NOT FOR QUOTATION
WITHOUT PERMISSION
OF THE AUTHORS

MULTISTATE POPULATION PROJECTIONS

Dimiter Philipov
Andrei Rogers

April 1980
WP-80-57

INTERNATIONAL INSTITUTE FOR APPLIED SYSTEMS ANALYSIS
A-2361 Laxenburg, Austria

FOREWORD

Declining rates of national population growth, continuing differential levels of regional economic activity, and shifts in the migration patterns of people and jobs are characteristic empirical aspects of many developed countries. In some regions they have combined to bring about relative (and in some cases absolute) population decline of highly urbanized areas; in others they have brought about rapid metropolitan growth.

The objective of the Urban Change Task in IIASA's Human Settlements and Services Area is to bring together and synthesize available empirical and theoretical information on the principal determinants and consequences of such urban growth and decline.

This paper, the second of a series on multistate projection, focuses on place-of-residence-by-place-of-birth (PRPB) multiregional population analysis. The states are regions of birth. Projections carried out with the Markovian assumption are contrasted with those for which this assumption is relaxed.

A list of publications in the Urban Change Series appears at the end of this paper.

Andrei Rogers
Chairman
Human Settlements
and Services Area

ABSTRACT

This paper develops a procedure for carrying out multiregional population projections disaggregated by region of birth. Two classes of projections are developed: *native-independent* projections that assign to all residents of a region identical probabilities of transition and *native-dependent* projections that further disaggregate such probabilities by region of birth. The results underscore the importance of incorporating place-of-birth-specific information in demographic analysis.

ACKNOWLEDGMENTS

The authors are grateful to Tatiana Zaslavskaya for suggestions and criticisms on the topic of this paper. Jacques Ledent kindly provided the native-dependent data and offered useful comments on an earlier draft. Thanks also go to Denise Baker-Promper for a careful job of typing.

CONTENTS

MULTISTATE POPULATION PROJECTIONS

1. INTRODUCTION

Much of mathematical demography is concerned with the measurement and projection of changes of state, or status, experienced by individuals during their lifetime, e.g., changes in marital status, in employment status, in educational status, and in residential location. The study of such transitions from state to state and the evolution of the associated status-specific populations is the focus of a growing body of methodological techniques and applications sometimes referred to as multistate demography (Rogers, 1980).

Recent work in multistate mathematical demography has identified a unifying matrix-based generalization of classical techniques which illuminates the common features of many of the well-known methods for dealing with transfers between multiple states of existence. For example, it is now understood that multiple decrement life tables, marital status life tables, tables of working life, tables of educational life, and multiregional life tables all are members of a general class of increment-decrement life tables known as multistate life tables. It also has become evident that projections of populations disaggregated by status can be carried out using a common methodology of multistate projection.

Although traditional single-state methods are more parsimonious in their data requirements and provide reasonably adequate results for many purposes, they cannot deal with interstate transitions differentiated by origins and destinations and must, therefore, account for changes in stocks by reference to net totals, e.g., net migration. In a recent paper we have shown that such an approach may introduce biases and inconsistencies into a projection and that multistate models have a decisive advantage over single-state models as a consequence of their capability for producing disaggregated projections that trace the evolution of subcategories of a population over time and space (Rogers and Philipov, 1979). This feature of multistate projection methods is further developed in this paper, in the particular context of multiregional demography.

2. STATIONARY AND STABLE POPULATION DISTRIBUTIONS

To provide a measure of concreteness for our argument, imagine a population of a single sex (females) disaggregated into 5-year age groups and for ease of exposition, consider its spatial distribution to extend over only two regions, North and South. For a numerical illustration let us draw on 1965-1970 data for the United States previously examined in Rogers and Castro (1976) and, more recently, in Ledent (1980). These data are set out in the Appendices and will be used throughout this paper. Note that the three Census Regions: Northeast, North Central, and West have been aggregated together to form a single region: the Rest of the United States or, more simply, the North.

In 1968, the female population of the U.S. stood at 102.3 million, with 32.5 million in the South and 69.8 million in the North (Appendix A). Conventional single-region life table calculations give a Southern-born baby girl a life expectancy of 74.11 years, just three months less than the corresponding life expectancy of a baby girl born in the North. The gross reproduction rates in the two regions are 1.18 and 1.16, respectively.

Consider next the results of a multiregional (two state) analysis (Rogers, 1975). First, computing a biregional life table (Appendix B.1) we observe that about 27 percent of a Southern-born baby girl's life expectancy[1] can be expected to be lived in the North. Projecting the biregional population 30 years forward on the assumption of constant rates gives a 1998 national total of 138.6 million, with 33.0 percent residing in the South (Appendix B.2). Continuing this projection to stability yields an ultimate share for the South of 34.5 percent and an intrinsic rate of growth of 4.361 per thousand (Appendices B.3 and B.4).

The expectation of life at birth in a conventional single-state life table with a unit radix may be interpreted as the stationary population that underlies the life table calculations. This feature also carries over to multistate life tables; hence, we may conclude that in the stationary biregional population set out in Appendix B.1 about 72.6 percent of the total Southern-born population resides in the South as natives whereas 84.8 percent of the Northern-born population lives in the North, leaving the remaining 15.2 percent to live in the South as aliens (i.e., individuals living in a place different from their place of birth).

Multiplying the stationary population in each age group by $e^{-r(x+2.5)}$, where r is the intrinsic rate of growth and x is the starting age of the age group, gives the relative age distribution of the place-of-birth-specific stable population resident in each region. Since r is relatively small in our U.S. illustration (r=.004361) the stable share of natives and aliens in each region differs only slightly from the stationary (life-table) share, with the above 72.6 and 84.8 percentage-natives totals shifting to 72.3 and 86.4, respectively. Multiplying each of these by the stable shares of the national population in each region (i.e., 34.5 and 65.5 percent, respectively) gives the stable shares of the national population in each of the four place-of-residence-by-place-of-birth (PRPB) subcategories, set out as the bottom line in Table 1.

---

[1]This expectancy is a bit higher in the biregional calculation because interregional migration exposes some of these babies to the slightly lower mortality levels in the North.

Table 1. PRPB Stable Shares of Total National Population: U.S. Females, r=.004361

Population Residing in Region (%)				TOTAL
South		North		
Natives	Aliens	Natives	Aliens	
72.3	27.7	86.4	13.6	200.0
34.5		65.5		100.0
24.9	9.6	56.6	8.9	100.0

3. NATIVE-INDEPENDENT MULTISTATE PRPB POPULATION PROJECTIONS

Several recent studies of migration have underscored the importance of analyzing the flow patterns of <u>return</u> migrants, pointing to the not-surprising empirical fact that the migration rates of people returning to their region of birth are significantly higher than the average (Ledent, 1980; Lee, 1974; Long and Hansen, 1975; Miller, 1977). In the next section we follow this advice and introduce higher transition probabilities for return migrants in the multistate projection model. We shall call the outputs of such models <u>native-dependent projections</u>. In this section, however, we treat first the simpler case of <u>native-independent projections</u>, that is, projections carried out with models which assume that all of the individuals in a regional population experience identical age-specific risks of moving, dying, and bearing offspring.[2]

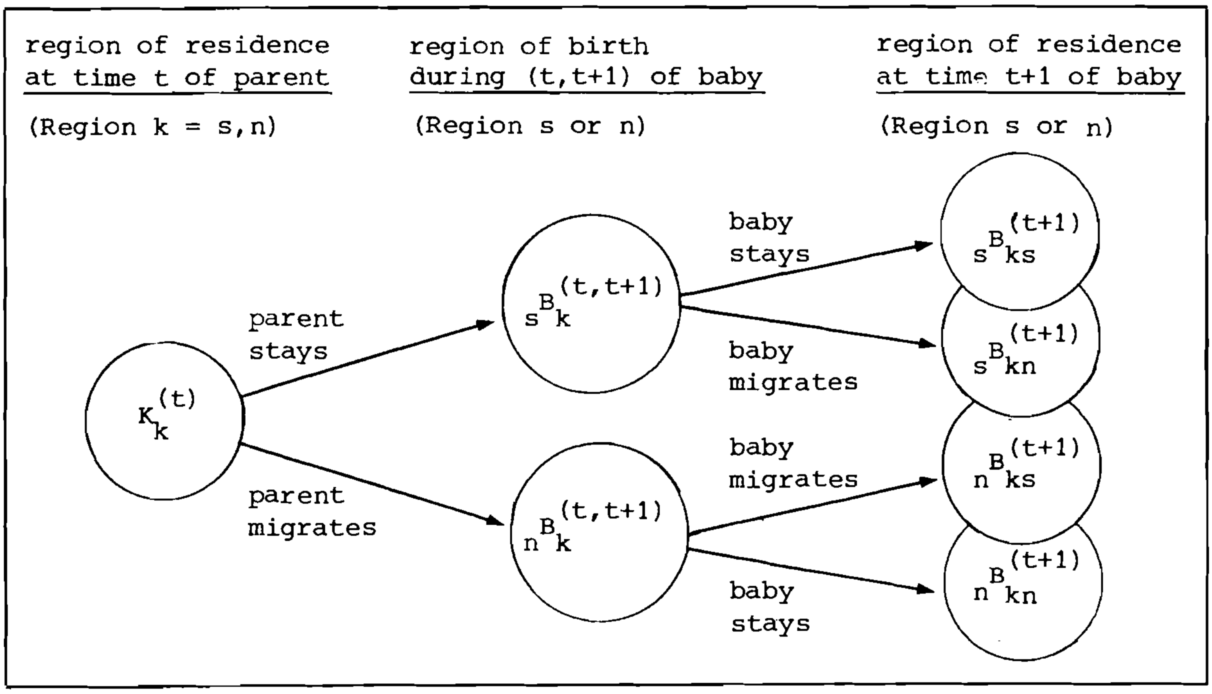
---

[2]Because of the unavailability of the necessary fertility and mortality data, we are unable to introduce native-dependency in birth and death rates.

3.1 Fertility

In projecting a multistate population forward over time we shall at times refer to people by where they live and at other times by where they were born. This poses no difficulties when we are dealing with survivors of a current population; it becomes simply a matter of keeping track of individuals born in each region. It is the births of new individuals that needs to be examined, because babies may be born in the region of residence of their parents at the start or at the end of the unit interval of time, and they themselves may migrate during the same interval into yet another region.

