scenario 4.

Region	Total population (in thousands)			Absolute change (in thousands)		Change (in percent)	
	1975	2000	2030	1975-2000	1975-2030	1975-2000	1975-2030
North	2,085	2,232	2,220	+147	+135	+7.1	+6.5
Berlin	1,098	1,458	1,794	+360	+696	+32.8	+63.4
Southwest	2,530	2,661	2,656	+131	+126	+5.2	+5.0
South	7,135	6,734	6,133	-401	-1002	-5.7	-14.0
Middle	3,972	4,202	4,225	+230	+253	+5.8	+6.4
Total	16,820	17,287	17,029	+467	+209	+2.8	+1.2

In scenario 4, the South region shows the lowest population loss in comparison with all previous scenarios. Nevertheless, although the fertility increase is overestimated, the population loss is primarily a result of the high negative migration balance and the above-average share of the older population. This result emphasizes the necessity of a change in the population distribution policy that would benefit the South region in the future. On the other hand the capital of Berlin will have a population gain by about 700,000 people, which is much more than the present population of Leipzig.

Although fertility is expected to increase, the replacement level will not be reached. Scenario 4 leads, together with a higher life expectancy (75.4 years), to an increase of the mean age but at a lower pace than in the previous scenarios. The regional differences are expected to diminish (Table 20).

Table 20. Mean age of the population by region, 1975-2030, scenario 4.

	Mean age		
Region	1975	2000	2030
North	34.56	37.62	41.42
Berlin	37.12	36.99	39.86
Southwest	36.69	38.50	41.15
South	38.36	39.75	41.83
Middle	36.15	38.32	41.45
Total	37.03	38.70	41.37

The percentages of the three main age groups up to 2030 are given in Table 21. Although the fertility rate will be much higher in 2030 than in 1975, a continuous decrease of the share of children will take place in all regions. The principal evolution of the two other age groups is similar to the previous scenario.

Table 21. Percentage of population in the three main age groups of the GDR, 1975-2030, scenario 4.

Age group	1975	2000	2030
Pre-labor force age	21.3	19.0	17.4
Labor force age	62.4	66.0	61.1
Post-labor force age	16.3	15.0	21.5

Scenario 5

Scenario 5 includes changes in all components. The fertility rate is expected to increase by 20 percent until 1980 and tends to be stable beyond that year. This assumption excludes the overestimation of the natural growth in regions with below-average fertility rates (South region). The death rate will decrease in the same way as in scenario 2.

With regard to migration the gross inmigration rates to Berlin are expected to be stable until 1990 and then will decline by 20 percent from all regions until 2030. To diminish the population loss of the South, a 20 percent inmigration rate to this region from 1985 to 2030 is assumed. In accordance with the change from long-distance to short-distance migration, a 20 percent decline of the gross migraproduction rate can be expected in the large regions by 2030. For Berlin the GMR is expected to be stable, because Berlin has strong interrelations with its hinterland, and the suburbanization process, which can actually be observed in its initial stage, might continue in the future.

The total population development shows nearly zero growth until 2015 and then a decline (Figure 13). This decline results above all from the high number of persons in the oldest age groups, who were born in the two post-war decades. In this scenario the total population loss is higher than in scenario 4 because here the regional differentiation of natural increase was taken into account.

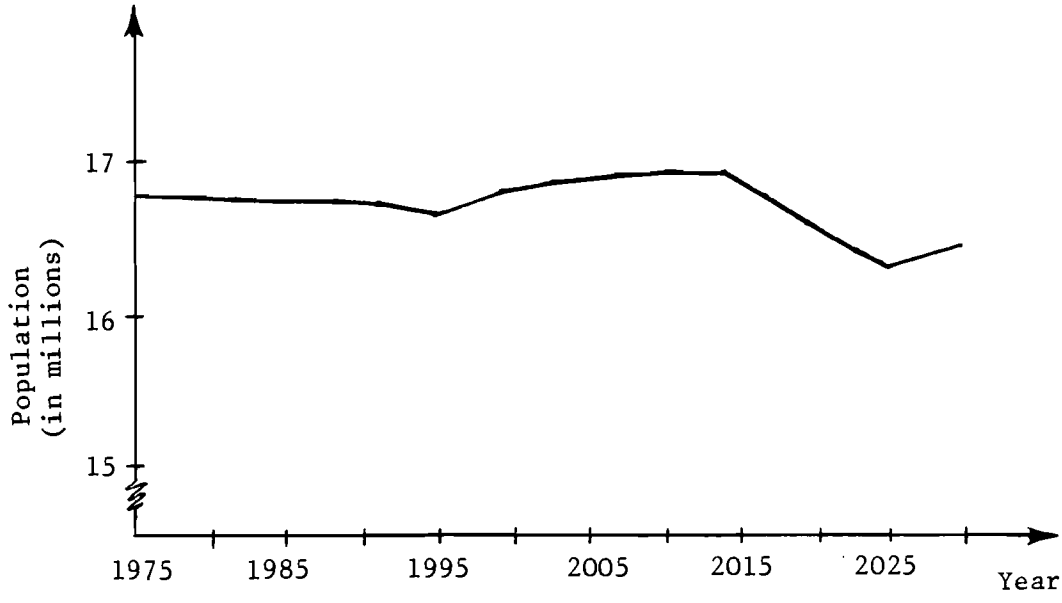

Figure 13. Development of the GDR population, 1975-2030, scenario 5.

The assumed change of migration patterns leads to a different population development of the regions (Table 22). Although an inmigration increase to the South region is assumed, a considerable population loss for this region is evident. It is higher than in scenario 4 with its stable migration rates. The main reason for this is the overestimation of fertility in this region in scenario 4. The changing migration patterns are illustrated in Figure 14. Although inmigration to the South region shows a continuous increase, it does not outweigh outmigration until 2020. In addition, natural increase never is positive during the entire projection period.

The migration gain of Berlin is expected to decrease continuously. At the end of the period it becomes smaller than the gain of the South region. Along with the favorable inmigration to the South region, scenario 5 projects a less favorable migration balance in all other regions. Nevertheless, the total population development of Berlin is positive because of natural increase. This holds true especially for the North region with its continuous negative net migration balance.

Table 22. Total population change by region, 1975-2030, scenario 5.

Region	Total population (in thousands)			Absolute change (in thousands)		Change (in percent)	
	1975	2000	2030	1975-2000	1975-2030	1975-2000	1975-2030
North	2,085	2,194	2,184	+109	+99	+5.2	+4.7
Berlin	1,098	1,428	1,679	+330	+581	+30.1	+52.9
Southwest	2,530	2,597	2,543	+67	+13	+2.6	+0.5
South	7,135	6,524	5,982	-611	-1153	-8.6	-16.4
Middle	3,972	4,080	3,979	+108	+7	+2.7	+0.2
Total	16,820	o6,823	16,370	+3	-450	+0.0	-2.7

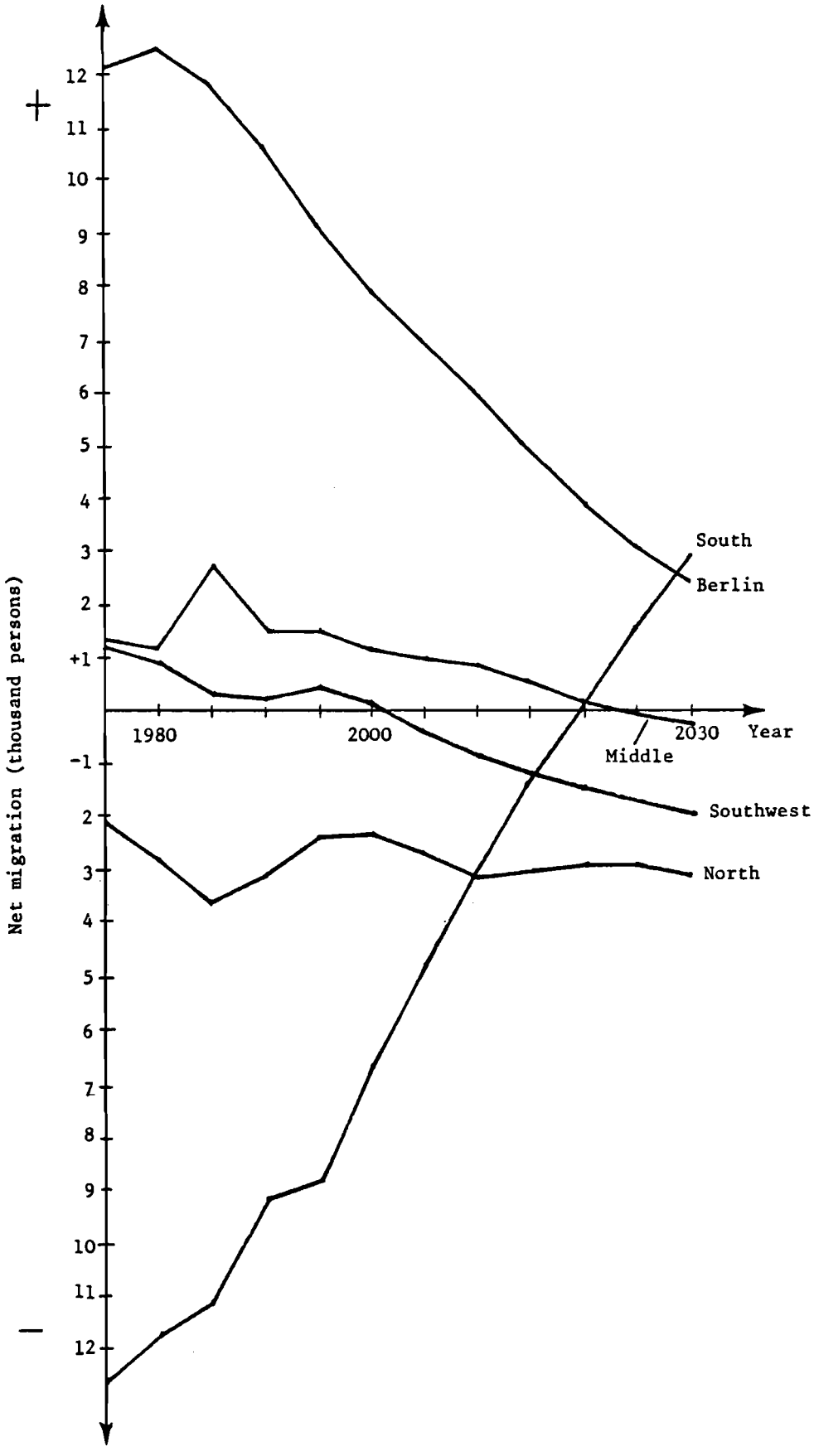

Figure 14. Change of net migration balance by region, 1975-2030, scenario 5.

