IV. PROJECTION OF BASELINE MIGRATION INTO THE FUTURE

There are two problems in projecting future migration. The first and major problem is to make reasonable assumptions about future migration trends for each region. The second and more minor problem with migration projections is a technical one. Even if it is assumed that past trends will continue, the populations in regions are likely to change at different rates so that when the same rates are applied to these regions over time, the sum of the number of net migrants across all regions, which was zero for the base period, will not be zero in the future periods. The various solutions to these problems are discussed below.

A. Alternative strategies for projecting migration

Because migration can change dramatically from one period to the next, past rates of migration may be poor predictors of future rates. It is often advisable to prepare two or more alternative sets of subnational projections: one is based on the assumption that past trends will continue; the other assumes a particular change in migration. Sometimes, it is also helpful to prepare subnational projections that assume no migration so that the effect of alternate migration assumptions can be seen. There are four conflicting objectives which can be fulfilled in projecting future migration (United States of America, 1990). These objectives are:

(*a*) To use a long time period so that random or abnormal fluctuations will be averaged out;
(*b*) To use the most recent data available to take account of shifts in migration patterns;
(*c*) To continue recent changes so that emergent trends will be projected, provided one is satisfied that these changes are not random or unusual fluctuations;
(*d*) To ensure convergence of migration rates towards equilibrium at some point in the future.

No one set of regional projections is likely to satisfy all of these objectives. Objectives (*a*) and (*c*) appear to be in direct contradiction. The first would tend to ignore divergent changes in the last year or two of a data series while objective (*c*) would take these changes as suggesting continued divergence and would project them to continue. By carefully studying the factors responsible for recent changes in migration patterns for different regions, it may be possible to make a judgement as to which changes are likely to continue and which are due to unusual events or factors that are unlikely to reoccur.

An example of the use of alternative migration assumptions is the set of state projections prepared by the United States Bureau of the Census (1990). This publication includes four different projection series based on different assumptions about migration. Three of these series vary in the amount and recency of the past migration data used, while the fourth assumes no migration and is useful as a basis of comparison. The assumptions of these series and the regional summaries of the results are shown in table 14. Series A used regression on annual migration data from 1975 to 1988 to extract the trend for each migration stream; and these trends were used, with some modification of extreme values, to project migration into the future. This series attempts to satisfy all four objectives to some degree. Series B used the mean value of the migration rates for each stream over the period 1975-1988 which satisfies the first objective of using a long time period. Series B meets objective (*b*) by using only the most recent three years to compute a mean for each state-by-state migration rate. The fourth series assumed no internal migration and provided a base to compare the effects of migration on the future distribution of the population. Although other assumptions could have been made, the approach taken by the Bureau of the Census illustrates the importance of using alternative migration assumptions.

Another approach is to begin with rates from the base period but to adjust them towards zero so that they become zero at some specified future time-point, such as 25 or 30 years from the base period. This approach satisfies objective (*d*) of projecting a trend towards equilibrium and reduces errors caused by assuming that

some unusual movements during the base period will continue indefinitely. The scaling of the rates can be done in a linear way.

For example, if equilibrium is assumed within 25 years, the rates for the first period are 80 per cent of those in the base period, the rates in the second period are 60 per cent, etc.

TABLE 14. ESTIMATES AND PROJECTIONS OF THE POPULATION OF THE UNITED STATES OF AMERICA BY REGION, 1988-2010
(*Thousands*)

Series and region	*1988 estimate*	*Projections*			*Percentage of total population*				*Average annual percentage change*		
		1990	*2000*	*2010*	*1988*	*1990*	*2000*	*2010*	*1988-1990*	*1990-2000*	*2000-2010*
Series A											
United States	245 807	249 891	267 748	282 056	100.0	100.0	100.0	100.0	0.8	0.7	0.5
North East	50 595	50 850	52 419	53 801	20.6	20.3	19.6	19.1	0.3	0.3	0.3
Midwest	59 878	60 288	60 528	59 696	24.4	24.1	22.6	21.2	0.3	-	-0.1
South	84 655	86 517	95 575	103 529	34.4	34.6	35.7	36.7	1.1	1.0	0.8
West	50 679	52 237	59 226	65 030	20.6	20.9	22.1	23.1	1.5	1.3	0.9
Series B											
United States	245 807	249 891	267 748	282 056	100.0	100.0	100.0	100.0	0.8	0.7	0.5
North East	50 595	50 707	51 005	50 763	20.6	20.3	19.0	18.0	0.1	0.1	-
Midwest	59 878	60 205	61 342	61 997	24.4	24.1	22.9	22.0	0.3	0.2	0.1
South	84 655	86 644	95 382	102 577	34.4	34.6	35.6	36.4	1.2	1.0	0.7
West	50 679	52 336	60 019	66 719	20.6	20.9	22.4	23.7	1.6	1.4	1.1
Series C											
United States	245 807	249 891	267 748	282 056	100.0	100.0	100.0	100.0	0.8	0.7	0.5
Northeast	50 595	50 814	51 662	51 961	20.6	20.3	19.3	18.4	0.2	0.2	0.1
Midwest	59 878	60 296	61 815	62 744	24.4	24.1	23.1	22.2	0.3	0.2	0.1
South	84 655	86 489	94 483	101 008	34.4	34.6	35.3	35.8	1.1	0.9	0.7
West	50 679	52 292	59 778	66 344	20.6	20.9	22.3	23.5	1.6	1.3	1.0
Series D											
United States	245 807	249 801	267 748	282 056	100.0	100.0	100.0	100.0	0.8	0.7	0.5
Northeast	50 595	51 179	53 583	55 028	20.6	20.5	20.0	19.5	0.6	0.5	0.3
Midwest	59 878	60 723	64 231	66 824	24.4	24.3	24.0	23.7	0.7	0.6	0.4
South	84 655	85 998	91 750	96 318	34.4	34.4	34.3	34.1	0.8	0.6	0.5
West	50 679	51 990	58 186	63 886	20.6	20.8	21.7	22.7	1.3	1.1	0.9