In the conventional multistate projection model, some of the babies born in a given region during a unit time interval (t, t+1) can be living in another region by the end of that interval. Consequently, at time t+1 these babies can be distinguished both by their place of residence, j, and by their place of birth, i. Moreover, they also may be classified by the region of residence, say k, of their parent at the <u>start</u> of the time interval, because each regional population of parents is a potential contributor of babies to each PRPB-specific category of babies. For example, in our two-region illustration based on U.S. data, we distinguish the following four categories of babies for each of the two residence-specific categories of parent.



Let

$$b_{kj}^{i}(x) = \frac{{}_{i}B_{kj}^{(t+1)}(x)}{K_{k}^{(t)}(x)} \tag{1}$$

denote the average number of babies born during time interval (t, t+1) in region i and alive in region j at time t+1, per x-year-old individual living in region k at time t. Summing over all birth places i gives the conventional multiregional birth rate (Rogers, 1975, p. 121):

$$b_{kj}(x) = \frac{1}{2}\left[\frac{{}_{k0}L_{j}(0)}{\ell_{k}(0)} F_{k}(x) + \sum_{h=1}^{m} s_{kh}(x) \frac{{}_{h0}L_{j}(0)}{\ell_{h}(0)} F_{h}(x+5)\right] \tag{2}$$

where

$F_h(x)$ = annual birth rate of people aged x to x+4 residing in region h;

${}_{h0}L_j(x)$ = total number of person-years lived between ages 0 to 5 in region j, per person born in region h (the stationary life table population);

$s_{kh}(x)$ = proportion of people in region k and aged x to x+4 that survive to be in region j and aged x+5 to x+9, five years later; and

$\ell_h(0)$ = radix of region h (set equal to unity in our calculations).

Since, by definition,

$$b_{kj}(x) = \sum_{i=1}^{m} b_{kj}^{i}(x) \tag{3}$$

one can readily develop computational formulas for $b_{kj}^{i}(x)$ by "picking off" the appropriate components in Equation (2). For our two-region (South-North) example, this gives four equations of the form:

$$b_{kj}^{k}(x) = \frac{1}{2} \frac{{}_{k0}L_{j}(0)}{\ell_{k}(0)} \left[F_{k}(x) + s_{kk}(x) F_{k}(x+5)\right] \qquad k,j=s,n \tag{4}$$

for our two region-specific nonmigrating parents, (each with one equation for migrating babies and one for nonmigrating babies), and another four of the form:

$$b^{i}_{kj}(x) = \frac{1}{2}\,\frac{{}_{i0}L_{j}(0)}{\ell_{i}(0)}\left[s_{ki}(x)\,F_{i}\,(x+5)\right] \qquad k,i,j=s,n \quad (i\neq k) \qquad (5)$$

for our two region-specific migrating parents (again each with one for migrating babies and one for nonmigrating babies).

3.2 Projection

The age-specific birth rates, by location of birth, may be incorporated into the standard multiregional projection model (Rogers, 1975, Ch. 5) transforming that model into a <u>multistate</u> projection model, where the states of interest in our instance are places of birth. Such a transformation allows one to generate projections that keep track of the regions of birth, i.e., that produce place-of-residence-by-place-of-birth (PRPB) projections.

Appendix B.5 describes the details of the matrix model. Note that the Markovian assumption is still retained. All individuals in a region, recent inmigrants as well as old residents, aliens as well as natives, are assumed to experience identical probabilities of transition. This assumption is relaxed in the next section.

Appendix B.6 sets out the multistate growth matrix for our two-region (South and North), two-state (natives and aliens) example. Appendix B.7 presents the stable distribution across states that ultimately arises if this projection matrix is applied to <u>any</u> observed population. The stable distribution depends only on the elements of the growth matrix and not on the initial (base-year) population distribution. (Inasmuch as it is also of some interest to use the matrix to generate projections, a 30-year projection based on the 1968 population is included in Appendix B.8 for future reference.)

The stable growth results in Appendix B.7 may be compared with those presented earlier for the conventional projection set out in Appendix B.3. Note that the intrinsic rate of growth remains the same (r=.004361) as does the spatial distribution of the national population (SHA_s = 34.46% and SHA_n = 65.54%). The national and regional age compositions remain unchanged, with the mean age in the South being 37.94 years and that in the North 36.65. In short, the two projections to stability give identical results, as they indeed must. The multistate projection, however, includes additional information; namely, it disaggregates regional populations by place of birth. It reveals, for example, that, at stability, the mean age of the alien population in the South will be about 13 years older than that of the native population and some 2.5 years younger than the North's alien population. All of these stable growth results, however, could be obtained without the multistate growth matrix. We have shown earlier (Table 1) that a simple weighting of the stationary multiregional life table population gives identical results. The usefulness of the growth matrix, therefore, lies in generating projections, such as the one for 1998 presented in Appendix B.8.

4. NATIVE-DEPENDENT MULTISTATE PRPB POPULATION PROJECTIONS

4.1 Data

It is widely recognized that the migration rates of return migrants are significantly above the average (Ledent, 1980; Long and Hansen, 1975; Miller, 1977). Migration data published in the 1970 U.S. Census provide empirical support for this observation. Appendix C sets out the relevant figures for our two-region example.

Appendix C.1 presents data on the Southern-born population residing in the South in 1968. It shows a crude migration rate of Southern-born females to the North of 6.12 per thousand. Appendix C.2 sets out the corresponding data for the Southern-born population living in the North, and gives them a crude migration rate to the South (i.e., return migration) of 23.79, roughly 4 times as large. Nevertheless, because the population at risk is much larger in the South, the corresponding net migration of Southern-born into the South is negative.

Appendix C.3 presents data on the Northern-born population living in the South. Their crude rate of return migration to the North is 32.39 per thousand, again about 4 times the rate of Northern-born migrating in the opposite direction (8.72 according to Appendix C.4). Once again, the net migration of natives into their region of birth is negative.

Appendix C also indicates that the native-alien composition of the flows in the two directions differs. The flow from the South to the North consists of 883.4 thousand Southern-borns and 580.9 thousand returning Northern-borns, a 1.5 to 1 native-to-alien ratio. The flow from the North to the South, on the other hand, consists of 2.8 million Northern-borns against 730.8 thousand returning Southern-borns, a 3.8 to 1 native-to-alien ratio. The principal reason for this compositional difference is the 2 to 1 ratio of the two populations at risk. The North, with about two-thirds of the national population sends roughly 2.4 times as many migrants to the South as it receives in return.

Although native-dependent migration data such as appear in Appendix C are available for the U.S., apparently no comparable data on fertility and mortality exist. Thus in what follows we retain the Markovian assumption for birth and death rates, assuming that everyone residing in a given region is exposed to identical risks of fertility and mortality. Consequently our development of a native-dependent multistate projection model will treat only migration as being native-dependent. The necessary extensions to include fertility and mortality should be straightforward, but in the U.S. context, at least, it is likely that such an extension would not produce significantly different results.

4.2 Life Table

The computation of a PRPB native-dependent life table is a straightforward exercise (Ledent, 1980). One simply calculates a separate table for each cohort, applying to it the appropriate PRPB probabilities. No new conceptual innovations are required; indeed a standard multiregional life table program (Willekens and Rogers, 1978) may be used. Such a program, applied to the data in Appendix C, produced the native-dependent life table summarized in Appendices D.1 and D.2.

Appendix D.1 shows that the probabilities of return migration are significantly larger than those of non-return migration. For example, the probability that a Southern-born 20 year-old female living in the South will be in the North 5 years later is .0551. For the corresponding Northern-born female residents of the South this probability is .2749; the return migration probability is 5 times higher. Roughly the same differential is exhibited by return migration to the South (.0263 as against .1300).

Applying such probabilities to Southern-born and Northern-born cohorts in a multistate life table gives the expectations of life set out in Appendix D.2. Table 2 presents, for example, the expectations of remaining lifetime at age 20. Illustrated there are the sharp differences in the locations where remaining lifetimes are expected to be lived. A Southern-born female living in the North at age 20 is likely to spend over half of her remaining expected lifetime of 56.59 years back in her region of birth, about 6 times the corresponding duration of residence for a Northern-born female at the same age and location.

4.3 Fertility

The introduction of native-dependent migration behavior into the calculation of the fertility elements of the multistate growth matrix is straightforward and uses the native-dependent probabilities and survivorship proportions defined in the native-dependent life table. The formulas for $b^i_{kj}(x)$ receive an additional subscript denoting the place of birth of the parent. Thus

$$b^i_{kj} = \sum_{h=1}^{m} {}_h b^i_{kj}(x) \qquad (6)$$

Table 2. Expectations of Remaining Lifetime at Age 20, by Place of Birth and Place of Future Residence

A. Southern-born population

		Residence at Age 20: South	Residence at Age 20: North
Place of Future Residence	South	46.41	32.43
	North	10.10	24.16
	TOTAL	56.51	56.59

B. Northern-born population

		Residence at Age 20: South	Residence at Age 20: North
Place of Future Residence	South	13.06	5.08
	North	43.52	51.55
	TOTAL	56.58	56.63

where the rates now receive a subscript on the left-hand side to denote the place-of-birth-specific probabilities used to calculate expected births.

The required computation procedure can be more readily understood if Equations (4) and (5) are first re-expressed in the alternative form (Willekens and Rogers, 1978, p. 59):

$$b^{k}_{kj}(x) = \frac{5}{4}\, p_{kj}(0)\,[F_k(x) + s_{kk}(x)F_k(x+5)] \quad , \; j \neq k \tag{7}$$

$$= \frac{5}{4}\,[1 + p_{kk}(0)]\,[F_k(x) + s_{kk}(x)F_k(x+5)] \quad , \; j = k \tag{8}$$

and

$$b^{i}_{kj}(x) = \frac{5}{4}\, p_{ij}(0)\,[s_{ki}(x)F_i(x+5)] \quad , \; j \neq i \tag{9}$$

$$= \frac{5}{4}\,[1 + p_{ii}(0)]\,[s_{ki}(x)F_i(x+5)] \quad , \; j = i \tag{10}$$

since

$$\frac{{}_{k0}L_j(0)}{\ell_k(0)} = \frac{5}{2}\, p_{kj}(0) \quad , \; k \neq j \tag{11}$$

and

$$\frac{{}_{k0}L_k(0)}{\ell_k(0)} = \frac{5}{2}\,[1 + p_{kk}(0)] \quad , \; k = j \tag{12}$$

when the linear integration formula is used to calculate person-years on a unit radix.