The regional population development in scenario 5 will lead to an increase of the mean age of population to 42.7 years on the average, with the highest value being in the South region (43.8 years) and the lowest in Berlin (40.8).

From these results the following conclusions can be drawn:

1. The assumed increase of inmigration to the South region leads to a positive net migration balance beginning in 2020. A considerable change in the South's labor force age group requires a more extensive redistribution of the population at an earlier stage.

2. The natural increase of the population in the South region has to be improved. This can be accomplished by higher investments in infrastructural sectors, which further improve living conditions and support an increase in the fertility rate.

Scenario 6

Based on the conclusions of scenario 5, the special aim of this scenario is to decrease the population loss of the South region. Therefore it is assumed that besides the general growth of the fertility rates until 1980, a further growth will occur in the South and Middle regions, those with the lowest fertility rates, to equalize the regional fertility rates until 1990. The same assumption for mortality is used as in scenario 5. To improve the migration balance of the South region, the inmigration rates to the South from all regions should increase by 30 percent from 1985 to 2000 and then remain stable. On the other hand the outmigration rates from the South should decrease by 20 percent during the same period.

From Table 23 it can be seen that the population loss of the South region is comparatively lower in scenario 6 than in all other scenarios. Nevertheless the decrease of the total population of the GDR is a result of the population loss of the South region, because all other regions register a population gain.

Table 23. Total population change by region, 1975-2030, scenario 6.

Region	Total population (in thousands)			Absolute change (in thousands)		Change (in percent)	
	1975	2000	2030	1975-2000	1975-2030	1975-2000	1975-2030
North	2,085	2,191	2,177	+106	+92	+5.1	+4.4
Berlin	1,098	1,421	1,663	+323	+565	+29.4	+51.4
Southwest	2,530	2,591	2,530	+61	±0	+2.4	±0
South	7,135	6,568	6,209	-567	-926	-7.9	-15.6
Middle	3,972	4,079	4,018	+107	+46	+2.6	+1.2
GDR	16,820	16,851	16,597	+31	-223	+0.2	-1.4

The population loss of the South region is a result of both a long-term negative migration balance and negative natural increase rates. Despite a considerable increase in inmigration rates and a decrease in outmigration rates assumed in scenario 6 for the South region, a positive migration balance will not appear until the end of the projection period (Figure 15). The natual increase will be negative during the whole projection period despite the initial increasing fertility rates (Figure 16).[2] On the contrary, the Berlin region has a positive migration balance until 2030 and a substantially favorable natural increase rate (Figure 17).

The increase in the mean age of the population is somewhat smaller than in scenario 5, which has more equality between regions (Table 24). The fast increase of the mean age in the second half of the projection period is connected with the changing age structure of the population. The post-war baby boom (those born before 1965), will come into the post-labor force age group in 2030. This large birth cohort reflects the changing proportions of the three main age groups (Table 25).

The share of persons in the labor force ages is greatest between 1985 and 1995. The Middle region has the least percentage of this main age group because of its strong migration connections to Berlin and the South region, whose inmigration rates are growing in this scenario. In general the change is similar to most of the other scenarios.

With respect to the main aim of scenario 6, the improvement of population development especially in the South region, the following conclusion can be drawn:

By increasing the fertility rate and considerably reorienting migration flows to benefit the South region, a lower population loss of this region can be reached in comparison with the previous scenarios. But since the population loss amounts to more than 900,000 persons before 2030, a stronger population redistribution policy would be necessary to solve the labor force problem in the future. This seems to be possible from

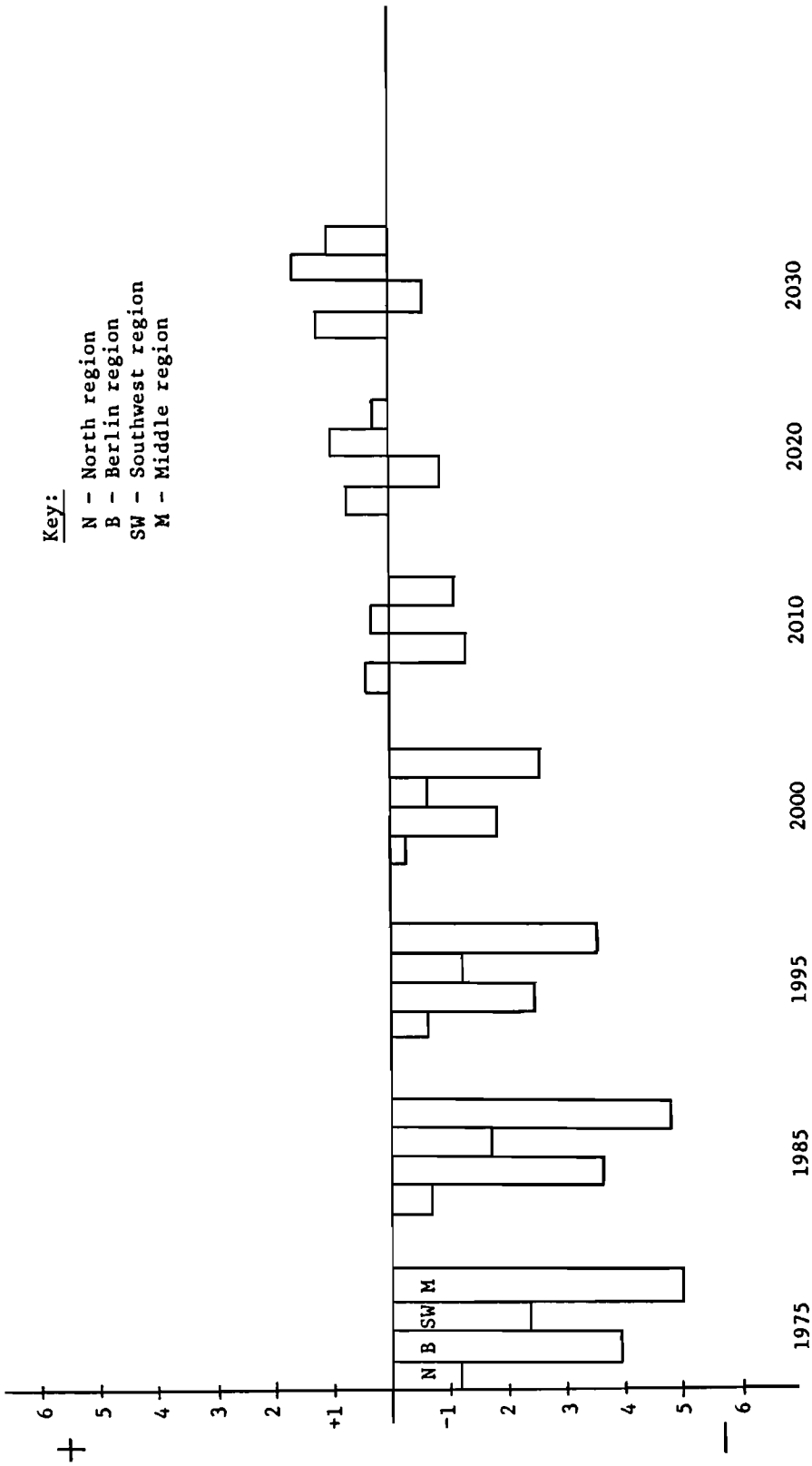

Figure 15. Net migration balance between the South region and all other regions, scenario 6.

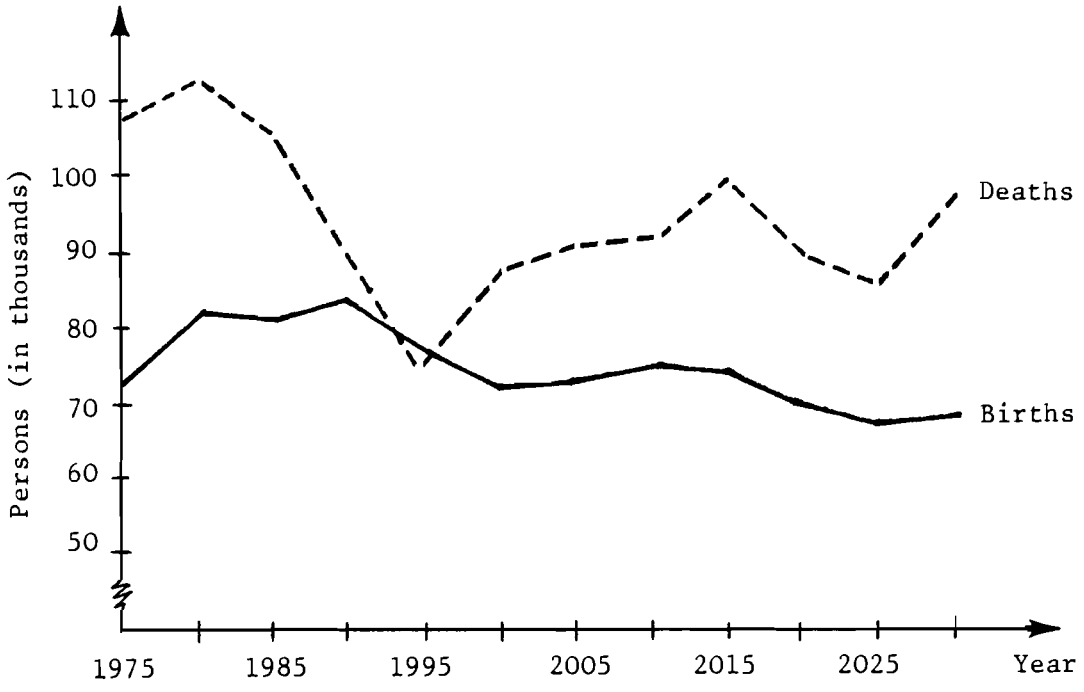

Figure 16. Births and deaths in the South region, 1975-2030 (in thousand persons), scenario 6.