Source: United States of America, Bureau of the Census, *Projections of the Population of States by Age, Sex and Race: 1989 to 2010*, Current Population Reports, P-25, No. 1053 (Washington, D.C., Government Printing Office, 1990), table A.

NOTES: As of 1 July. Series A, B, C and D reflect different interstate migration assumptions. The percentage change is based on total beginning population.

Series A is a modified linear trend of the patterns of state-to-state migration observed from 1975 to 1988.

Series B is the average of the state-to-state migration rates observed from 1975 to 1988.

Series C is the average of the state-to-state migration rates observed from 1985 to 1988.

Series D assumes zero net internal migration.

Unless a full multiregional projection method is used which includes migration rates for each migration stream, it is likely that the projected number of internal migrants will not sum to zero. To provide consistent results, some adjustment will be necessary. Three methods are discussed here: (*a*) the projection of numbers of migrants rather than rates; (*b*) the use of data on the destinations of out-migrants to adjust in-migration; and (*c*) the scaling of in-migration to equal out-migration.

1. Projection of number of migrants

Projection of the number of migrants is the approach most commonly used when the only available data on migration for the base period cover net migration for each region by age and sex. One can assume that the numbers of observed net migrants in each age and sex group remains the same. Since these summed to zero in the base period, they will sum to zero in each future period. It is unlikely, however, that the numbers will remain constant for very many years. Even if the factors that give rise to interregional migration do not change, the populations within the different regions are likely to change at different rates. If migration rates remain constant, which is somewhat more likely to be the case, the numbers of migrants will change as the population of the regions change.

2. Use of data on destination of out-migrants to adjust in-migrants

In many cases, the total migration in each stream is known, but a full multiregional method is not used in projections because the age and sex details for each stream are lacking or the volume of computations is considered to be too cumbersome to be worth the effort. In such cases, the base data on the total migrants in each stream can be used to adjust the in-migration. For each projection period and each region, the migration from each of the other regions to the region under consideration is summed to get the number of in-migrants. The projected numbers of in-migrants for each region are then scaled to equal these numbers. Alternatively, the rates of in-migration by age and sex can be scaled so that the total number of projected migrants equals this number.

Table 15 illustrates the method for the five regions of Indonesia. Although these data could have been used with a multiregional projection programme, it is assumed that separate projections are made for each region using in migration and out-migration rates. Only the totals are shown here, but one would usually apply separate rates for each age and sex group.

Panel A of table 15 shows the total number of migrants in each of the streams among the five regions. The second panel shows the calculation of the in-migration and out-migration rates. The number of in-migrants to a region is the number in the "total" column of panel A minus the number who were in the region in 1975. The number of out-migrants is the number in the "total" column minus those in the region in 1980. The numbers of in-migrants and out-migrants are divided by the population tabulated by previous place of residence (column (6) of panel A) and the result is multiplied by 1,000 to compute rates. Lastly, the net migration rate is computed as the difference between the in-migration and out-migration rates.

Panel C of table 15 shows the percentages of out-migrants from each region who move to every other region. These percentages are needed for the final calculation given in panel D.

Panel D shows how the in-migration and out-migration rates are applied to the 1980 population to project the number of migrants between 1980 and 1985. As expected, the number of projected in-migrants does not

equal the number of projected out-migrants, illustrating the problem with independent projection of in-migration and out-migration. The correct number of in-migrants is obtained by using the proportions given in panel C to allocate the projected out-migrants to each of the other regions, which forces the number of in-migrants to equal the number of out-migrants.