Equations (7)-(10) may be transformed into native-dependent formulas by replacing $p_{kj}(0)$ by ${}_{h}p_{kj}(0)$ and $s_{ki}(x)$ by ${}_{h}s_{ki}(x)$, respectively. The native-dependent probabilities and survivorship proportions may be obtained from the multistate life table (see, for example, Appendices D.1 and D.3). In our two-region numerical example, the birth rates with h equal to the baby's place of birth may be found as a residual:

$${}_{h}b^{h}_{kj}(x) = {}_{h}b_{kj}(x) - {}_{h}b^{i}_{kj}(x) \quad . \tag{13}$$

4.4 Projection

Collecting the various native-dependent birth rates and survivorship proportions to form the matrices $\underset{\sim}{B}(x)$ and $\underset{\sim}{S}(x)$ defined in Equation (B.6) of Appendix B.5 and organizing them in the structure of the growth matrix defined in Equation (B.5), and illustrated in Appendix D.3, yields a native-dependent multistate projection model that distinguishes among transition probabilities and regional populations according to place of birth. Such a model produces rather different projections than does its native-independent counterpart discussed in Section 3 of this paper. Table 3 provides a comparison of selected outputs. More detailed outputs of the native-dependent model may be found in Appendices D.4 and D.5.

Table 3 identifies two very important characteristics of native-dependent and native-independent projections. First, aggregate totals and growth rates are the same in the two kinds of projections if the Markovian assumption is retained for fertility and mortality rates. For example, in both projections, the U.S. total female population is projected to stand at 138.6 million in 1998 and to ultimately converge to an intrinsic rate of growth of .00436. Second, the percentage share of natives in each regional population is consistently underestimated in the native-independent projections because they do not take into account the higher migration probabilities of return migrants. This suggests that disaggregations by place of birth may not lead to significant improvements in accuracy with which national population growth is projected; however, they are an important input to projected redistributions of national populations.

Note that in the native-dependent projection the South's share of the national population total consistently hovers at the level of 32 percent, whereas in the native-independent projection it increases slightly over time to an ultimate share of just over 34 percent. A comparison of the mean ages of natives and aliens in Appendices B.7 and D.5 suggests that the native-dependent projection generates a slightly older native population and a younger alien population in each region.

Table 3. Alternative PRPB Projections to 1998 and Stability: U.S. Females, 1968*

A. Native-Dependent Projections (Appendices D.4 and D.5): r = .004360

Year	Population Residing in Region				TOTAL
	South		North		
	Natives	Aliens	Natives	Aliens	
1968	28,885,548	3,586,779	63,662,232	6,142,451	102,277,016
%	(28.2)	(3.5)	(62.2)	(6.0)	(100.0)
1998	38,495,044	6,289,250	86,446,904	7,378,696	138,609,888
%	(27.8)	(4.5)	(62.4)	(5.3)	(100.0)
Stable %	(26.9)	(5.0)	(63.3)	(4.7)	(100.0)

B. Native-Independent Projections (Appendices B.7 and B.8): r = .004361

Year	Population Residing in Region				TOTAL
	South		North		
	Natives	Aliens	Natives	Aliens	
1968	28,885,548	3,586,779	63,662,232	6,142,451	102,277,016
%	(28.2)	(3.5)	(62.2)	(6.0)	(100.0)
1998	34,966,964	10,832,081	81,580,392	11,213,493	138,592,928
%	(25.2)	(7.8)	(58.9)	(8.1)	(100.0)
Stable %	(24.9)	(9.6)	(56.6)	(8.9)	(100.0)

*Totals may differ slightly due to independent rounding.

5. EXTENSIONS

The fundamental concepts discussed in this paper have been illustrated with a four-state projection model in which two of the states referred to regions of residence and the other two to regions of birth. This disaggregation produced PRPB population projections, i.e., projections of regional populations disaggregated into natives and aliens. The extension of this projection methodology to a larger number of states is relatively straightforward. For example, we may further disaggregate natives into stayers, who never have left the region of birth, and returners.[3] And aliens may be disaggregated into new aliens, inmigranting aliens arriving during the time interval just concluded, and old aliens. Thus we have the following disaggregation:

residents = natives + aliens
= stayers + returners + old aliens + new aliens

Appendix E sets out such a disaggregation of the projected native-independent stable population presented earlier in Appendix B.7. An analogous result could be obtained for the native-dependent stable population in Appendix D.5.

Table 4 extracts selected results from Appendix E. Note the surprisingly large shares of the native and alien populations accounted for by stayers and old aliens, respectively. And observe the large variations exhibited by the mean ages of the various status-specific populations.

[3]Stayers can only be approximated with the assumption that individuals present in a region both at the beginning and end of a unit interval of time never left the region during that time period.

Table 4. Stayers, Returners, Old Aliens, and New Aliens in the Stable Population*: Native-Independent Multistate Projection (r = .004361).

Region of Residence	Residents	Natives		Aliens	
		Stayers	Returners	Old Aliens	New Aliens
<u>South</u>					
Population (stable)	44,748,500	30,996,010	1,377,703	10,674,229	1,700,556
Share of Total (%)	100.0	69.3	3.1	23.8	3.8
Mean Age	37.94	32.71	56.29	51.82	31.42
<u>North</u>					
Population (stable)	85,099,416	71,193,688	2,320,481	10,225,156	1,360,090
Share of Total (%)	100.0	83.7	2.7	12.0	1.6
Mean Age	36.65	34.48	53.83	49.35	25.42

*The stable population shown here is not the stable equivalent population set out in Appendix B.7, but it is proportional to it and could be scaled to the same totals.

6. CONCLUSION

Multistate population projections disaggregate conventional population projections into a number of state-specific subcategories, such as region of residence, region of birth, and duration of residence in the current location. To the extent that interstate transition probabilities vary with such statuses, the disaggregated projections should produce more accurate results. This appears to be particularly the case in projections of the distribution of an aggregate population across several status categories. Because in our numerical example we had to assume native-independent fertility and mortality rates, the aggregate growth rate of the population, not surprisingly, was unaffected by the disaggregation. However, it is likely that this would no longer be the case, for example, were disaggregated rural and urban data on fertility used in a projection for a typical developing country.

REFERENCES

Ledent, J. (1980) *Constructing Multiregional Life Tables Using Place-of-Birth-Specific Migration Data.* WP-80-00. Laxenburg, Austria: International Institute for Applied Systems Analysis.

Lee, A.S. (1974) Return Migration in the United States, *International Migration Review*, 8, 283-300.

Long, L.H. and K.A. Hansen (1975) Trends in Return Migration to the South, *Demography*, 12, 601-614.

Miller, A.R. (1977) Interstate Migrants in the United States: Some Social-Economic Differences by Type of Move, *Demography*, 14, 1-17.

Rogers, A. (1975) *Introduction to Multiregional Mathematical Demography.* New York: Wiley.

Rogers, A., ed. (1980) *Essays in Multistate Demography*. RR-80-10. Laxenburg, Austria: International Institute for Applied Systems Analysis (reprinted from a special issue of *Environment and Planning A*, XII:5, May 1980).

Rogers, A. and L.J. Castro (1976) *Model Multiregional Life Tables and Stable Populations*. RR-76-9. Laxenburg, Austria: International Institute for Applied Systems Analysis.

Rogers, A. and D. Philipov (1979) *Multiregional Methods for Subnational Population Projections*. WP-79-40. Laxenburg, Austria: International Institute for Applied Systems Analysis (forthcoming in *Sistemi Urbani*, 1980).

Willekens, F. and A. Rogers (1978) *Spatial Population Analysis: Methods and Computer Programs*. RR-78-18. Laxenburg, Austria: International Institute for Applied Systems Analysis.

APPENDICES

APPENDIX A.1: Input Data: South, 1968

age	population number	population - % -	births number	births - % -	deaths number	deaths - % -	arrivals number	arrivals - % -	departures number	departures - % -	observed rates (x 1000) birth	death	inmig	outmig	net mig
0	3334898.	10.27	0.	0.00	17782.	8.24	209403.	11.99	199715.	13.64	0.000	5.332	12.558	11.977	0.581
5	3542782.	10.91	0.	0.00	1504.	0.70	172787.	9.89	153848.	10.51	0.000	0.425	9.754	8.685	1.069
10	3339162.	10.28	2626.	0.49	1161.	0.54	162400.	9.30	148174.	10.12	0.786	0.348	9.727	8.875	0.852
15	2891785.	8.91	114390.	21.48	1853.	0.86	272908.	15.62	272329.	18.60	39.557	0.641	18.875	18.835	0.040
20	2311419.	7.12	183919.	34.54	1786.	0.83	215741.	12.35	219342.	14.98	79.570	0.773	18.667	18.979	-0.312
25	1990180.	6.13	121960.	22.90	1888.	0.87	141976.	8.13	125653.	8.58	61.281	0.949	14.268	12.627	1.640
30	2037422.	6.27	67009.	12.58	2846.	1.32	107328.	6.14	89143.	6.09	32.889	1.397	10.536	8.751	1.785
35	1985913.	6.12	32854.	6.17	4479.	2.08	85610.	4.90	67244.	4.59	16.544	2.255	8.622	6.772	1.850
40	1986324.	6.12	9189.	1.73	6585.	3.05	72598.	4.16	51118.	3.49	4.626	3.315	7.310	5.147	2.163
45	1978231.	6.09	584.	0.11	9402.	4.36	57991.	3.32	34586.	2.36	0.295	4.753	5.863	3.497	2.366
50	1734004.	5.34	0.	0.00	11382.	5.27	54761.	3.13	25819.	1.76	0.000	6.564	6.316	2.978	3.338
55	1607191.	4.95	0.	0.00	15289.	7.08	68248.	3.91	20932.	1.43	0.000	9.513	8.493	2.605	5.888
60	1086849.	3.35	0.	0.00	14476.	6.71	55626.	3.18	17635.	1.20	0.000	13.319	10.236	3.245	6.991
65	932570.	2.87	0.	0.00	19581.	9.07	33834.	1.94	14781.	1.01	0.000	20.997	7.256	3.170	4.086
70	709600.	2.19	0.	0.00	22675.	10.51	19852.	1.14	13320.	0.91	0.000	31.955	5.595	3.754	1.841
75	495358.	1.53	0.	0.00	26323.	12.20	11912.	0.68	7993.	0.55	0.000	53.139	4.809	3.227	1.582
80	299348.	0.92	0.	0.00	25558.	11.84	2979.	0.17	1998.	0.14	0.000	85.379	1.990	1.335	0.655
85	209286.	0.64	0.	0.00	31275.	14.49	994.	0.06	667.	0.05	0.000	149.437	0.950	0.637	0.312
tot	32472326.	100.00	532531.	100.00	215845.	100.00	1746948.	100.00	1464297.	100.00					
gross											1.178	1.952	0.809	0.625	
crude(x1000)											16.400	6.647	10.760	9.019	1.741
m.age		30.80		25.08		62.15		25.86		22.10	25.80	77.51	34.60	29.13	
e(0)												74.11			