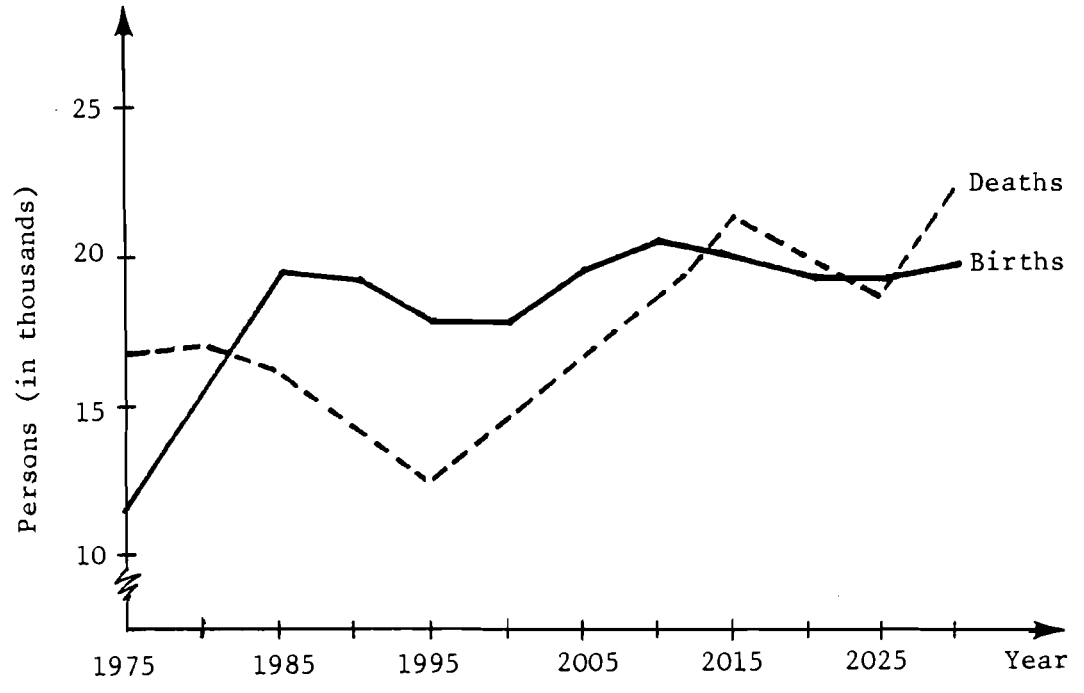

Figure 17. Births and deaths in the Berlin region, 1975-2030 (in thousand persons), scenario 6.

Table 24. Mean age of population by region, 1975-2030, scenario 6.

Region	Mean age		
	1975	2000	2030
North	34.56	37.32	42.11
Berlin	37.12	36.68	40.80
Southwest	36.69	38.36	42.32
South	38.36	39.82	42.56
Middle	36.15	38.35	42.75
GDR	37.03	38.65	42.33

the pure demographic/geographic point of view, because all other regions, especially Berlin, have an increasing population and a more favorable age structure (except the Middle region at the end of the period). It is urgent that this problem be solved, because despite a high percentage share of the labor force in the year 2000 the total number of persons in this age group will be continuously decreasing from 4.4 million (1975) to 4.3 million (2000) and 3.7 million (2030). The chances of increasing fertility above the projected level seem smaller than reorienting the migration flows to the benefit of the South region, more so even than assumed in this scenario. Such a policy is connected with many economic, environmental, and individual problems of the migrants that are too numerous to be discussed in this paper. That a planned economy has all possibilities for such a policy has been demonstrated in the GDR in the past by many examples (see Mohs 1980).

General Assessment of the Scenarios and Their Results

The base run and the six scenarios treated in this paper are based on different changes in the components of population development, i.e., fertility, mortality, and migration. The

Table 25. Percentage of the population in the three main age groups by region, 1975-2030, scenario 6.

	Region																	
	North			Berlin			Southwest			South			Middle			GDR		
Year	PrA	LA	PoA	PrA	LA	PoA	PrA	LA	PoA	PrA	LA	PoA	PrA	LA	PoA	PrA	LA	PoA
1975	24.0	62.5	13.5	21.3	62.6	16.1	21.6	62.9	15.5	20.0	62.1	17.9	22.4	62.3	15.3	21.3	62.4	16.3
2000	19.8	57.2	13.0	10.1	69.0	10.9	19.1	66.8	14.2	18.0	65.9	16.1	19.0	67.2	13.8	18.8	66.8	14.4
2030	17.0	59.9	23.1	17.5	62.3	20.2	16.7	60.3	23.0	16.5	59.9	23.5	16.4	59.7	23.9	16.7	60.2	23.1

PrA = Pre-labor force age
LA = Labor force age
PoA = Post-labor force age

observed initial data are from 1975 and for a first assessment of all scenario results it is possible to compare the projected values for 1980 with observed data for this time (Table 26).

It is evident that the projected values of scenarios 1, 5, and 6 have the best fit with the observed values both for the whole country and for the regions. In the base run and scenarios 2 and 3 an underestimation can be observed, because they deal with the low fertility rates of 1975 over the whole period. On the other hand scenario 4 shows an overestimation, because fertility is expected to increase to a unit level of 0.95 in 1985, which is true for the North and Berlin regions but is too high for the other regions.

Comparison with the values for 1980 shows that the last two scenarios and the base run give the closest fit to possible development under unchanged conditions. This has been done in the previous sections.

In all scenarios that assume increasing fertility rates, these rates remained stable after 1980 (except in the case of the Middle and South regions). This assumption was also made in the population projection by the State Planning Commission. Note that currently the GDR population does not reach the replacement level, which is true for most of the developed countries.

On the other hand in some scenarios the death rates are expected to decrease to a level that leads to a life expectancy at birth of 75-77 years in 2030, a result of the improvement of health care and other living conditions which is a general aim of the socialist society. It was already mentioned that the GDR belongs to the group of countries having an extremely low infant mortality rate and small regional differences in death rates.

With regard to migration it is assumed that:

1. Berlin will be an important location for investment activities in the future, at least until 1990, which is also in accordance with the government program.

Table 26. Comparison between the observed and projected values for 1980, for all scenarios.

	Regions					
	GDR	North	Berlin	Southwest	South	Middle
Observed population in 1980	16,739,538	2,100,594	1,152,529	2,529,009	6,981,660	3,975,746
Projected population by						
I. Base run	16,641,906	2,086,653	1,142,995	2,519,815	6,947,690	3,944,753
deviation in %	-0.60	-0.67	-0.87	-0.36	-0.49	-0.78
II. Scenario 1	16,762,373	2,099,871	1,149,479	2,536,284	7,000,616	3,976,123
deviation in %	+0.13	-0.05	-0.35	+0.25	+0.27	+0.01
III. Scenario 2	16,666,322	2,089,343	1,144,974	2,523,425	6,958,233	3,950,447
deviation in %	-0.45	-0.58	-0.61	-0.24	-0.34	-0.66
IV. Scenario 3	16,641,898	2,084,277	1,143,400	2,519,658	6,948,071	3,946,493
deviation in %	-0.59	-0.81	-0.87	-0.36	-0.49	-0.76
V. Scenario 4	16,803,198	2,104,488	1,152,867	2,542,383	7,017,596	3,985,865
deviation in %	+0.37	+0.14	+0.01	+0.51	+0.52	+0.25
VI. Scenario 5	16,758,101	2,101,165	1,151,352	2,536,753	6,993,741	3,975,089
deviation in %	+0.10	+0.02	-0.18	+0.31	+0.17	-0.02
VII. Scenario 6	same values as in scenario 5					

This is connected with a further attraction of migrants from all regions and is expressed by its growing population in all scenarios.

2. The existing lack of labor force age groups, above all in the highly developed South region, requires measures for both an increase of the fertility rate, at least to the present national average (scenario 6), and a reorientation of the actual migration flows to the South region. The results of scenarios 5 and 6 show that the measures have to be much stronger than assumed here, to reach an essential change until the end of this century.

3. In accordance with recent migration patterns, in general a further decrease of migration flows can be expected between the large five regions. This results from a tendency to short-distance migration and also from the changing age structure of the population, which has a decreasing number of persons in the high mobility age groups.

5. CONCLUSIONS

In this paper the simulation package of multiregional population projections, available at IIASA, is applied to population projections of the five large regions of the GDR, which are the regions used for long-term territorial planning. Information about future population development and regional distribution tendencies are essential for adequate planning. In this sense multiregional population projections with different scenarios may contribute to the improvement of planning proposals. The possibility of changing demographic rates greatly improves the multiregional population projections that use only stable rates, which were the ones applied in all comparative studies of the NMOs. In the same way possible different territorial and economic strategies that influence regional population distributions, age structures, and growth can be studied.

This paper gives the results for a projection with stable rates as well as with changed rates. In nearly all scenarios the total population of the GDR is expected to decline. The main reason for this is that the country does not reach the replacement level, despite the high increase of the fertility rate in the second half of the 1970s. A further scenario could deal with a considerable increase of fertility.

It could be shown that the main contributor to the population loss of the country would be the densely populated South region with its continuous negative natural increase rate and its high migration loss. The problems of this region and possible changes are discussed in several scenarios.

In future work it will be necessary to study changing migration patterns within large regions, because two-thirds of all migrations occur within the districts. They have a great influence on population redistribution between different settlement-size groups. The main problem of this task is the availability of detailed statistical data (for instance, the differentiation by age groups) for small regional units.

The simulation model used in this paper is an important tool to study a multiregional population system. Few suggestions can be made in order to improve the model. The first one is that there should be an option to deal with both sexes simultaneously. The second one is that the variable gross death rate should not be taken as a scenario variable. That is because the GDR is much more affected by death rates in older age groups than in younger ones. Therefore it would be better to use another scenario variable instead of growth death rates, such as, for example, life expectancy.

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APPENDIX A1: OBSERVED POPULATION CHARACTERISTICS (1975)

region North

age	population	births	deaths	migration from North to North	Berlin	Southwes	South	Middle		
0	130449.	0.	519.	0.	337.	247.	532.	865.	0.	0.
5	164503.	0.	76.	0.	188.	139.	298.	488.	0.	0.
10	204645.	1.	51.	0.	130.	126.	225.	499.	0.	0.
15	189898.	5100.	167.	0.	270.	191.	417.	598.	0.	0.
20	188590.	13550.	196.	0.	876.	615.	1364.	1933.	0.	0.
25	116643.	4452.	119.	0.	421.	211.	491.	742.	0.	0.
30	124046.	1896.	172.	0.	228.	128.	304.	450.	0.	0.
35	163270.	887.	313.	0.	150.	91.	201.	369.	0.	0.
40	140364.	196.	423.	0.	75.	50.	111.	213.	0.	0.
45	117915.	3.	501.	0.	51.	31.	71.	142.	0.	0.
50	96209.	0.	676.	0.	31.	18.	42.	92.	0.	0.
55	66299.	0.	651.	0.	11.	6.	23.	53.	0.	0.
60	95490.	0.	1765.	0.	34.	20.	35.	65.	0.	0.
65	100051.	0.	3033.	0.	35.	23.	38.	95.	0.	0.
70	84113.	0.	4544.	0.	22.	12.	29.	54.	0.	0.
75	97898.	0.	12783.	0.	38.	21.	47.	115.	0.	0.
total	2085383.	26085.	25989.	0.	2897.	1929.	4228.	6773.	0.	0.