TABLE 15. INTERREGIONAL MIGRATION IN FIVE YEARS BEFORE AND AFTER THE 1980 CENSUS IN INDONESIA, POPULATION AGED 5 OR OVER

Region of residence in 1975	*Region of residence at census in 1980*					
	Sumatra (1)	*Java* (2)	*Kalimantan* (3)	*Sulawesi* (4)	*Other Islands* (5)	*Total* (6)
			A. Total number of migrants			
Sumatra	22 530 497	267 717	9 947	16 992	24 047	22 849 200
Java	835 743	78 224 144	143 024	57 070	39 178	79 299 159
Kalimatan	5 486	46 410	5 467 847	7 737	1 757	5 529 237
Sulawesi	7 932	41 357	43 603	8 726 380	51 272	8 870 544
Other	13 068	101 426	2 574	29 826	8 772 323	8 919 217
Total	23 392 726	78 681 054	5 666 995	8 838 005	8 888 577	125 467 357
			B. Computation of in-migration and out-migration rates for base period			
Previous population	22 489 200	79 299 159	5 529 237	8 870 544	8 919 217	125 467 357
Out-migrants*	318 703	1 075 015	61 390	144 164	146 894	1 746 166
Out-migration rate (per 1,000)	13.9	13.6	11.1	16.3	16.5	13.9
In-migrants	862 229	456 910	199 148	111 625	116 254	1 746 166
In-migration rate (per 1,000)	37.7	5.8	36.0	12.6	13.0	-3.7
Net migration rate (per 1,000)	23.8	-7.8	24.9	-3.7	-3.4	0
			C. Percentage distribution of out-migrants			
Sumatra	0.0	84.0	3.1	5.3	7.5	100.0
Java	77.7	0.0	13.3	5.3	3.6	100.0
Kalimatan	8.9	75.6	0.0	12.6	2.9	100.0
Sulawesi	5.5	28.7	30.2	0.0	35.6	100.0
Other	8.9	69.0	1.8	20.3	0.0	100.0
			D. Projected number of in-migrants and out-migrants using base period rates			
Population at census	28 016 160	91 269 528	6 723 086	10 409 533	11 071 991	147 490 298
Out-migration rate	13.9	13.6	11.1	16.3	16.5	-
Projected out-migrants	390 772	1 237 291	74 645	169 176	182 349	2 054 233
In-migration rate	37.7	5.8	36.0	12.6	13.0	-
Projected in-migrants	1 057 208	525 881	242 147	130 991	144 313	2 100 541
Calculated in-migrants	994 101	559 126	231 173	132 952	136 881	2 054 233

Source: For panel A, table 1, excluding persons with previous place abroad or unknown.

NOTES: Calculated in-migrants were obtained by multiplying the percentages in panel C by the projected out-migrants in panel D.

Total 1980 population given in line 1 of panel D is larger than given in panel A because it includes persons aged 0-4 and those living abroad in 1975.

Although this example deals only with the total population, the same procedure can be applied to each age and sex group if the data are available. If migration streams are not available by age and sex, the ratio of the corrected in-migrants to the originally projected in-migrants can be applied to each age and sex group to adjust the number of in-migrants. This assumes that the age and sex composition of each of the migration streams is the same and should be avoided whenever more detailed data are available.

3. Adjustment of total number of in-migrants to equal total out-migrants

In many cases, the destinations of the out-migrants are unknown, so that it is not possible to use the method outlined above, but an acceptable solution to this problem can often be obtained by simply scaling the projected number of migrants so that the in-migrants are equal to the out-migrants. This is illustrated with the Indonesian data given in table 16. Each of the projected regional totals of in-migrants is multiplied by the ratio of the total number of in-migrants to the total number of out-migrants (2,054,233/2,100,541, or 0.978 in this case). This must be done for each projection period before proceeding to the next projection period. Note that the numbers given in table 16 are not the same as those shown in the last line of panel D of table 15, and the difference can be taken as a measure of the error in this procedure.

TABLE 16. ADJUSTMENT OF PROJECTED IN-MIGRANTS AND OUT-MIGRANTS, REGIONS OF INDONESIA

Region	*Previous population*	*Out-migrants*	*Out-migration rate (per 1,000)*	*In-migrants*	*In-migration rate (per 1,000)*
		A. Computation of in-migration and out-migration rates for base period, 1975-1980			
Sumatra	22 849 200	318 703	13.9	862 229	37.7
Java	79 299 159	1 075 015	13.6	456 910	5.8
Kalimantan	5 529 237	61 390	11.1	199 148	36.0
Sulawesi	8 870 544	144 164	16.3	111 625	12.6
Other	8 919 217	146 894	16.5	116 254	13.0
TOTAL	125 467 357	1 746 166	13.9	1 746 166	13.9

B. Projected in-migrants and out-migrants using base period rates

	Population at census	*Out-migration rate*	*Projected out-migration*	*In-migration rate*	*Trial projected in-migration*	*Adjusted in-migration*
Sumatra	28 016 160	13.9	390 772	37.7	1 057 208	1 033 900
Java	91 269 528	13.6	1 237 291	5.8	525 881	514 288
Kalimantan	6 723 086	11.1	74 645	36.0	242 147	236 809
Sulawesi	10 409 533	16.3	169 176	12.6	130 991	128 103
Other	11 071 991	16.5	182 349	13.0	144 313	141 132
TOTAL	147 490 298	-	2 054 233	-	2 100 541	2 054 233

Source: For base data, *Penduduk Indonesia 1980* (Population of Indonesia, 1980), (Jakarta, Biro Pusat Statistic, 1982).

NOTES: Excluding persons from abroad or with unknown previous residence from in-migrants and from previous population. Projected in-migrants = trial in-migrants times (total projected out-migrants/total trial in-migrants).