APPENDIX A.2: Input Data; North, 1968

age	population number	population - % -	births number	births - % -	deaths number	deaths - % -	arrivals number	arrivals - % -	departures number	departures - % -	observed rates (x 1000) birth	death	inmig	outmig	net mig
0	7452446.	10.68	0.	0.00	36704.	8.08	420076.	13.03	429764.	12.26	0.000	4.925	11.274	11.534	-0.260
5	7848825.	11.24	0.	0.00	2855.	0.63	330062.	10.24	349001.	9.95	0.000	0.364	8.410	8.893	-0.483
10	7183312.	10.29	2296.	0.21	2015.	0.44	306192.	9.50	320418.	9.14	0.320	0.281	8.525	8.921	-0.396
15	6089654.	8.72	165521.	15.25	3426.	0.75	582227.	18.06	582806.	16.62	27.181	0.563	19.122	19.141	-0.019
20	4912590.	7.04	370626.	34.16	3229.	0.71	492922.	15.29	489321.	13.96	75.444	0.657	20.068	19.921	0.147
25	4167663.	5.97	280926.	25.89	3245.	0.71	281210.	8.72	297533.	8.49	67.406	0.779	13.495	14.278	-0.783
30	4380822.	6.28	162729.	15.00	4860.	1.07	199438.	6.19	217623.	6.21	37.146	1.109	9.105	9.935	-0.830
35	4279997.	6.13	79516.	7.33	7808.	1.72	150179.	4.66	168545.	4.81	18.579	1.824	7.018	7.876	-0.858
40	4459036.	6.39	22108.	2.04	12563.	2.77	117653.	3.65	139133.	3.97	4.958	2.817	5.277	6.240	-0.963
45	4572721.	6.55	1358.	0.13	18994.	4.18	83246.	2.58	106651.	3.04	0.297	4.154	3.641	4.665	-1.024
50	3706203.	5.31	0.	0.00	22826.	5.03	63045.	1.96	91987.	2.62	0.000	6.159	3.402	4.964	-1.562
55	3319385.	4.76	0.	0.00	30054.	6.62	56278.	1.75	103594.	2.95	0.000	9.054	3.391	6.242	-2.851
60	2069925.	2.97	0.	0.00	27637.	6.08	47710.	1.48	85701.	2.44	0.000	13.352	4.610	8.281	-3.671
65	1731326.	2.48	0.	0.00	36548.	8.05	36645.	1.14	55698.	1.59	0.000	21.110	4.233	6.434	-2.201
70	1438705.	2.06	0.	0.00	49052.	10.80	31528.	0.98	38060.	1.09	0.000	34.095	4.383	5.291	-0.908
75	1066579.	1.53	0.	0.00	60513.	13.32	18919.	0.59	22838.	0.65	0.000	56.736	3.548	4.282	-0.735
80	668357.	0.96	0.	0.00	59863.	13.18	4730.	0.15	5711.	0.16	0.000	89.567	1.415	1.709	-0.294
85	457131.	0.65	0.	0.00	71996.	15.85	1579.	0.05	1906.	0.05	0.000	157.495	0.691	0.834	-0.143
tot	69804680.	100.00	1085080.	100.00	454188.	100.00	3223639.	100.00	3506290.	100.00					
gross											1.157	2.025	0.658	0.747	
crude(x1000)											15.545	6.507	9.236	10.046	-0.810
m.age		30.40		26.05		63.52		22.87		24.68	26.63	78.09	30.61	33.38	
e(0)												74.45			

APPENDIX A.3: Input Data; USA, 1968

age	population number	population - % -	births number	births - % -	deaths number	deaths - % -	arrivals number	arrivals - % -	departures number	departures - % -	observed rates (x 1000) birth	death	inmig	outmig	net mig
0	10787344.	10.55	0.	0.00	54486.	8.13	629479.	12.66	629479.	12.66	0.000	5.051	11.671	11.671	0.000
5	11391607.	11.14	0.	0.00	4359.	0.65	502849.	10.12	502849.	10.12	0.000	0.383	8.828	8.828	0.000
10	10522474.	10.29	4922.	0.30	3176.	0.47	468592.	9.43	468592.	9.43	0.468	0.302	8.906	8.906	0.000
15	8981439.	8.78	279911.	17.30	5279.	0.79	855135.	17.20	855135.	17.20	31.165	0.588	19.042	19.042	0.000
20	7224009.	7.06	554545.	34.28	5015.	0.75	708663.	14.26	708663.	14.26	76.764	0.694	19.620	19.620	0.000
25	6157843.	6.02	402886.	24.91	5133.	0.77	423186.	8.51	423186.	8.51	65.426	0.834	13.745	13.745	0.000
30	6418244.	6.28	229738.	14.20	7706.	1.15	306766.	6.17	306766.	6.17	35.795	1.201	9.559	9.559	0.000
35	6265910.	6.13	112370.	6.95	12287.	1.83	235789.	4.74	235789.	4.74	17.934	1.961	7.526	7.526	0.000
40	6445360.	6.30	31297.	1.93	19148.	2.86	190251.	3.83	190251.	3.83	4.856	2.971	5.904	5.904	0.000
45	6550952.	6.41	1942.	0.12	28396.	4.24	141237.	2.84	141237.	2.84	0.296	4.335	4.312	4.312	0.000
50	5440207.	5.32	0.	0.00	34208.	5.11	117806.	2.37	117806.	2.37	0.000	6.288	4.331	4.331	0.000
55	4926576.	4.82	0.	0.00	45343.	6.77	124526.	2.51	124526.	2.51	0.000	9.204	5.055	5.055	0.000
60	3156774.	3.09	0.	0.00	42113.	6.29	103336.	2.08	103336.	2.08	0.000	13.341	6.547	6.547	0.000
65	2663896.	2.60	0.	0.00	56129.	8.38	70479.	1.42	70479.	1.42	0.000	21.070	5.291	5.291	0.000
70	2148305.	2.10	0.	0.00	71727.	10.70	51380.	1.03	51380.	1.03	0.000	33.388	4.783	4.783	0.000
75	1561937.	1.53	0.	0.00	86836.	12.96	30831.	0.62	30831.	0.62	0.000	55.595	3.948	3.948	0.000
80	967705.	0.95	0.	0.00	85421.	12.75	7709.	0.16	7709.	0.16	0.000	88.272	1.593	1.593	0.000
85	666417.	0.65	0.	0.00	103271.	15.41	2573.	0.05	2573.	0.05	0.000	154.965	0.772	0.772	0.000
tot	102277000.	100.00	1617611.	100.00	670033.	100.00	4970587.	100.00	4970587.	100.00					
gross											1.164	2.002	0.707	0.707	
crude(x1000)											15.816	6.551	9.720	9.720	0.000
m.age		30.53		25.73		63.08		23.92		23.92	26.36	77.91	32.13	32.13	
e(0)												74.34			

APPENDIX B.1: Biregional Life Table: South and North, 1968

age	q(x,1)	p(x,1,1)	p(x,2,1)	l(x,1,1)	l(x,2,1)	ll(x,1,1)	ll(x,2,1)	m(x,2,1)	md(x,1)	s(x,1,1)	s(x,2,1)	e(x,1,1)	e(x,2,1)
0	0.026254	0.917796	0.055950	100000.	0.	4.79449	0.13987	0.011977	0.005332	0.935958	0.049674	53.81	20.34
5	0.002114	0.955917	0.041968	91780.	5595.	4.49081	0.37282	0.008685	0.000425	0.955671	0.042408	50.34	20.74
10	0.001730	0.955400	0.042870	87853.	9318.	4.29977	0.55462	0.008875	0.000348	0.932966	0.064580	45.82	20.40
15	0.003182	0.909020	0.087799	84138.	12867.	4.02897	0.81370	0.018835	0.000641	0.908391	0.088108	41.47	19.86
20	0.003830	0.907739	0.088430	77021.	19681.	3.69352	1.13255	0.018979	0.000773	0.920653	0.075086	37.43	19.09
25	0.004707	0.935336	0.059957	70720.	25621.	3.44241	1.36386	0.012627	0.000949	0.942773	0.051420	33.74	17.98
30	0.006930	0.951020	0.042050	66976.	28933.	3.28382	1.49600	0.008751	0.001397	0.953487	0.037473	30.30	16.64
35	0.011179	0.956178	0.032643	64377.	30907.	3.16321	1.57597	0.006772	0.002255	0.957411	0.028812	27.05	15.18
40	0.016409	0.958764	0.024827	62152.	32132.	3.05613	1.62128	0.005147	0.003315	0.959195	0.020903	23.98	13.67
45	0.023460	0.959691	0.016849	60093.	32720.	2.95411	1.63448	0.003497	0.004753	0.956670	0.015511	21.07	12.14
50	0.032276	0.953504	0.014220	58071.	32659.	2.84757	1.61731	0.002978	0.006564	0.947575	0.013182	18.30	10.62
55	0.046446	0.941315	0.012239	55832.	32033.	2.72515	1.56780	0.002605	0.009513	0.931320	0.013439	15.65	9.12
60	0.064451	0.920663	0.014885	53174.	30679.	2.57216	1.48528	0.003245	0.013319	0.904106	0.014378	13.15	7.69
65	0.099752	0.886180	0.014068	49712.	28732.	2.35660	1.36962	0.003170	0.020997	0.862672	0.014670	10.78	6.32
70	0.148032	0.836188	0.015780	44552.	26053.	2.05271	1.21038	0.003754	0.031955	0.798310	0.013793	8.64	5.09
75	0.234636	0.753037	0.012326	37556.	22363.	1.65070	0.98608	0.003227	0.053139	0.706043	0.008502	6.76	3.97
80	0.351842	0.643685	0.004474	28472.	17080.	1.17125	0.69970	0.001335	0.085379	1.043796	0.008439	5.26	3.06
85	1.000000	0.000000	0.000000	18378.	10907.	1.22661	0.69560	0.000637	0.149437	0.000000	0.000000	4.19	2.38