region Berlin

age	population	births	deaths	migration from Berlin to North	Berlin	Southwes	South	Middle		
0	62653.	0.	221.	108.	0.	56.	135.	481.	0.	0.
5	79009.	0.	30.	83.	0.	42.	103.	367.	0.	0.
10	92259.	2.	30.	99.	0.	82.	164.	359.	0.	0.
15	73156.	1428.	53.	105.	0.	67.	181.	315.	0.	0.
20	72651.	5451.	69.	216.	0.	137.	368.	643.	0.	0.
25	66688.	2840.	62.	132.	0.	62.	191.	406.	0.	0.
30	90215.	1426.	112.	87.	0.	54.	187.	443.	0.	0.
35	100196.	505.	164.	60.	0.	33.	115.	324.	0.	0.
40	76735.	89.	212.	36.	0.	21.	65.	193.	0.	0.
45	62934.	7.	287.	19.	0.	5.	32.	134.	0.	0.
50	48528.	0.	357.	11.	0.	12.	27.	84.	0.	0.
55	38995.	0.	453.	4.	0.	3.	19.	42.	0.	0.
60	56860.	0.	1171.	18.	0.	3.	14.	75.	0.	0.
65	64747.	0.	2194.	14.	0.	4.	14.	61.	0.	0.
70	52249.	0.	3005.	0.	0.	6.	14.	42.	0.	0.
75	60299.	0.	8338.	20.	0.	5.	18.	79.	0.	0.
total	1098174.	11748.	16758.	1021.	0.	592.	1647.	4048.	0.	0.

region Southwes

age	population	births	deaths	migration from Southwes to North	Berlin	Southwes	South	Middle		
0	147410.	0.	583.	162.	155.	0.	675.	334.	0.	0.
5	185894.	0.	72.	128.	123.	0.	530.	263.	0.	0.
10	212098.	4.	75.	97.	67.	0.	388.	180.	0.	0.
15	203787.	4777.	157.	227.	233.	0.	874.	461.	0.	0.
20	202382.	13731.	187.	446.	459.	0.	1718.	906.	0.	0.
25	153362.	5490.	113.	220.	331.	0.	875.	435.	0.	0.
30	158742.	3405.	221.	135.	146.	0.	503.	252.	0.	0.
35	197410.	1057.	330.	87.	88.	0.	303.	155.	0.	0.
40	153749.	200.	421.	43.	51.	0.	195.	99.	0.	0.
45	149926.	11.	514.	28.	49.	0.	146.	67.	0.	0.
50	139022.	0.	844.	23.	21.	0.	85.	42.	0.	0.
55	95091.	0.	889.	10.	8.	0.	36.	22.	0.	0.
60	137037.	0.	2407.	20.	19.	0.	72.	36.	0.	0.
65	141890.	0.	4360.	15.	10.	0.	82.	39.	0.	0.
70	118205.	0.	6325.	12.	8.	0.	60.	28.	0.	0.
75	133800.	0.	17446.	17.	22.	0.	113.	56.	0.	0.
total	2529805.	28675.	34944.	1670.	1790.	0.	6655.	3375.	0.	0.

region South

age	population	births	deaths	migration from South to North	Berlin	Southwes	South	Middle		
0	384605.	0.	1296.	583.	512.	902.	0.	1590.	0.	0.
5	485010.	0.	183.	452.	396.	701.	0.	1236.	0.	0.
10	554272.	8.	196.	327.	299.	553.	0.	887.	0.	0.
15	535508.	12342.	390.	839.	863.	1385.	0.	2345.	0.	0.
20	531815.	36299.	560.	1158.	1132.	1960.	0.	3181.	0.	0.
25	407753.	14537.	357.	727.	1008.	1187.	0.	1875.	0.	0.
30	466059.	6633.	555.	458.	531.	707.	0.	1184.	0.	0.
35	537937.	2607.	839.	268.	328.	448.	0.	785.	0.	0.
40	436263.	469.	1178.	183.	151.	298.	0.	498.	0.	0.
45	429621.	25.	1772.	126.	107.	187.	0.	314.	0.	0.
50	396536.	0.	2551.	75.	59.	129.	0.	228.	0.	0.
55	282475.	0.	2610.	35.	51.	65.	0.	124.	0.	0.
60	406848.	0.	7021.	69.	48.	101.	0.	162.	0.	0.
65	445774.	0.	12854.	55.	38.	104.	0.	190.	0.	0.
70	383328.	0.	19309.	50.	48.	93.	0.	188.	0.	0.
75	451037.	0.	56259.	68.	84.	183.	0.	282.	0.	0.
total	7134846.	72920.	107930.	5473.	5655.	9003.	0.	15069.	0.	0.

region Middle

age	population	births	deaths	migration from Middle to North	Berlin	Southwes	South	Middle		
0	232948.	0.	864.	620.	856.	302.	1036.	0.	0.	0.
5	293763.	0.	138.	468.	647.	229.	779.	0.	0.	0.
10	361577.	3.	147.	407.	532.	215.	692.	0.	0.	0.
15	327065.	7715.	280.	1209.	2000.	806.	2247.	0.	0.	0.
20	324810.	22286.	341.	812.	1357.	547.	1561.	0.	0.	0.
25	219846.	8127.	214.	657.	1185.	368.	1173.	0.	0.	0.
30	256253.	3451.	361.	437.	757.	220.	791.	0.	0.	0.
35	324814.	1549.	598.	314.	568.	153.	571.	0.	0.	0.
40	260360.	293.	761.	181.	315.	100.	332.	0.	0.	0.
45	229616.	10.	954.	103.	225.	57.	209.	0.	0.	0.
50	195077.	0.	1333.	69.	167.	40.	127.	0.	0.	0.
55	138687.	0.	1381.	30.	75.	18.	75.	0.	0.	0.
60	199906.	0.	3688.	33.	108.	35.	105.	0.	0.	0.
65	215871.	0.	6465.	50.	133.	28.	134.	0.	0.	0.
70	180240.	0.	9734.	48.	101.	32.	103.	0.	0.	0.
75	211208.	0.	27527.	73.	166.	60.	136.	0.	0.	0.
total	3972041.	43434.	54786.	5511.	9192.	3210.	10071.	0.	0.	0.

APPENDIX A2: AGE-SPECIFIC RATES (1975)

North

age	fertility	mortality	migration from North to North	Berlin	Southwes	South	Middle	abroad
0	0.	0.003979	0.	0.002533	0.001893	0.004078	0.006631	0.
5	0.	0.000462	0.	0.001143	0.000845	0.001812	0.002967	0.
10	0.000005	0.000249	0.	0.000635	0.000616	0.001099	0.002438	0.
15	0.026857	0.000879	0.	0.001422	0.001006	0.002196	0.003149	0.
20	0.071849	0.001039	0.	0.004645	0.003261	0.007233	0.010250	0.
25	0.038168	0.001020	0.	0.003609	0.001809	0.004209	0.006361	0.
30	0.015285	0.001387	0.	0.001838	0.001032	0.002451	0.003628	0.
35	0.005271	0.001960	0.	0.000891	0.000541	0.001195	0.002193	0.
40	0.001396	0.003014	0.	0.000534	0.000356	0.000791	0.001517	0.
45	0.000025	0.004249	0.	0.000433	0.000263	0.000602	0.001204	0.
50	0.	0.007026	0.	0.000322	0.000187	0.000437	0.000956	0.
55	0.	0.009819	0.	0.000166	0.000090	0.000347	0.000799	0.
60	0.	0.018484	0.	0.000356	0.000209	0.000367	0.000681	0.
65	0.	0.030315	0.	0.000350	0.000230	0.000380	0.000950	0.
70	0.	0.054023	0.	0.000262	0.000143	0.000345	0.000642	0.
75	0.	0.130575	0.	0.000388	0.000215	0.000480	0.001175	0.
total	0.794279	1.341894	0.	0.097888	0.063479	0.140100	0.227704	0.

Berlin

age	fertility	mortality	migration from Berlin to North	Berlin	Southwes	South	Middle	abroad
0	0.	0.003527	0.001724	0.	0.000894	0.002155	0.007677	0.
5	0.	0.000380	0.001051	0.	0.000532	0.001304	0.004645	0.
10	0.000022	0.000325	0.001073	0.	0.000889	0.001778	0.003891	0.
15	0.019520	0.000724	0.001435	0.	0.000916	0.002474	0.004306	0.
20	0.075030	0.000950	0.002973	0.	0.001886	0.005065	0.008851	0.
25	0.042586	0.000930	0.001979	0.	0.000930	0.002864	0.006088	0.
30	0.015807	0.001241	0.000964	0.	0.000599	0.002073	0.004910	0.
35	0.005040	0.001637	0.000599	0.	0.000329	0.001148	0.003234	0.
40	0.001160	0.002763	0.000469	0.	0.000274	0.000847	0.002515	0.
45	0.000111	0.004560	0.000302	0.	0.000079	0.000508	0.002129	0.
50	0.	0.007357	0.000227	0.	0.000247	0.000556	0.001731	0.
55	0.	0.011617	0.000103	0.	0.000077	0.000487	0.001077	0.
60	0.	0.020594	0.000317	0.	0.000053	0.000246	0.001319	0.
65	0.	0.033886	0.000216	0.	0.000062	0.000216	0.000942	0.
70	0.	0.057513	0.000172	0.	0.000115	0.000268	0.000804	0.
75	0.	0.138278	0.000332	0.	0.000083	0.000299	0.001310	0.
total	0.796379	1.431409	0.069677	0.	0.039815	0.111441	0.277148	0.

Southwes

age	fertility	mortality	migration from Southwes to North	Berlin	Southwes	South	Middle	abroad
0	0.	0.003955	0.001099	0.001051	0.	0.004579	0.002266	0.
5	0.	0.000387	0.000689	0.000662	0.	0.002851	0.001415	0.
10	0.000019	0.000354	0.000457	0.000316	0.	0.001829	0.000849	0.
15	0.023441	0.000770	0.001114	0.001143	0.	0.004289	0.002262	0.
20	0.067847	0.000924	0.002204	0.002268	0.	0.008489	0.004477	0.
25	0.035798	0.000737	0.001435	0.002158	0.	0.005705	0.002836	0.
30	0.021450	0.001392	0.000850	0.000920	0.	0.003169	0.001587	0.
35	0.005354	0.001672	0.000441	0.000446	0.	0.001535	0.000785	0.
40	0.001301	0.002738	0.000280	0.000332	0.	0.001268	0.000644	0.
45	0.000073	0.003428	0.000187	0.000327	0.	0.000974	0.000447	0.
50	0.	0.006071	0.000165	0.000151	0.	0.000611	0.000302	0.
55	0.	0.009349	0.000105	0.000084	0.	0.000379	0.000231	0.
60	0.	0.017565	0.000146	0.000139	0.	0.000525	0.000263	0.
65	0.	0.030728	0.000106	0.000070	0.	0.000578	0.000275	0.
70	0.	0.053509	0.000102	0.000068	0.	0.000508	0.000237	0.
75	0.	0.130389	0.000127	0.000164	0.	0.000845	0.000419	0.
total	0.776415	1.319837	0.047527	0.051496	0.	0.190669	0.096472	0.