age	q(x,2)	p(x,2,2)	p(x,1,2)	l(x,2,2)	l(x,1,2)	ll(x,2,2)	ll(x,1,2)	m(x,1,2)	md(x,2)	s(x,2,2)	s(x,1,2)	e(x,2,2)	e(x,1,2)
0	0.024352	0.949396	0.026252	100000.	0.	4.87349	0.06563	0.005620	0.004925	0.962689	0.024097	63.16	11.29
5	0.001820	0.976904	0.021276	94940.	2625.	4.69492	0.17886	0.004403	0.000364	0.976834	0.021552	59.74	11.50
10	0.001405	0.976753	0.021842	92857.	4529.	4.59374	0.27212	0.004522	0.000281	0.966459	0.031430	55.03	11.34
15	0.002817	0.955401	0.041781	90893.	6355.	4.45724	0.39826	0.008963	0.000563	0.955595	0.041349	50.39	11.07
20	0.003293	0.955783	0.040924	87397.	9575.	4.29440	0.54608	0.008783	0.000657	0.959360	0.037042	45.93	10.69
25	0.003899	0.963750	0.032351	84379.	12268.	4.16088	0.66182	0.006813	0.000779	0.967108	0.028165	41.64	10.17
30	0.005548	0.970906	0.023546	82056.	14205.	4.05805	0.74114	0.004900	0.001109	0.971198	0.021478	37.49	9.52
35	0.009101	0.971616	0.019283	80266.	15441.	3.96894	0.79382	0.004000	0.001824	0.970921	0.017534	33.47	8.80
40	0.014008	0.970285	0.015707	78492.	16312.	3.87640	0.82961	0.003256	0.002817	0.968736	0.013995	29.60	8.05
45	0.020573	0.967205	0.012222	76564.	16872.	3.77255	0.85000	0.002536	0.004154	0.961465	0.013131	25.88	7.28
50	0.030341	0.955548	0.014110	74338.	17128.	3.64036	0.86271	0.002955	0.006159	0.946179	0.016611	22.32	6.50
55	0.044290	0.936389	0.019321	71277.	17380.	3.45581	0.87795	0.004112	0.009054	0.924003	0.021793	18.92	5.74
60	0.064600	0.910747	0.024653	66955.	17738.	3.20497	0.89297	0.005375	0.013352	0.897232	0.020939	15.72	4.97
65	0.100253	0.882401	0.017345	61243.	17981.	2.88844	0.87445	0.003908	0.021110	0.858492	0.014408	12.76	4.18
70	0.157026	0.831374	0.011600	54294.	16997.	2.49253	0.79598	0.002760	0.034095	0.791290	0.009920	10.13	3.42
75	0.248372	0.743096	0.008532	45407.	14842.	1.98330	0.66016	0.002234	0.056736	0.695346	0.005863	7.85	2.73
80	0.365879	0.631134	0.002987	33925.	11564.	1.38469	0.47773	0.000891	0.089567	0.980017	0.005810	6.04	2.16
85	1.000000	0.000000	0.000000	21463.	7545.	1.36105	0.50670	0.000435	0.157495	0.000000	0.000000	4.69	1.75

APPENDIX B.2: Biregional Projection; 1998

population

age	total	south	north
0	11191921.	3665005.	7526916.
5	11330953.	3653294.	7677659.
10	11523384.	3719317.	7804067.
15	10917141.	3559833.	7357308.
20	9664246.	3166043.	6498203.
25	8365251.	2744050.	5621202.
30	10471771.	3335232.	7136539.
35	11122236.	3573490.	7548746.
40	10164837.	3315739.	6849099.
45	8537646.	2822215.	5715432.
50	6708680.	2231955.	4476725.
55	5522833.	1882367.	3640466.
60	5470576.	1885838.	3584738.
65	4943318.	1740152.	3203166.
70	4501880.	1570753.	2931126.
75	3750906.	1300461.	2450444.
80	2258454.	819373.	1439081.
85	2146892.	813921.	1332971.
total	138592928.	45799032.	92793888.

percentage distribution

age	total	south	north
0	8.0754	8.0024	8.1114
5	8.1757	7.9768	8.2739
10	8.3146	8.1210	8.4101
15	7.8771	7.7727	7.9287
20	6.9731	6.9129	7.0028
25	6.0358	5.9915	6.0577
30	7.5558	7.2823	7.6907
35	8.0251	7.8025	8.1350
40	7.3343	7.2398	7.3810
45	6.1602	6.1622	6.1593
50	4.8406	4.8734	4.8244
55	3.9849	4.1101	3.9232
60	3.9472	4.1176	3.8631
65	3.5668	3.7995	3.4519
70	3.2483	3.4297	3.1587
75	2.7064	2.8395	2.6407
80	1.6296	1.7891	1.5508
85	1.5491	1.7772	1.4365
total	100.0000	100.0000	100.0000
m.ag	34.8294	35.4515	34.5224
sha	100.0000	33.0457	66.9543
lam	1.040688	1.045199	1.038476
r	0.007976	0.008841	0.007551

APPENDIX B.3: Biregional Projection: Stable Equivalent Population

stable equivalent to original population

age	total	south	north
0	10085119.	3412733.	6672386.
5	9733339.	3282591.	6450748.
10	9507037.	3205440.	6301597.
15	9281257.	3119844.	6161413.
20	9051945.	3022177.	6029768.
25	8822863.	2940894.	5881969.
30	8588644.	2874887.	5713757.
35	8337015.	2802114.	5534902.
40	8056895.	2719865.	5337030.
45	7739962.	2625686.	5114277.
50	7374423.	2523439.	4850984.
55	6941856.	2418413.	4523444.
60	6421507.	2300187.	4121320.
65	5769569.	2119189.	3650379.
70	4936833.	1840190.	3096642.
75	3889733.	1467411.	2422322.
80	2687830.	1027604.	1660227.
85	2659351.	1058911.	1600440.
total	129885200.	44761572.	85123616.

percentage distribution

age	total	south	north
0	7.7646	7.6242	7.8385
5	7.4938	7.3335	7.5781
10	7.3196	7.1611	7.4029
15	7.1457	6.9699	7.2382
20	6.9692	6.7517	7.0835
25	6.7928	6.5701	6.9099
30	6.6125	6.4227	6.7123
35	6.4188	6.2601	6.5022
40	6.2031	6.0763	6.2697
45	5.9591	5.8659	6.0081
50	5.6776	5.6375	5.6988
55	5.3446	5.4029	5.3140
60	4.9440	5.1388	4.8416
65	4.4421	4.7344	4.2883
70	3.8009	4.1111	3.6378
75	2.9947	3.2783	2.8457
80	2.0694	2.2957	1.9504
85	2.0475	2.3657	1.8801
total	100.0000	100.0000	100.0000
m.ag	37.0983	37.9440	36.6536
sha	100.0000	34.4624	65.5376
lam	1.022046	1.022046	1.022046
r	0.004361	0.004361	0.004361

APPENDIX B.4: Biregional Projection: Stable Equivalent Components and Intrinsic Rates

	births		deaths		outmigration		inmigration	
	number	rate	number	rate	number	rate	number	rate
south	700743.	0.015659	554107.	0.012383	359335.	0.008030	407843.	0.009114
north	1363633.	0.016024	943958.	0.011092	407843.	0.004793	359335.	0.004223
total	2064376.	0.015898	1498065.	0.011537	767178.	0.005908	767178.	0.005908

stable growth rate 0.004361

normalizing factor 74.0755

APPENDIX B.5: Native-Independent Multistate Projection: Biregional Model

Expressing each set of four age-specific birth rates defined in (4) and (5) in the form of a matrix, with the place-of-birth dependence (the subscript on the left-hand side) suppressed by assumption, gives

$$ {}_{s}\underset{\sim}{B}^{s}(x) = {}_{n}\underset{\sim}{B}^{s}(x) = {}_{\bullet}\underset{\sim}{B}^{s}(x) = \begin{bmatrix} b^{s}_{ss}(x) & b^{s}_{ns}(x) \\ b^{s}_{sn}(x) & b^{s}_{nn}(x) \end{bmatrix} \qquad (B.1) $$

$$ {}_{s}\underset{\sim}{B}^{n}(x) = {}_{n}\underset{\sim}{B}^{n}(x) = {}_{\bullet}\underset{\sim}{B}^{n}(x) = \begin{bmatrix} b^{n}_{ss}(x) & b^{n}_{ns}(x) \\ b^{n}_{sn}(x) & b^{n}_{nn}(x) \end{bmatrix} \qquad (B.2) $$

and setting out the corresponding survivorship proportions* as the matrix

$$ {}_{s}\underset{\sim}{S}(x) = {}_{n}\underset{\sim}{S}(x) = {}_{\bullet}\underset{\sim}{S}(x) = \begin{bmatrix} s_{ss}(x) & s_{ns}(x) \\ s_{sn}(x) & s_{nn}(x) \end{bmatrix} \qquad (B.3) $$

---

*Survivorship proportions are defined in the normal way (Rogers, 1975; p. 79) as:

$$ \underset{\sim}{S}(x) = \underset{\sim}{L}(x+5)\ \underset{\sim}{L}^{-1}(x) \quad . $$

with the place-of-birth dependence suppressed once again, gives the usual population growth process defined as the matrix multiplication:

$$\{\underset{\sim}{K}^{(t+1)}\} = \underset{\sim}{G}\{\underset{\sim}{K}^{(t)}\} \tag{B.4}$$

where

$$\underset{\sim}{G} = \begin{bmatrix} \underset{\sim}{B}(0) & \underset{\sim}{B}(5) & \cdots \\ \underset{\sim}{S}(0) & \underset{\sim}{0} & \cdots \\ \underset{\sim}{0} & \underset{\sim}{S}(5) & \\ \cdot & & \cdot \\ \cdot & & \quad\cdot \\ \cdot & & \qquad\cdot \end{bmatrix} \tag{B.5}$$

$$\underset{\sim}{B}(x) = \begin{bmatrix} {}_{\cdot}\underset{\sim}{B}^{s}(x) & {}_{\cdot}\underset{\sim}{B}^{s}(x) \\ {}_{\cdot}\underset{\sim}{B}^{n}(x) & {}_{\cdot}\underset{\sim}{B}^{n}(x) \end{bmatrix} \qquad \underset{\sim}{S}(x) = \begin{bmatrix} {}_{\cdot}\underset{\sim}{S}(x) & \underset{\sim}{0} \\ \underset{\sim}{0} & {}_{\cdot}\underset{\sim}{S}(x) \end{bmatrix}$$

and

$$\{\underset{\sim}{K}^{(t)}\} = \begin{bmatrix} \{\underset{\sim}{K}^{(t)}(0)\} \\ \{\underset{\sim}{K}^{(t)}(5)\} \\ \cdot \\ \cdot \\ \cdot \\ \cdot \end{bmatrix} \qquad \{\underset{\sim}{K}^{(t)}(x)\} = \begin{bmatrix} {}_{s}K_{s}^{(t)}(x) \\ {}_{s}K_{n}^{(t)}(x) \\ {}_{n}K_{s}^{(t)}(x) \\ {}_{n}K_{n}^{(t)}(x) \end{bmatrix}$$