South

age	fertility	mortality	migration from South to North	Berlin	Southwes	South	Middle	abroad
0	0.	0.003370	0.001516	0.001331	0.002345	0.	0.004134	0.
5	0.	0.000377	0.000932	0.000816	0.001445	0.	0.002548	0.
10	0.000014	0.000354	0.000590	0.000539	0.000998	0.	0.001600	0.
15	0.023047	0.000728	0.001567	0.001612	0.002586	0.	0.004379	0.
20	0.068255	0.001053	0.002177	0.002129	0.003685	0.	0.005981	0.
25	0.035651	0.000876	0.001783	0.002472	0.002911	0.	0.004598	0.
30	0.014232	0.001191	0.000983	0.001139	0.001517	0.	0.002540	0.
35	0.004846	0.001560	0.000498	0.000610	0.000833	0.	0.001459	0.
40	0.001075	0.002700	0.000419	0.000346	0.000683	0.	0.001142	0.
45	0.000058	0.004125	0.000293	0.000249	0.000435	0.	0.000731	0.
50	0.	0.006433	0.000189	0.000149	0.000325	0.	0.000575	0.
55	0.	0.009240	0.000124	0.000181	0.000230	0.	0.000439	0.
60	0.	0.017257	0.000170	0.000118	0.000248	0.	0.000398	0.
65	0.	0.028835	0.000123	0.000085	0.000233	0.	0.000426	0.
70	0.	0.050372	0.000130	0.000125	0.000243	0.	0.000490	0.
75	0.	0.124733	0.000151	0.000186	0.000406	0.	0.000625	0.
total	0.735899	1.266013	0.058229	0.060438	0.095623	0.	0.160339	0.

Middle

age	fertility	mortality	migration from Middle to North	Berlin	Southwes	South	Middle	abroad
0	0.	0.003709	0.002662	0.003675	0.001296	0.004447	0.	0.
5	0.	0.000470	0.001593	0.002202	0.000780	0.002652	0.	0.
10	0.000008	0.000407	0.001126	0.001471	0.000595	0.001914	0.	0.
15	0.023589	0.000856	0.003697	0.006115	0.002464	0.006870	0.	0.
20	0.068612	0.001050	0.002500	0.004178	0.001684	0.004806	0.	0.
25	0.036967	0.000973	0.002988	0.005390	0.001674	0.005336	0.	0.
30	0.013467	0.001409	0.001705	0.002954	0.000859	0.003087	0.	0.
35	0.004769	0.001841	0.000967	0.001749	0.000471	0.001758	0.	0.
40	0.001125	0.002923	0.000695	0.001210	0.000384	0.001275	0.	0.
45	0.000044	0.004155	0.000449	0.000980	0.000248	0.000910	0.	0.
50	0.	0.006833	0.000354	0.000856	0.000205	0.000651	0.	0.
55	0.	0.009958	0.000216	0.000541	0.000130	0.000541	0.	0.
60	0.	0.018449	0.000165	0.000540	0.000175	0.000525	0.	0.
65	0.	0.029948	0.000232	0.000616	0.000130	0.000621	0.	0.
70	0.	0.054006	0.000266	0.000560	0.000178	0.000571	0.	0.
75	0.	0.130331	0.000346	0.000786	0.000284	0.000644	0.	0.
total	0.742905	1.336586	0.099798	0.169117	0.057780	0.183039	0.	0.

APPENDIX A3: MULTIREGIONAL POPULATION PROJECTIONS (BASE RUN)

year 1975

population

age	total	North	Berlin	Southwes	South	Middle
0	958065.	130449.	62653.	147410.	324605.	292948.
5	1208179.	164503.	79009.	185904.	495010.	293763.
10	1424851.	204645.	92259.	212099.	554272.	361577.
15	1329414.	199998.	73156.	203787.	535508.	327065.
20	1320243.	189500.	72651.	202332.	531815.	324810.
25	964292.	116643.	66608.	153362.	407753.	219846.
30	1095315.	124046.	90219.	158742.	466059.	256253.
35	1329627.	169270.	100196.	197410.	537937.	324814.
40	1067476.	140264.	76735.	153749.	476268.	260360.
45	999012.	117915.	62954.	149926.	429621.	229616.
50	875372.	94209.	48529.	139027.	396536.	195077.
55	621547.	66299.	38995.	95091.	282475.	138687.
60	896141.	95490.	56860.	137037.	406849.	199906.
65	969333.	100051.	64747.	141890.	445774.	215871.
70	813135.	84117.	52249.	118205.	383328.	180240.
75	954242.	97898.	60299.	133800.	451037.	211208.
total	16320250.	2085303.	1098174.	2529805.	7134846.	3972041.

percentage distribution

age	total	North	Berlin	Southwes	South	Middle
0	5.8959	6.2554	5.7052	5.8269	5.3905	5.8647
5	7.1829	7.8894	7.1946	7.3482	6.7978	7.3958
10	8.4710	9.8133	8.4011	8.3940	7.7685	9.1031
15	7.9037	9.1061	6.6616	8.0554	7.5055	8.2342
20	7.8492	9.0474	6.6156	7.9999	7.4538	8.1774
25	5.7329	5.5934	6.0726	6.0622	5.7150	5.5348
30	6.5119	5.9494	8.2150	6.2749	6.5322	6.4514
35	7.9000	8.0690	9.1239	7.8034	7.5396	8.1775
40	6.3464	6.7309	6.9875	6.0775	6.1146	6.5548
45	5.8859	5.6544	5.7308	5.9264	6.0214	5.7808
50	5.2043	4.6139	4.4190	5.4954	5.5577	4.9113
55	3.6952	3.1792	3.5509	3.7598	3.9591	3.4916
60	5.3279	4.5790	5.1777	5.4160	5.7023	5.0328
65	5.7569	4.7977	5.8959	5.6087	6.2478	5.4348
70	4.8640	4.0335	4.7578	4.6725	5.3726	4.5377
75	5.6732	4.6945	5.4908	5.2889	6.3216	5.3174
total	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000

year 2000

population

age	total	North	Berlin	Southwes	South	Middle
0	762782.	107629.	72261.	123780.	277402.	182710.
5	847145.	117524.	79590.	135617.	308900.	205505.
10	944904.	133949.	89257.	149469.	345396.	231934.
15	967297.	133992.	94525.	153145.	356627.	234058.
20	912711.	129712.	80664.	145897.	342962.	220668.
25	935123.	132267.	86064.	145605.	351373.	229723.
30	1184739.	154672.	113099.	183995.	443961.	289010.
35	1389372.	177949.	134309.	209705.	508778.	340631.
40	1285492.	171054.	111232.	197600.	486365.	319242.
45	1260569.	169507.	100071.	193631.	483260.	313201.
50	999960.	137701.	74697.	143922.	367274.	237372.
55	987974.	111500.	86687.	145409.	411861.	232516.
60	1127350.	141001.	89353.	169577.	452596.	275533.
65	713904.	105175.	59350.	118736.	332368.	198275.
70	628506.	73361.	39709.	95583.	274620.	145142.
75	774553.	91455.	40475.	120708.	363083.	168832.
total	15730376.	2051239.	1337382.	2432676.	6106726.	3802353.

percentage distribution

age	total	North	Berlin	Southwes	South	Middle
0	4.8555	5.2470	5.4032	5.0882	4.5426	4.8052
5	5.3854	5.7294	5.9512	5.5748	5.0585	5.4047
10	6.0069	6.4765	6.3749	6.1442	5.6560	6.0998
15	6.1492	6.7706	6.3239	6.2953	5.8390	6.1556
20	5.8004	6.2749	6.0315	5.9935	5.6145	5.8035
25	5.9447	6.4506	6.4353	5.9891	5.7539	6.0416
30	7.5315	7.5404	8.4567	7.5635	7.2700	7.6008
35	8.8324	8.6727	10.0424	8.6204	8.3314	9.1688
40	8.1720	8.3391	8.3171	8.1227	7.9644	8.3959
45	8.0136	8.2636	7.5499	7.9596	7.9136	8.2370
50	6.3576	6.7136	5.5853	5.9162	6.0143	6.2379
55	6.2807	5.4359	6.4819	5.9773	6.7444	6.1151
60	7.1667	6.8739	6.6804	6.9731	7.4113	7.2464
65	4.5391	5.1274	4.4378	4.8809	5.4427	5.2145
70	3.9955	3.5764	2.9759	3.9291	4.4970	3.8172
75	4.9239	4.4590	3.0264	4.9620	5.9456	4.4402
total	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000
l	0.995699	0.999840	1.038160	1.000227	0.982600	0.997590
r	-0.000862	-0.000032	0.007490	0.000045	-0.003511	-0.000482

year 2030

population

age	total	North	Berlin	Southwes	South	Middle
0	541933.	77772.	65429.	89987.	180319.	128828.
5	569925.	79262.	67521.	94230.	190612.	136694.
10	614193.	85990.	71017.	101189.	207351.	148652.
15	662609.	94102.	76143.	108733.	225256.	158309.
20	693023.	97401.	79909.	113685.	234659.	166289.
25	707357.	95966.	82431.	114042.	242283.	172735.
30	741779.	98476.	88045.	119042.	255178.	180636.
35	824504.	109622.	97410.	131063.	285689.	201715.
40	911093.	120904.	105746.	143490.	317054.	224291.
45	919359.	122601.	102021.	144344.	323401.	226973.
50	854009.	113696.	90434.	134937.	306612.	209428.
55	838529.	107100.	85971.	131497.	307753.	206209.
60	997174.	127795.	99579.	156546.	370194.	244061.
65	1046098.	138717.	101023.	159872.	382703.	262728.
70	890155.	104023.	69059.	123954.	306054.	198167.
75	1077194.	138217.	70498.	164100.	432691.	262688.
total	12797533.	1709914.	1358897.	2029540.	4570788.	3128404.