The extension to the native-dependent case is straightforward. The subscript on the left-hand side is then no longer suppressed and

$$\underset{\sim}{B}(x) = \begin{bmatrix} {}_{s}\underset{\sim}{B}^{s}(x) & {}_{n}\underset{\sim}{B}^{s}(x) \\ {}_{s}\underset{\sim}{B}^{n}(x) & {}_{n}\underset{\sim}{B}^{n}(x) \end{bmatrix} \qquad \underset{\sim}{S}(x) = \begin{bmatrix} {}_{s}\underset{\sim}{S}(x) & \underset{\sim}{0} \\ \underset{\sim}{0} & {}_{n}\underset{\sim}{S}(x) \end{bmatrix} \tag{B.6}$$

APPENDIX B.6: Native-Independent Multistate Projection; Growth Matrix, 1968

region s -> s

age	first row s -> s	s -> n	n -> s	n -> n
0	0.000000	0.000000	0.000000	0.000000
5	0.001802	0.000053	0.000000	0.000033
10	0.090356	0.002636	0.000058	0.004277
15	0.268101	0.007822	0.000218	0.016198
20	0.325997	0.009511	0.000166	0.012333
25	0.221237	0.006454	0.000063	0.004654
30	0.116658	0.003403	0.000023	0.001696
35	0.050277	0.001467	0.000005	0.000348
40	0.011769	0.000343	0.000000	0.000015
45	0.000708	0.000021	0.000000	0.000000
50	0.000000	0.000000	0.000000	0.000000
55	0.000000	0.000000	0.000000	0.000000
60	0.000000	0.000000	0.000000	0.000000
65	0.000000	0.000000	0.000000	0.000000
70	0.000000	0.000000	0.000000	0.000000
75	0.000000	0.000000	0.000000	0.000000
80	0.000000	0.000000	0.000000	0.000000

age	survivorship proportions s -> s	s -> n	n -> s	n -> n
0	0.935958	0.049674	0.000000	0.000000
5	0.955671	0.042408	0.000000	0.000000
10	0.932966	0.064580	0.000000	0.000000
15	0.908390	0.088108	0.000000	0.000000
20	0.920653	0.075086	0.000000	0.000000
25	0.942773	0.051420	0.000000	0.000000
30	0.953487	0.037474	0.000000	0.000000
35	0.957411	0.028812	0.000000	0.000000
40	0.959195	0.020903	0.000000	0.000000
45	0.956670	0.015511	0.000000	0.000000
50	0.947575	0.013182	0.000000	0.000000
55	0.931320	0.013439	0.000000	0.000000
60	0.904106	0.014379	0.000000	0.000000
65	0.862672	0.014670	0.000000	0.000000
70	0.798310	0.013793	0.000000	0.000000
75	0.706043	0.008502	0.000000	0.000000
80	1.043797	0.008439	0.000000	0.000000

region s -> n

age	first row s -> s	s -> n	n -> s	n -> n
0	0.000000	0.000000	0.000000	0.000000
5	0.000041	0.000001	0.000010	0.000761
10	0.002980	0.000087	0.000872	0.064790
15	0.007887	0.000230	0.003258	0.241907
20	0.005442	0.000159	0.004598	0.341414
25	0.002221	0.000065	0.003391	0.251789
30	0.000852	0.000025	0.001811	0.134482
35	0.000194	0.000006	0.000768	0.057001
40	0.000010	0.000000	0.000172	0.012782
45	0.000000	0.000000	0.000010	0.000724
50	0.000000	0.000000	0.000000	0.000000
55	0.000000	0.000000	0.000000	0.000000
60	0.000000	0.000000	0.000000	0.000000
65	0.000000	0.000000	0.000000	0.000000
70	0.000000	0.000000	0.000000	0.000000
75	0.000000	0.000000	0.000000	0.000000
80	0.000000	0.000000	0.000000	0.000000

age	survivorship proportions s -> s	s -> n	n -> s	n -> n
0	0.024097	0.962689	0.000000	0.000000
5	0.021552	0.976834	0.000000	0.000000
10	0.031430	0.966459	0.000000	0.000000
15	0.041349	0.955595	0.000000	0.000000
20	0.037042	0.959360	0.000000	0.000000
25	0.028165	0.967107	0.000000	0.000000
30	0.021478	0.971198	0.000000	0.000000
35	0.017534	0.970921	0.000000	0.000000
40	0.013995	0.968736	0.000000	0.000000
45	0.013131	0.961465	0.000000	0.000000
50	0.016611	0.946179	0.000000	0.000000
55	0.021793	0.924003	0.000000	0.000000
60	0.020939	0.897232	0.000000	0.000000
65	0.014408	0.858492	0.000000	0.000000
70	0.009920	0.791290	0.000000	0.000000
75	0.005863	0.695346	0.000000	0.000000
80	0.005810	0.980017	0.000000	0.000000

APPENDIX B.6: Native-Independent Multistate Projection; Growth Matrix, 1968, continued.

region n -> s

age	first row s -> s	s -> n	n -> s	n -> n
0	0.000000	0.000000	0.000000	0.000000
5	0.001802	0.000053	0.000000	0.000033
10	0.090356	0.002636	0.000058	0.004277
15	0.268101	0.007822	0.000218	0.016198
20	0.325997	0.009511	0.000166	0.012333
25	0.221237	0.006454	0.000063	0.004654
30	0.116658	0.003403	0.000023	0.001696
35	0.050277	0.001467	0.000005	0.000348
40	0.011769	0.000343	0.000000	0.000015
45	0.000708	0.000021	-0.000000	0.000000
50	0.000000	0.000000	0.000000	0.000000
55	0.000000	0.000000	0.000000	0.000000
60	0.000000	0.000000	0.000000	0.000000
65	0.000000	0.000000	0.000000	0.000000
70	0.000000	0.000000	0.000000	0.000000
75	0.000000	0.000000	0.000000	0.000000
80	0.000000	0.000000	0.000000	0.000000

age	survivorship proportions s -> s	s -> n	n -> s	n -> n
0	0.000000	0.000000	0.935958	0.049674
5	0.000000	0.000000	0.955671	0.042408
10	0.000000	0.000000	0.932966	0.064580
15	0.000000	0.000000	0.908390	0.088108
20	0.000000	0.000000	0.920653	0.075086
25	0.000000	0.000000	0.942773	0.051420
30	0.000000	0.000000	0.953487	0.037474
35	0.000000	0.000000	0.957411	0.028812
40	0.000000	0.000000	0.959195	0.020903
45	0.000000	0.000000	0.956670	0.015511
50	0.000000	0.000000	0.947575	0.013182
55	0.000000	0.000000	0.931320	0.013439
60	0.000000	0.000000	0.904106	0.014379
65	0.000000	0.000000	0.862672	0.014670
70	0.000000	0.000000	0.798310	0.013793
75	0.000000	0.000000	0.706043	0.008502
80	0.000000	0.000000	1.043797	0.008439

region n -> n

age	first row s -> s	s -> n	n -> s	n -> n
0	0.000000	0.000000	0.000000	0.000000
5	0.000041	0.000001	0.000010	0.000761
10	0.002980	0.000087	0.000872	0.064790
15	0.007887	0.000230	0.003258	0.241907
20	0.005442	0.000159	0.004598	0.341414
25	0.002221	0.000065	0.003391	0.251789
30	0.000852	0.000025	0.001811	0.134482
35	0.000194	0.000006	0.000768	0.057001
40	0.000010	0.000000	0.000172	0.012782
45	0.000000	0.000000	0.000010	0.000724
50	0.000000	0.000000	0.000000	0.000000
55	0.000000	0.000000	0.000000	0.000000
60	0.000000	0.000000	0.000000	0.000000
65	0.000000	0.000000	0.000000	0.000000
70	0.000000	0.000000	0.000000	0.000000
75	0.000000	0.000000	0.000000	0.000000
80	0.000000	0.000000	0.000000	0.000000

age	survivorship proportions s -> s	s -> n	n -> s	n -> n
0	0.000000	0.000000	0.024097	0.962689
5	0.000000	0.000000	0.021552	0.976834
10	0.000000	0.000000	0.031430	0.966459
15	0.000000	0.000000	0.041349	0.955595
20	0.000000	0.000000	0.037042	0.959360
25	0.000000	0.000000	0.028165	0.967107
30	0.000000	0.000000	0.021478	0.971198
35	0.000000	0.000000	0.017534	0.970921
40	0.000000	0.000000	0.013995	0.968736
45	0.000000	0.000000	0.013131	0.961465
50	0.000000	0.000000	0.016611	0.946179
55	0.000000	0.000000	0.021793	0.924003
60	0.000000	0.000000	0.020939	0.897232
65	0.000000	0.000000	0.014408	0.858492
70	0.000000	0.000000	0.009920	0.791290
75	0.000000	0.000000	0.005863	0.695346
80	0.000000	0.000000	0.005810	0.980017