percentage distribution

age	total	North	Berlin	Southwes	South	Middle
0	4.2347	4.5490	4.8149	4.4339	3.9450	4.1180
5	4.4456	4.6700	4.9699	4.6429	4.1702	4.3695
10	4.7993	5.0293	5.2259	4.9852	4.5364	4.7517
15	5.1776	5.5037	5.6034	5.3575	4.9277	5.0604
20	5.4153	5.7009	5.8804	5.5523	5.1777	5.3155
25	5.5273	5.6165	6.0669	5.6191	5.3007	5.5215
30	5.7931	5.7591	6.4792	5.8655	5.5828	5.7741
35	6.4427	6.4128	7.1684	6.4579	6.2503	6.4479
40	7.1193	7.0709	7.7823	7.0705	6.9365	7.1695
45	7.1839	7.1700	7.5077	7.1131	7.0754	7.2552
50	6.6732	6.5907	6.6550	6.6497	6.7091	6.6944
55	6.5523	6.2635	6.3266	6.4791	6.7330	6.5915
60	7.7919	7.4737	7.3543	7.7134	8.0991	7.8015
65	8.1742	8.1123	7.4387	7.8772	8.3747	8.3981
70	6.9554	6.0835	5.0823	6.1026	6.6959	6.3344
75	8.4172	8.0833	5.1902	8.0856	9.4664	8.3969
total	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000
l	0.965004	0.969060	0.991970	0.966116	0.953353	0.967923
r	-0.007125	-0.006286	-0.001613	-0.006894	-0.009554	-0.006521

APPENDIX A4: SUMMARY TABLE (BASE RUN)

Summary table, 1975

region	population ,000.	% tot	m.age	rates of natural increase birth	death	growth	internal migration rates out	in	net	ext.mig. net	growth rate
North	2085.	12.40	34.56	0.012508	0.012462	0.000046	0.007589	0.006558	-0.001032	0.	-0.000986
Berlin	1098.	6.53	37.12	0.010693	0.015260	-0.004562	0.006655	0.017788	0.011133	0.	0.006571
Southwes	2530.	15.04	36.69	0.011335	0.013813	-0.002478	0.005332	0.005824	0.000492	0.	-0.001986
South	7135.	42.42	38.36	0.010220	0.015127	-0.004907	0.004934	0.003168	-0.001766	0.	-0.006673
Middle	3972.	23.61	36.15	0.010935	0.013793	-0.002858	0.007045	0.007368	0.000323	0.	-0.002535
total	16820.	100.00	37.03	0.010872	0.014293	-0.003421	0.005934	0.005934	0.	0.	-0.003421

Summary table, 2000

region	population ,000.	% tot	m.age	rates of natural increase birth	death	growth	internal migration rates out	in	net	ext.mig. net	growth rate
North	2051.	13.04	38.27	0.010356	0.012159	-0.001803	0.006681	0.005617	-0.001064	0.	-0.002867
Berlin	1337.	8.50	37.53	0.010450	0.011165	-0.000715	0.006466	0.012347	0.005880	0.	0.005165
Southwes	2433.	15.46	39.23	0.009883	0.013354	-0.003471	0.004797	0.004907	0.000110	0.	-0.003361
South	6107.	38.82	40.91	0.008759	0.014642	-0.005883	0.004435	0.003266	-0.001169	0.	-0.007052
Middle	3802.	24.17	39.36	0.009227	0.012993	-0.003766	0.006311	0.006625	0.000313	0.	-0.003453
total	15730.	100.00	39.64	0.009398	0.013425	-0.004027	0.005410	0.005410	0.	0.	-0.004027

Summary table, 2030

region	population ,000.	% tot	m.age	rates of natural increase birth	death	growth	internal migration rates out	in	net	ext.mig. net	growth rate
North	1710.	13.36	43.43	0.009031	0.019855	-0.010823	0.005999	0.004893	-0.001105	0.	-0.011929
Berlin	1359.	10.62	41.62	0.009574	0.017322	-0.007748	0.005914	0.008738	0.002824	0.	-0.004924
Southwes	2030.	15.86	43.57	0.008736	0.019565	-0.010828	0.004338	0.004175	-0.000163	0.	-0.010991
South	4571.	35.72	45.24	0.007736	0.020997	-0.013261	0.003974	0.003304	-0.000670	0.	-0.013931
Middle	3128.	24.45	44.36	0.008051	0.020489	-0.012438	0.005582	0.006045	0.000463	0.	-0.011976
total	12798.	100.00	44.14	0.008340	0.020103	-0.011763	0.004902	0.004902	-0.000000	0.	-0.011763

APPENDIX A5: MULTIREGIONAL POPULATION PROJECTIONS (Scenario 6)

year 1975

population

age	total	North	Berlin	Southwes	South	Middle
0	958065.	130449.	62653.	147410.	384605.	232948.
5	1208179.	164503.	79009.	185894.	485010.	293763.
10	1424851.	204645.	92259.	212098.	554272.	361577.
15	1329414.	189998.	73156.	203787.	535508.	327065.
20	1320248.	188590.	72651.	202382.	531815.	324810.
25	964292.	116643.	66688.	153362.	407753.	219846.
30	1095315.	124046.	90215.	158742.	466059.	256253.
35	1328627.	169270.	100196.	197410.	537937.	324814.
40	1067476.	140364.	76735.	153749.	436268.	260360.
45	990012.	117915.	62934.	149926.	429621.	229616.
50	875372.	96209.	48529.	139022.	396536.	195077.
55	621547.	66299.	38995.	95091.	292475.	138687.
60	896141.	95490.	56860.	137037.	406843.	199906.
65	968333.	100051.	64747.	141890.	445774.	215871.
70	818135.	84113.	52249.	118205.	383328.	180240.
75	954242.	97898.	60290.	133800.	451037.	211208.
total	16820250.	2085383.	1098174.	2529805.	7134846.	3972041.

percentage distribution

age	total	North	Berlin	Southwes	South	Middle
0	5.6959	6.2554	5.7052	5.8269	5.3905	5.8647
5	7.1829	7.8884	7.1946	7.3482	6.7978	7.3958
10	8.4710	9.8133	8.4011	8.3840	7.7685	9.1031
15	7.9037	9.1061	6.6616	8.0554	7.5055	8.2342
20	7.8492	9.0434	6.6156	7.9999	7.4538	8.1774
25	5.7329	5.5974	6.0726	6.0622	5.7150	5.5348
30	6.5119	5.9484	8.2150	6.2749	6.5322	6.4514
35	7.8990	8.0690	9.1239	7.8034	7.5396	8.1775
40	6.3464	6.7308	6.9875	6.0775	6.1146	6.5548
45	5.8858	5.6544	5.7309	5.9264	6.0214	5.7808
50	5.2043	4.6135	4.4190	5.4954	5.5577	4.9113
55	3.6952	3.1792	3.5509	3.7588	3.9591	3.4916
60	5.3278	4.5790	5.1777	5.4169	5.7023	5.0328
65	5.7569	4.7977	5.8959	5.6087	6.2478	5.4348
70	4.8640	4.0335	4.7579	4.6725	5.3726	4.5377
75	5.6732	4.6945	5.4908	5.2889	6.3216	5.3174
total	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000

year 2000

population

age	total	North	Berlin	Southwes	South	Middle
0	978109.	134186.	88753.	153221.	365240.	236709.
5	1051615.	141525.	95294.	162736.	394045.	258014.
10	1142852.	158543.	101557.	178031.	423434.	281286.
15	1122956.	164666.	99439.	181371.	409621.	267860.
20	1010328.	140803.	87489.	159216.	379808.	243013.
25	936529.	121806.	84755.	144825.	355182.	229961.
30	1136716.	153951.	111640.	182768.	448785.	289571.
35	1392308.	197195.	133271.	208399.	513369.	350074.
40	1289191.	170650.	110860.	196905.	489845.	320930.
45	1265852.	169502.	101045.	193525.	486359.	315422.
50	906687.	108075.	75073.	144371.	370066.	209103.
55	997605.	112404.	87601.	146430.	416021.	235149.
60	1145113.	143177.	90055.	172190.	459360.	280331.
65	835457.	108052.	61366.	121711.	340427.	203900.
70	656640.	76836.	42113.	99869.	285757.	152066.
75	932942.	99248.	50959.	145959.	431138.	205638.
total	16850902.	2190619.	1421269.	2591529.	6568457.	4079027.

percentage distribution

age	total	North	Berlin	Southwes	South	Middle
0	5.8045	6.1255	6.2446	5.9124	5.5605	5.8031
5	6.2407	6.4605	6.7049	6.2796	5.9990	6.3254
10	6.7821	7.2374	7.1455	6.8697	6.4465	6.8959
15	6.6641	7.5169	6.9964	6.9986	6.2362	6.5668
20	5.9957	6.4275	6.1557	6.1437	5.7823	5.9576
25	5.5577	5.5604	5.9633	5.5884	5.4074	5.6377
30	7.0424	7.0277	7.8550	7.0525	6.8324	7.0990
35	8.2625	8.5453	9.3769	8.0415	7.8157	8.5823
40	7.6506	7.7900	7.8001	7.5980	7.4575	7.8678
45	7.5121	7.7376	7.1095	7.4676	7.4045	7.7328
50	5.3806	4.9335	5.2821	5.5709	5.6340	5.1263
55	5.9202	5.1311	6.1636	5.6503	6.3336	5.7648
60	6.7956	6.5359	6.3362	6.6443	6.9934	6.8725
65	4.9579	4.9325	4.3177	4.6965	5.1828	4.9987
70	3.8968	3.5075	2.9630	3.8537	4.3504	3.7280
75	5.5365	4.5306	3.5855	5.6322	6.5638	5.0413
total	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000
l	1.015109	1.017708	1.051751	1.017458	1.004689	1.016861
r	0.002999	0.003511	0.010091	0.003462	0.000936	0.003344

year 2030

population

age	total	North	Berlin	Southwes	South	Middle
0	909071.	122401.	96925.	138271.	336455.	215019.
5	912542.	121208.	96244.	139221.	338271.	217597.
10	945579.	125537.	98189.	144576.	350073.	227204.
15	985465.	133598.	102680.	151338.	364563.	233285.
20	991514.	134296.	103813.	151760.	367907.	233739.
25	962641.	126138.	101256.	146125.	359434.	229689.
30	955783.	122271.	102275.	144424.	358877.	227941.
35	1030472.	130531.	110562.	154623.	387089.	247617.
40	1112109.	144110.	118972.	168263.	412251.	268513.
45	1081236.	145005.	113904.	168252.	394184.	259891.
50	957160.	124918.	96126.	147425.	356568.	232122.
55	864143.	109440.	85246.	132781.	325746.	210930.
60	1045278.	133093.	101149.	161146.	394970.	254921.
65	1130234.	149341.	108945.	169909.	418090.	283950.
70	909604.	118376.	78740.	139145.	347244.	226099.
75	1803704.	236493.	148022.	272821.	697092.	449277.
total	16596540.	2176805.	1663049.	2530080.	6208814.	4017793.