APPENDIX B.7: Native-Independent Multistate Projection: Stable Equivalent Population

age	total	s -> s	s -> n	n -> s	n -> n	south	north
0	10085108.	3324184.	96980.	88548.	6575398.	3412731.	6672377.
5	9733327.	3046470.	252910.	236119.	6197828.	3282589.	6450738.
10	9507027.	2853957.	368129.	351481.	5933459.	3205438.	6301589.
15	9281247.	2616531.	528440.	503311.	5632966.	3119842.	6161405.
20	9051934.	2346942.	719647.	675233.	5310112.	3022175.	6029760.
25	8822855.	2140195.	847929.	800698.	5034033.	2940893.	5881962.
30	8588633.	1997563.	910026.	877321.	4803722.	2874884.	5713748.
35	8337005.	1882691.	937992.	919421.	4596901.	2802112.	5534893.
40	8056885.	1779722.	944147.	940141.	4392876.	2719863.	5337022.
45	7739954.	1683207.	931299.	942478.	4182971.	2625685.	5114270.
50	7374416.	1587504.	901642.	935933.	3949336.	2523437.	4850978.
55	6941849.	1486486.	855188.	931926.	3668249.	2418412.	4523437.
60	6421499.	1372767.	792697.	927419.	3328617.	2300186.	4121313.
65	5769562.	1230596.	715204.	888592.	2935169.	2119188.	3650373.
70	4936827.	1048784.	618416.	791406.	2478221.	1840190.	3096638.
75	3889730.	825197.	492945.	642214.	1929374.	1467411.	2422319.
80	2687827.	572886.	342238.	454718.	1317986.	1027603.	1660224.
85	2659347.	587023.	332895.	471887.	1267543.	1058910.	1600437.
total	129885040.	32382706.	11588724.	12378844.	73534760.	44761552.	85123488.

percentage distribution

age	total	s -> s	s -> n	n -> s	n -> n	south	north
0	7.7646	10.2653	0.8368	0.7153	8.9419	7.6242	7.8385
5	7.4938	9.4077	2.1824	1.9074	8.4284	7.3335	7.5781
10	7.3196	8.8132	3.1766	2.8394	8.0689	7.1611	7.4029
15	7.1457	8.0800	4.5599	4.0659	7.6603	6.9699	7.2382
20	6.9692	7.2475	6.2099	5.4547	7.2212	6.7517	7.0835
25	6.7928	6.6091	7.3168	6.4683	6.8458	6.5701	6.9099
30	6.6125	6.1686	7.8527	7.0873	6.5326	6.4227	6.7123
35	6.4188	5.8139	8.0940	7.4274	6.2513	6.2601	6.5022
40	6.2031	5.4959	8.1471	7.5947	5.9739	6.0763	6.2697
45	5.9591	5.1979	8.0363	7.6136	5.6884	5.8659	6.0081
50	5.6776	4.9023	7.7803	7.5607	5.3707	5.6375	5.6988
55	5.3446	4.5904	7.3795	7.5284	4.9885	5.4029	5.3140
60	4.9440	4.2392	6.8402	7.4920	4.5266	5.1388	4.8416
65	4.4421	3.8002	6.1716	7.1783	3.9915	4.7344	4.2883
70	3.8009	3.2387	5.3364	6.3932	3.3701	4.1111	3.6378
75	2.9947	2.5483	4.2537	5.1880	2.6238	3.2783	2.8457
80	2.0694	1.7691	2.9532	3.6733	1.7923	2.2957	1.9504
85	2.0475	1.8128	2.8726	3.8120	1.7237	2.3657	1.8801
total	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000
m.ag	37.0983	33.7122	46.5403	49.0142	35.0955	37.9440	36.6536
sha	200.0000	24.9318	8.9223	9.5306	56.6153	34.4624	65.5376
lam	1.022046	1.022046	1.022045	1.022045	1.022046	1.022045	1.022046
r	0.004361	0.004361	0.004361	0.004361	0.004361	0.004361	0.004361

APPENDIX B.8: Native-Independent Multistate Projection: 1998

population

age	total	s -> s	s -> n	n -> s	n -> n	south	north
0	11191920.	3565044.	104007.	99961.	7422908.	3665005.	7526915.
5	11330953.	3371462.	279890.	281833.	7397768.	3653295.	7677658.
10	11523383.	3282105.	423356.	437212.	7380711.	3719317.	7804066.
15	10917140.	2955789.	596957.	604044.	6760351.	3559833.	7357308.
20	9664246.	2434663.	746544.	731380.	5751659.	3166043.	6498204.
25	8365251.	1974378.	782234.	769672.	4838967.	2744050.	5621201.
30	10471771.	2155525.	1113533.	1179707.	6023006.	3335233.	7136539.
35	11122237.	2303537.	1213501.	1269953.	6335245.	3573490.	7548747.
40	10164838.	2163192.	1154347.	1152548.	5694752.	3315739.	6849099.
45	8537646.	1865530.	1009215.	956685.	4706216.	2822215.	5715431.
50	6708679.	1547194.	835889.	684761.	3640835.	2231955.	4476725.
55	5522834.	1375220.	672039.	507147.	2968426.	1882368.	3640466.
60	5470576.	1382930.	601518.	502908.	2983219.	1885838.	3584737.
65	4943318.	1276115.	512907.	464037.	2690258.	1740152.	3203166.
70	4501880.	1139681.	429441.	431072.	2501685.	1570753.	2931127.
75	3750906.	943571.	354143.	356891.	2096301.	1300461.	2450444.
80	2258454.	610544.	200112.	208828.	1238969.	819373.	1439081.
85	2146892.	620479.	183859.	193442.	1149112.	813921.	1332971.
total	138592928.	34966964.	11213492.	10832081.	81580392.	45799036.	92793888.

percentage distribution

age	total	s -> s	s -> n	n -> s	n -> n	south	north
0	8.0754	10.1955	0.9275	0.9228	9.0989	8.0024	8.1114
5	8.1757	9.6418	2.4960	2.6018	9.0681	7.9768	8.2739
10	8.3146	9.3863	3.7754	4.0363	9.0472	8.1210	8.4101
15	7.8771	8.4531	5.3236	5.5764	8.2867	7.7727	7.9287
20	6.9731	6.9628	6.6576	6.7520	7.0503	6.9129	7.0028
25	6.0358	5.6464	6.9758	7.1055	5.9315	5.9915	6.0577
30	7.5558	6.1645	9.9303	10.8909	7.3829	7.2823	7.6907
35	8.0251	6.5878	10.8218	11.7240	7.7656	7.8025	8.1350
40	7.3343	6.1864	10.2943	10.6401	6.9805	7.2398	7.3810
45	6.1602	5.3351	9.0000	8.8320	5.7688	6.1622	6.1593
50	4.8406	4.4247	7.4543	6.3216	4.4629	4.8734	4.8244
55	3.9849	3.9329	5.9931	4.6819	3.6387	4.1101	3.9232
60	3.9472	3.9550	5.3642	4.6428	3.6568	4.1176	3.8631
65	3.5668	3.6495	4.5740	4.2839	3.2977	3.7995	3.4519
70	3.2483	3.2593	3.8297	3.9796	3.0665	3.4297	3.1587
75	2.7064	2.6985	3.1582	3.2948	2.5696	2.8395	2.6407
80	1.6296	1.7461	1.7846	1.9279	1.5187	1.7891	1.5508
85	1.5491	1.7745	1.6396	1.7858	1.4086	1.7772	1.4365
total	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000
m.ag	34.8294	33.3544	42.8966	42.2211	33.3714	35.4515	34.5224
sha	200.0000	25.2300	8.0910	7.8158	58.8633	33.0457	66.9543
lam	1.040688	1.026520	1.070213	1.110426	1.034260	1.045199	1.038476
r	0.007976	0.005235	0.013572	0.020949	0.006737	0.008841	0.007551

APPENDIX C.1: Input Data: Southern-born, Southern residents, 1968

age	population		births		deaths		arrivals		departures		observed rates (x 1000)				
	number	- % -	number	- % -	number	- % -	number	- % -	number	- % -	birth	death	inmig	outmig	net mig
0	3111200.	10.77	0.	0.00	16589.	8.84	55363.	9.85	138291.	15.65	0.000	5.332	3.559	8.890	-5.331
5	3252861.	11.26	0.	0.00	1381.	0.74	58046.	10.33	90082.	10.20	0.000	0.425	3.569	5.539	-1.970
10	3041703.	10.53	2392.	0.51	1058.	0.56	46802.	8.33	97055.	10.99	0.786	0.348	3.077	6.382	-3.304
15	2549596.	8.83	100854.	21.57	1634.	0.87	59746.	10.63	194217.	21.99	39.557	0.641	4.687	15.235	-10.548
20	2014624.	6.97	160303.	34.28	1557.	0.83	80736.	14.36	122898.	13.91	79.570	0.773	8.015	12.201	-4.186
25	1755229.	6.08	107562.	23.00	1665.	0.89	60874.	10.83	67339.	7.62	61.281	0.949	6.936	7.673	-0.737
30	1794786.	6.21	59029.	12.62	2507.	1.34	45896.	8.16	45655.	5.17	32.889	1.397	5.114	5.088	0.027
35	1749412.	6.06	28941.	6.19	3946.	2.10	35970.	6.40	34458.	3.90	16.543	2.256	4.112	3.939	0.173
40	1739408.	6.02	8046.	1.72	5766.	3.07	28055.	4.99	25869.	2.93	4.626	3.315	3.226	2.974	0.251
45	1732323.	6.00	511.	0.11	8234.	4.39	21837.	3.88	17446.	1.97	0.295	4.753	2.521	2.014	0.507
50	1529112.	5.29	0.	0.00	10038.	5.35	16854.	3.00	13216.	1.50	0.000	6.565	2.204	1.729	0.476
55	1417283.	4.91	0.	0.00	13483.	7.18	19924.	3.54	10694.	1.21	0.000	9.513	2.812	1.509	1.302
60	931085.	3.22	0.	0.00	12401.	6.61	13856.	2.46	8263.	0.94	0.000	13.319	2.976	1.775	1.201
65	798916.	2.77	0.	0.00	16775.	8.94	8632.	1.54	6842.	0.77	0.000	20.997	2.161	1.713	0.448
70	607902.	2.10	0.	0.00	19426.	10.35	5292.	0.94	6140.	0.70	0.000	31.956	1.741	2.020	-0.279
75	424364.	1.47	0.	0.00	22551.	12.01	3175.	0.56	3684.	0.42	0.000	53.141	1.496	1.736	-0.240
80	256447.	0.89	0.	0.00	21895.	11.66	795.	0.14	921.	0.10	0.000	85.378	0.620	0.718	-0.098
85	179292.	0.62	0.	0.00	26793.	14.27	266.	0.05	307.	0.03	0.000	149.438	0.297	0.342	-0.046
tot	28885548.	100.00	467638.	100.00	187699.	100.00	562119.	100.00	883377.	100.00					
gross											1.178	1.952	0.296	0.407	
crude(x1000)											16.189	6.498	3.892	6.116	-2.224
m.age		30.34		25.08		61.57		26.62		20.46	25.80	77.51	34.39	27.06	
e(0)												74.11			