percentage distribution

age	total	North	Berlin	Southwes	South	Middle
0	5.4775	5.6229	5.8282	5.4651	5.4190	5.3517
5	5.4984	5.5682	5.7872	5.5026	5.4482	5.4158
10	5.6974	5.7670	5.9041	5.7143	5.6383	5.6549
15	5.9378	6.1373	6.1742	5.9815	5.8717	5.8063
20	5.9742	6.1694	6.2423	5.9932	5.9256	5.9176
25	5.8003	5.7946	6.0886	5.7755	5.7891	5.7168
30	5.7590	5.6170	6.1498	5.7083	5.7801	5.6733
35	6.2090	5.9988	6.6482	6.1114	6.2345	6.1630
40	6.7008	6.6202	7.1538	6.6505	6.6398	6.6831
45	6.5148	6.6614	6.8491	6.6501	6.3488	6.4685
50	5.7672	5.7386	5.7801	5.8269	5.7429	5.7773
55	5.2068	5.0275	5.1259	5.2491	5.2465	5.2499
60	6.2992	6.1141	6.0821	6.3692	6.3614	6.3448
65	6.8101	6.8606	6.5509	6.7155	6.7338	7.0673
70	5.4807	5.4381	4.7347	5.4996	5.5928	5.6275
75	10.8690	10.8642	8.9006	10.7831	11.2275	11.1822
total	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000
l	1.011655	1.014732	1.027921	1.004430	1.008187	1.013330
r	0.002318	0.002925	0.005509	0.000884	0.001631	0.002648

APPENDIX A6: SUMMARY TABLE (Scenario 6)

Summary table, 1975

region	population ,000.	% tot	m.age	rates of natural increase birth	death	growth	internal migration rates out	in	net	ext.mig. net	growth rate
North	2085.	12.40	34.56	0.012508	0.012462	0.000046	0.007589	0.006558	-0.001032	0.	-0.000986
Berlin	1098.	6.53	37.12	0.010699	0.015260	-0.004562	0.006655	0.017788	0.011133	0.	0.006571
Southwes	2530.	15.04	36.69	0.011335	0.013813	-0.002478	0.005332	0.005824	0.000492	0.	-0.001986
South	7135.	42.42	38.36	0.010220	0.015127	-0.004907	0.004934	0.003168	-0.001766	0.	-0.006673
Middle	3972.	23.61	36.15	0.010935	0.013793	-0.002858	0.007045	0.007368	0.000323	0.	-0.002535
total	16820.	100.00	37.03	0.010872	0.014293	-0.003421	0.005934	0.005934	0.	0.	-0.003421

Summary table, 2000

region	population ,000.	% tot	m.age	rates of natural increase birth	death	growth	internal migration rates out	in	net	ext.mig. net	growth rate
North	2191.	13.00	37.32	0.012433	0.010959	0.001473	0.006713	0.005552	-0.001161	0.	0.000312
Berlin	1421.	8.43	36.68	0.012359	0.009973	0.002385	0.006950	0.012107	0.005157	0.	0.007542
Southwes	2592.	15.38	38.36	0.011783	0.012190	-0.000407	0.004915	0.004839	-0.000076	0.	-0.000483
South	6568.	38.98	39.82	0.010996	0.013335	-0.002339	0.004287	0.003463	-0.000823	0.	-0.003162
Middle	4079.	24.21	38.35	0.011428	0.011721	-0.000293	0.006298	0.006499	0.000201	0.	-0.000092
total	16851.	100.00	38.65	0.011524	0.012176	-0.000652	0.005410	0.005410	0.000000	0.	-0.000652

Summary table, 2030

region	population ,000.	% tot	m.age	rates of natural increase birth	death	growth	internal migration rates out	in	net	ext.mig. net	growth rate
North	2177.	13.12	42.11	0.011436	0.015320	-0.003884	0.005969	0.004525	-0.001444	0.	-0.005327
Berlin	1663.	10.02	40.80	0.011812	0.013317	-0.001505	0.006566	0.008095	0.001530	0.	0.000024
Southwes	2530.	15.24	42.32	0.010976	0.015336	-0.004360	0.004808	0.003992	-0.000815	0.	-0.005175
South	6209.	37.41	42.56	0.010888	0.015713	-0.004824	0.003593	0.004197	0.000603	0.	-0.004221
Middle	4018.	24.21	42.75	0.010722	0.015752	-0.005030	0.005870	0.005600	-0.000270	0.	-0.005300
total	16597.	100.00	42.33	0.011026	0.015373	-0.004347	0.004939	0.004939	0.	0.	-0.004347

APPENDIX B1: DATA DECK FOR THE GDR

The data deck which was used for simulation of the GDR population is applied to in Appendix B1. The structure of the deck is the same as for the projection model except that the parameter which controls the printing of different indices. In the case that the country for which simulation model is applied has international migration flows the data of this migration should be added. Therefore we would not pay much attention here for data deck building. But we shall describe the parameters which are important to define scenarios for simulation run. These parameters can be specified interactively or prepared in advance. Here they are:

NREAD : year in which changes are made (or first year of changes)

NOPS : 1 : instantaneous change
2 : change is a linear function of time

IC : parameters referring to age schedules in which change occurs:

IC = 1 : fertility
IC = 2 : mortality
IC = 3 : interval migration
IC = 4 : emigration (external migration)
IC = 5 : immigration (external migration)

IRI : region (region-of-origin in case of internal migration)

IRJ : region-of-destination (specification only needed in case of internal migration)

ITYP : 1 : whole schedule changes
2 : only level under the curve changes (GRR, GMR)

In the case of immigration, absolute number of migrants are considered and not immigration rates. The meaning of the parameter ITYP is therefore

ITYP = 1 : Total number of immigrants changes but the relative age composition remains unchanged.

ITYP = 2 : Age structure immigrants changes.

ITIME : (only for NOPS = 2) : time period over which changes occur

In Appendix B2 as an example we used the protocol of scenario 1 specification. Here for all regions change in GRR is made starting in 1975 from their default values and in 5 years reaching 0.95. In Appendix B3 specification of scenario 6 is applied.

```
    0   gdr75-5t:   GDR'75   -   5 regions   -   total (male+female)
16 5 5 4 1 1 1 3197520301000 2 7 0 0
  multiregional  life-table, population projection (new)
     german democratic republic
       total  population,
       1975
North
Berlin
Southwest
South
Middle
 German Dem.Rep.
 100000. 100000. 100000. 100000. 100000. 100000. 100000. 100000. 100000.
   130449.   164503.   204645.   189879.   188590.   116643.   124046.
   168270.   140364.   117915.    96209.    66299.    95490.   100051.
    84113.    97898.
      0.        0.        1.     5100.    13550.     4452.     1896.      887.      196.
      3.        0.        0.        0.        0.        0.        0.
    519.       76.       51.      167.      196.      119.      172.      313.      423.
    501.      676.      651.     1765.     3033.     4544.    12783.
      0.        0.        0.        0.        0.        0.        0.        0.        0.
      0.        0.        0.        0.        0.        0.        0.        0.        0.
    337.      188.      130.      270.      876.      421.      228.      150.       75.
     51.       31.       11.       34.       35.       22.       38.
    247.      139.      126.      191.      615.      211.      128.       91.       50.
     31.       18.        6.       20.       23.       12.       21.
    532.      298.      225.      417.     1364.      491.      304.      201.      111.
     71.       42.       23.       35.       38.       29.       47.
    865.      488.      409.      598.     1933.      742.      450.      369.      213.
    142.       92.       53.       65.       95.       54.      115.
   62653.    79009.    92259.    73156.    72651.    66688.    90215.
  100196.    76735.    62934.    48529.    38905.    56860.    64747.
   52249.    60299.
      0.        0.        2.     1428.     5451.     2840.     1426.      505.       89.
      7.        0.        0.        0.        0.        0.        0.
    221.       30.       30.       53.       69.       62.      112.      164.      212.
    287.      357.      453.     1171.     2194.     3005.     8339.
    108.       83.       99.      105.      216.      132.       87.       60.       36.
     19.       11.        4.       18.       14.        9.       20.
      0.        0.        0.        0.        0.        0.        0.        0.        0.
      0.        0.        0.        0.        0.        0.        0.
     56.       42.       82.       67.      137.       62.       54.       33.       21.
      5.       12.        3.        3.        4.        6.        5.
    135.      103.      164.      181.      368.      191.      187.      115.       65.
     32.       27.       19.       14.       14.       14.       18.
    481.      367.      359.      315.      643.      406.      443.      324.      193.
    134.       84.       42.       75.       61.       42.       79.
  147410.   185894.   212098.   203787.   202382.   153362.   158742.
  197410.   153749.   149926.   139022.    95091.   137037.   141890.
  118205.   133800.
      0.        0.        4.     4777.    13731.     5490.     3405.     1057.      200.
     11.        0.        0.        0.        0.        0.        0.
    583.       72.       75.      157.      187.      113.      221.      330.      421.
    514.      844.      899.     2407.     4360.     6325.    17446.
    162.      128.       97.      227.      446.      220.      135.       87.       43.
     28.       23.       10.       20.       15.       12.       17.
    155.      123.       67.      233.      459.      331.      146.       88.       51.
     49.       21.        8.       19.       10.        8.       22.
      0.        0.        0.        0.        0.        0.        0.        0.        0.
      0.        0.        0.        0.        0.        0.        0.        0.        0.
```

675.	530.	393.	874.	1718.	875.	503.	303.	195.
146.	85.	36.	72.	82.	60.	113.		
334.	263.	180.	461.	906.	435.	252.	155.	99.
67.	42.	22.	36.	39.	28.	56.		
384605.	485010.	554272.	535508.	531815.	407753.	466059.		
537937.	436268.	429621.	396536.	282475.	406848.	445774.		
383328.	451037.							
0.	0.	8.	12342.	36299.	14537.	6633.	2607.	469.
25.	0.	0.	0.	0.	0.	0.		
1296.	183.	196.	390.	560.	357.	555.	839.	1178.
1772.	2551.	2610.	7021.	12854.	19309.	56259.		
583.	452.	327.	839.	1158.	727.	458.	268.	183.
126.	75.	35.	69.	55.	50.	68.		
512.	396.	299.	563.	1132.	1008.	531.	328.	151.
107.	59.	51.	48.	38.	48.	84.		
902.	701.	553.	1385.	1960.	1187.	707.	448.	298.
187.	129.	65.	101.	104.	93.	183.		
0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.
1590.	1236.	887.	2345.	3181.	1875.	1184.	785.	498.
314.	228.	124.	162.	190.	188.	282.		
232948.	293763.	361577.	327965.	324810.	219846.	256253.		
324814.	260360.	229616.	195077.	138687.	199906.	215871.		
180240.	211208.							
0.	0.	3.	7715.	22296.	8127.	3451.	1549.	293.
10.	0.	0.	0.	0.	0.	0.		
864.	138.	147.	280.	341.	214.	361.	598.	761.
954.	1333.	1381.	3688.	6465.	9734.	27527.		
620.	468.	407.	1209.	812.	657.	437.	314.	181.
103.	69.	30.	33.	50.	48.	73.		
856.	647.	532.	2000.	1357.	1185.	757.	568.	315.
225.	167.	75.	108.	133.	101.	166.		
302.	229.	215.	806.	547.	368.	220.	153.	100.
57.	40.	18.	35.	28.	32.	60.		
1036.	779.	692.	2247.	1561.	1173.	791.	571.	332.
209.	127.	75.	105.	134.	103.	136.		
0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.

APPENDIX B2: SIMULATION OF MULTIREGIONAL POPULATION CHANGE, IIASA-MODEL (Scenario 1)

```
closed (1) or open (2) population ;
 1
age-specific rates printed ;
 0
growth matrix printed ;
 0
interested in stable population ;
 0
nread  nops
1975 2
******
******

nops = 2      change is function of time
              --------------------------

itime  ic  ityp  iri  irj
year=1975   itime=   5   ic= 1   ityp= 2   region=North
print new gross rate
      0.950000
nops = 2      change is function of time
              --------------------------

itime  ic  ityp  iri  irj
year=1975   itime=   5   ic= 1   ityp= 2   region=Berlin
print new gross rate
      0.950000
nops = 2      change is function of time
              --------------------------

itime  ic  ityp  iri  irj
year=1975   itime=   5   ic= 1   ityp= 2   region=Southwes
print new gross rate
      0.950000
nops = 2      change is function of time
              --------------------------

itime  ic  ityp  iri  irj
year=1975   itime=   5   ic= 1   ityp= 2   region=South
print new gross rate
      0.950000
nops = 2      change is function of time
              --------------------------

itime  ic  ityp  iri  irj
year=1975   itime=   5   ic= 1   ityp= 2   region=Middle
print new gross rate
      0.950000
nops = 2      change is function of time
              --------------------------

itime  ic  ityp  iri  irj
```

APPENDIX B3: SIMULATION OF MULTIREGIONAL POPULATION CHANGE, IIASA-MODEL (Scenario 6)

```
closed (1) or open (2) population ;
 1
age-specific rates printed ;
 0
growth matrix printed ;
 0
interested in stable population ;
 0
nread  nops
1975 2
******
******

nops = 2     change is function of time
             -------------------------

itime  ic  ityp  iri  irj
year=1975   itime=   5   ic= 1   ityp= 2   region=North
print new gross rate
      0.950000
nops = 2     change is function of time
             -------------------------

itime  ic  ityp  iri  irj
year=1975   itime=   5   ic= 1   ityp= 2   region=Berlin
print new gross rate
      0.952000
nops = 2     change is function of time
             -------------------------

itime  ic  ityp  iri  irj
year=1975   itime=   5   ic= 1   ityp= 2   region=Southwes
print new gross rate
      0.928000
nops = 2     change is function of time
             -------------------------

itime  ic  ityp  iri  irj
year=1975   itime=   5   ic= 1   ityp= 2   region=South
print new gross rate
      0.880000
nops = 2     change is function of time
             -------------------------

itime  ic  ityp  iri  irj
year=1975   itime=   5   ic= 1   ityp= 2   region=Middle
print new gross rate
      0.889000
nops = 2     change is function of time
             -------------------------

itime  ic  ityp  iri  irj
```

```
year=1975   itime=  55   ic= 2   ityp= 2   region=North
print new gross rate
      0.900000
nops = 2      change is function of time
              -------------------------

itime  ic  ityp  iri  irj
year=1975   itime=  55   ic= 2   ityp= 2   region=Berlin
print new gross rate
      0.900000
nops = 2      change is function of time
              -------------------------

itime  ic  ityp  iri  irj
year=1975   itime=  55   ic= 2   ityp= 2   region=Southwes
print new gross rate
      0.900000
nops = 2      change is function of time
              -------------------------

itime  ic  ityp  iri  irj
year=1975   itime=  55   ic= 2   ityp= 2   region=South
print new gross rate
      0.900000
nops = 2      change is function of time
              -------------------------

itime  ic  ityp  iri  irj
year=1975   itime=  55   ic= 2   ityp= 2   region=Middle
print new gross rate
      0.900000
nops = 2      change is function of time
              -------------------------

itime  ic  ityp  iri  irj
year=1975   itime=  55   ic= 3   ityp= 2   region=North      Southwes
print new gross rate
      0.050800
nops = 2      change is function of time
              -------------------------

itime  ic  ityp  iri  irj
year=1975   itime=  10   ic= 3   ityp= 2   region=North      South
print new gross rate
      0.126000
nops = 2      change is function of time
              -------------------------

itime  ic  ityp  iri  irj
year=1975   itime=  55   ic= 3   ityp= 2   region=North      Middle
print new gross rate
      0.182200
nops = 2      change is function of time
              -------------------------

itime  ic  ityp  iri  irj
year=1975   itime=  55   ic= 3   ityp= 2   region=Berlin     North
print new gross rate
      0.069700
nops = 2      change is function of time
```

```
itime  ic  ityp  iri  irj
year=1975   itime=  55   ic= 3   ityp= 2   region=Berlin    Southwes
print new gross rate
      0.039800
nops = 2      change is function of time
              -------------------------

itime  ic  ityp  iri  irj
year=1975   itime=  10   ic= 3   ityp= 2   region=Berlin    South
print new gross rate
      0.099000
nops = 2      change is function of time
              -------------------------

itime  ic  ityp  iri  irj
year=1975   itime=  55   ic= 3   ityp= 2   region=Berlin    Middle
print new gross rate
      0.277100
nops = 2      change is function of time
              -------------------------

itime  ic  ityp  iri  irj
year=1975   itime=  55   ic= 3   ityp= 2   region=Southwes  North
print new gross rate
      0.038000
nops = 2      change is function of time
              -------------------------

itime  ic  ityp  iri  irj
year=1975   itime=  10   ic= 3   ityp= 2   region=Southwes  South
print new gross rate
      0.172000
nops = 2      change is function of time
              -------------------------

itime  ic  ityp  iri  irj
year=1975   itime=  55   ic= 3   ityp= 2   region=Southwes  Middle
print new gross rate
      0.077200
nops = 2      change is function of time
              -------------------------

itime  ic  ityp  iri  irj
year=1975   itime=  55   ic= 3   ityp= 2   region=South     North
print new gross rate
      0.046600
nops = 2      change is function of time
              -------------------------

itime  ic  ityp  iri  irj
year=1975   itime=  55   ic= 3   ityp= 2   region=South     Southwes
print new gross rate
      0.076500
nops = 2      change is function of time
              -------------------------

itime  ic  ityp  iri  irj
year=1975   itime=  55   ic= 3   ityp= 2   region=South     Middle
```

```
print new gross rate
      0.128300
nops = 2      change is function of time
              -------------------------

itime  ic  ityp  iri  irj
year=1975   itime=  55   ic= 3   ityp= 2   region=Middle     North
print new gross rate
      0.079800
nops = 2      change is function of time
              -------------------------

itime  ic  ityp  iri  irj
year=1975   itime=  55   ic= 3   ityp= 2   region=Middle     Southwes
print new gross rate
      0.046200
nops = 2      change is function of time
              -------------------------

itime  ic  ityp  iri  irj
year=1975   itime=  10   ic= 3   ityp= 2   region=Middle     South
print new gross rate
      0.165000
nops = 2      change is function of time
              -------------------------

itime  ic  ityp  iri  irj
nread  nops
1980 2
******
******

nops = 2      change is function of time
              -------------------------

itime  ic  ityp  iri  irj
year=1980   itime=  10   ic= 1   ityp= 2   region=South
print new gross rate
      0.925000
nops = 2      change is function of time
              -------------------------

itime  ic  ityp  iri  irj
year=1980   itime=  10   ic= 1   ityp= 2   region=Middle
print new gross rate
      0.925000
nops = 2      change is function of time
              -------------------------

itime  ic  ityp  iri  irj
nread  nops
1985 2
******
******

nops = 2      change is function of time
              -------------------------

itime  ic  ityp  iri  irj
year=1985   itime=  15   ic= 3   ityp= 2   region=North      South
```

```
print new gross rate
      0.182130
nops = 2      change is function of time
              -------------------------

itime  ic  ityp  iri  irj
year=1985   itime=  15   ic= 3   ityp= 2   region=Berlin     South
print new gross rate
      0.144370
nops = 2      change is function of time
              -------------------------

itime  ic  ityp  iri  irj
year=1985   itime=  15   ic= 3   ityp= 2   region=Southwes   South
print new gross rate
      0.247870
nops = 2      change is function of time
              -------------------------

itime  ic  ityp  iri  irj
year=1985   itime=  15   ic= 3   ityp= 2   region=Middle     South
print new gross rate
      0.237950
nops = 2      change is function of time
              -------------------------

itime  ic  ityp  iri  irj
year=1985   itime=  15   ic= 3   ityp= 2   region=South      North
print new gross rate
      0.046580
nops = 2      change is function of time
              -------------------------

itime  ic  ityp  iri  irj
year=1985   itime=  15   ic= 3   ityp= 2   region=South      Berlin
print new gross rate
      0.048350
nops = 2      change is function of time
              -------------------------

itime  ic  ityp  iri  irj
year=1985   itime=  15   ic= 3   ityp= 2   region=South      Southwes
print new gross rate
      0.076500
nops = 2      change is function of time
              -------------------------

itime  ic  ityp  iri  irj
year=1985   itime=  15   ic= 3   ityp= 2   region=South      Middle
print new gross rate
      0.128270
nops = 2      change is function of time
              -------------------------

itime  ic  ityp  iri  irj
nread  nops
1990 2
```

```
nops = 2      change is function of time
              -------------------------

itime  ic  ityp  iri  irj
year=1990   itime=  40   ic= 3   ityp= 2   region=North      Berlin
print new gross rate
      0.078300
nops = 2      change is function of time
              -------------------------

itime  ic  ityp  iri  irj
year=1990   itime=  40   ic= 3   ityp= 2   region=Southwes   Berlin
print new gross rate
      0.041200
nops = 2      change is function of time
              -------------------------

itime  ic  ityp  iri  irj
year=1990   itime=  40   ic= 3   ityp= 2   region=South      Berlin
print new gross rate
      0.048400
nops = 2      change is function of time
              -------------------------

itime  ic  ityp  iri  irj
year=1990   itime=  40   ic= 3   ityp= 2   region=Middle     Berlin
print new gross rate
      0.135300
nops = 2      change is function of time
              -------------------------

itime  ic  ityp  iri  irj
nread  nops
   0 0
```

NOTES

1. The work on the simulation package was initiated by IIASA and continued by F. Willekens and R. Ramachandran at Vrije Universiteit, Brussels.

2. Note that the comparison of the total number of births and deaths can be done only for 5-year steps. The values for the intervening years may differ, but for the South region it should not change the general picture to a great extent.