APPENDIX C.2: Input Data: Southern-born, Northern residents, 1968

age	population number	population - % -	births number	births - % -	deaths number	deaths - % -	arrivals number	arrivals - % -	departures number	departures - % -	observed rates (x 1000) birth	death	inmig	outmig	net mig
0	263013.	4.28	0.	0.00	1295.	3.12	152848.	14.53	69920.	9.57	0.000	4.924	116.228	53.168	63.060
5	356268.	5.80	0.	0.00	129.	0.31	108180.	10.28	76144.	10.42	0.000	0.362	60.730	42.745	17.984
10	401326.	6.53	128.	0.10	112.	0.27	111001.	10.55	60748.	8.31	0.319	0.279	55.317	30.274	25.043
15	484489.	7.89	13169.	10.56	272.	0.66	216239.	20.55	81768.	11.19	27.181	0.561	89.265	33.754	55.510
20	561604.	9.14	42370.	33.98	369.	0.89	150289.	14.29	108127.	14.80	75.445	0.657	53.521	38.506	15.015
25	537998.	8.76	36264.	29.09	419.	1.01	86430.	8.22	79965.	10.94	67.405	0.779	32.130	29.727	2.403
30	545053.	8.87	20246.	16.24	605.	1.46	60030.	5.71	60271.	8.25	37.145	1.110	22.027	22.116	-0.088
35	528164.	8.60	9813.	7.87	964.	2.32	45247.	4.30	46759.	6.40	18.579	1.825	17.134	17.706	-0.573
40	510761.	8.32	2533.	2.03	1439.	3.47	34069.	3.24	36255.	4.96	4.959	2.817	13.340	14.196	-0.856
45	523046.	8.52	155.	0.12	2173.	5.24	23433.	2.23	27824.	3.81	0.296	4.155	8.960	10.639	-1.679
50	396699.	6.46	0.	0.00	2443.	5.89	17071.	1.62	20709.	2.83	0.000	6.158	8.607	10.441	-1.834
55	353663.	5.76	0.	0.00	3202.	7.72	14319.	1.36	23549.	3.22	0.000	9.054	8.098	13.317	-5.220
60	189579.	3.09	0.	0.00	2531.	6.10	10633.	1.01	16226.	2.22	0.000	13.351	11.217	17.118	-5.900
65	158295.	2.58	0.	0.00	3342.	8.06	8563.	0.81	10353.	1.42	0.000	21.112	10.819	13.081	-2.262
70	131129.	2.13	0.	0.00	4471.	10.78	7595.	0.72	6747.	0.92	0.000	34.096	11.584	10.291	1.293
75	97578.	1.59	0.	0.00	5536.	13.35	4558.	0.43	4049.	0.55	0.000	56.734	9.342	8.299	1.043
80	61485.	1.00	0.	0.00	5507.	13.28	1139.	0.11	1013.	0.14	0.000	89.567	3.705	3.295	0.410
85	42301.	0.69	0.	0.00	6662.	16.06	381.	0.04	340.	0.05	0.000	157.490	1.801	1.608	0.194
tot	6142451.	100.00	124678.	100.00	41471.	100.00	1052025.	100.00	730767.	100.00					
gross											1.157	2.025	2.669	1.851	
crude(x1000)											20.298	6.752	34.254	23.794	10.460
m.age		35.47		26.66		66.00		21.22		26.29	26.63	78.09	22.13	28.81	
e(0)												74.45			

APPENDIX C.3: Input Data: Northern-born, Southern residents, 1968

age	population number	population - % -	births number	births - % -	deaths number	deaths - % -	arrivals number	arrivals - % -	departures number	departures - % -	observed rates (x 1000) birth	death	inmig	outmig	net mig
0	223698.	6.24	0.	0.00	1193.	4.24	154040.	13.00	61424.	10.57	0.000	5.333	137.721	54.917	82.804
5	289921.	8.08	0.	0.00	123.	0.44	114741.	9.68	63766.	10.98	0.000	0.424	79.153	43.989	35.165
10	297459.	8.29	234.	0.36	103.	0.37	115598.	9.76	51119.	8.80	0.787	0.346	77.724	34.370	43.353
15	342189.	9.54	13536.	20.86	219.	0.78	213162.	17.99	78112.	13.45	39.557	0.640	124.587	45.654	78.933
20	296795.	8.27	23616.	36.39	229.	0.81	135005.	11.39	96444.	16.60	79.570	0.772	90.975	64.990	25.985
25	234951.	6.55	14398.	22.19	223.	0.79	81102.	6.85	58314.	10.04	61.281	0.949	69.037	49.639	19.398
30	242636.	6.76	7980.	12.30	339.	1.20	61432.	5.18	43488.	7.49	32.889	1.397	50.637	35.846	14.791
35	236501.	6.59	3913.	6.03	533.	1.89	49640.	4.19	32786.	5.64	16.545	2.254	41.979	27.726	14.253
40	246916.	6.88	1143.	1.76	819.	2.91	44543.	3.76	25249.	4.35	4.629	3.317	36.079	20.451	15.628
45	245908.	6.86	73.	0.11	1168.	4.15	36154.	3.05	17140.	2.95	0.297	4.750	29.404	13.940	15.464
50	204892.	5.71	0.	0.00	1344.	4.78	37907.	3.20	12603.	2.17	0.000	6.560	37.002	12.302	24.700
55	189908.	5.29	0.	0.00	1806.	6.42	48324.	4.08	10238.	1.76	0.000	9.510	50.892	10.782	40.110
60	155764.	4.34	0.	0.00	2075.	7.37	41770.	3.53	9372.	1.61	0.000	13.321	53.632	12.034	41.599
65	133654.	3.73	0.	0.00	2806.	9.97	25202.	2.13	7939.	1.37	0.000	20.995	37.712	11.880	25.832
70	101698.	2.84	0.	0.00	3249.	11.54	14560.	1.23	7180.	1.24	0.000	31.948	28.634	14.120	14.514
75	70994.	1.98	0.	0.00	3772.	13.40	8737.	0.74	4309.	0.74	0.000	53.131	24.613	12.139	12.474
80	42901.	1.20	0.	0.00	3663.	13.01	2184.	0.18	1077.	0.19	0.000	85.383	10.182	5.021	5.161
85	29994.	0.84	0.	0.00	4482.	15.92	728.	0.06	360.	0.06	0.000	149.430	4.854	2.400	2.454
tot	3586779.	100.00	64893.	100.00	28146.	100.00	1184829.	100.00	580920.	100.00					
gross											1.178	1.952	4.924	2.361	
crude(x1000)											18.092	7.847	66.066	32.392	33.674
m.age		34.57		25.04		65.99		25.50		24.60	25.80	77.51	30.67	28.94	
e(0)												74.11			

APPENDIX C.4: Input Data: Northern-born, Northern residents, 1968

age	population number	population - % -	births number	births - % -	deaths number	deaths - % -	arrivals number	arrivals - % -	departures number	departures - % -	observed rates (x 1000) birth	death	inmig	outmig	net mig
0	7189433.	11.29	0.	0.00	35409.	8.58	267228.	12.31	359844.	12.96	0.000	4.925	7.434	10.010	-2.576
5	7492557.	11.77	0.	0.00	2726.	0.66	221882.	10.22	272857.	9.83	0.000	0.364	5.923	7.283	-1.361
10	6781986.	10.65	2168.	0.23	1903.	0.46	195191.	8.99	259670.	9.36	0.320	0.281	5.756	7.658	-1.901
15	5605165.	8.80	152352.	15.86	3154.	0.76	365988.	16.85	501038.	18.05	27.181	0.563	13.059	17.878	-4.819
20	4350986.	6.83	328256.	34.18	2860.	0.69	342633.	15.78	381194.	13.73	75.444	0.657	15.750	17.522	-1.773
25	3629665.	5.70	244662.	25.47	2826.	0.68	194780.	8.97	217568.	7.84	67.406	0.779	10.733	11.988	-1.256
30	3835769.	6.03	142483.	14.84	4255.	1.03	139408.	6.42	157352.	5.67	37.146	1.109	7.269	8.204	-0.936
35	3751833.	5.89	69703.	7.26	6844.	1.66	104932.	4.83	121786.	4.39	18.578	1.824	5.594	6.492	-0.898
40	3948275.	6.20	19575.	2.04	11124.	2.70	83584.	3.85	102878.	3.71	4.958	2.817	4.234	5.211	-0.977
45	4049675.	6.36	1203.	0.13	16821.	4.08	59813.	2.75	78827.	2.84	0.297	4.154	2.954	3.893	-0.939
50	3309504.	5.20	0.	0.00	20383.	4.94	45974.	2.12	71278.	2.57	0.000	6.159	2.778	4.307	-1.529
55	2965722.	4.66	0.	0.00	26852.	6.51	41959.	1.93	80045.	2.88	0.000	9.054	2.830	5.398	-2.568
60	1880346.	2.95	0.	0.00	25106.	6.08	37077.	1.71	69475.	2.50	0.000	13.352	3.944	7.390	-3.446
65	1573031.	2.47	0.	0.00	33206.	8.05	28082.	1.29	45345.	1.63	0.000	21.110	3.570	5.765	-2.195
70	1307576.	2.05	0.	0.00	44581.	10.80	23933.	1.10	31313.	1.13	0.000	34.094	3.661	4.789	-1.129
75	969001.	1.52	0.	0.00	54977.	13.32	14361.	0.66	18789.	0.68	0.000	56.736	2.964	3.878	-0.914
80	606872.	0.95	0.	0.00	54356.	13.17	3591.	0.17	4698.	0.17	0.000	89.567	1.183	1.548	-0.365
85	414830.	0.65	0.	0.00	65334.	15.83	1198.	0.06	1566.	0.06	0.000	157.496	0.578	0.755	-0.177
tot	63662232.	100.00	960402.	100.00	412717.	100.00	2171614.	100.00	2775523.	100.00					
gross											1.157	2.025	0.501	0.650	
crude(x1000)											15.086	6.483	6.822	8.720	-1.897
m.age		29.92		25.97		63.28		23.66		24.25	26.63	78.09	32.12	33.53	
e(0)												74.45			

APPENDIX D.1: Native-Dependent Multistate Life Table: Probabilities, 1968

region s -> s

age	death	migration from s -> s to s -> s	s -> n	n -> s	n -> n
0	0.026271	0.935243	0.038486	0.000000	0.000000
5	0.002117	0.972648	0.025236	0.000000	0.000000
10	0.001733	0.968610	0.029657	0.000000	0.000000
15	0.003186	0.927746	0.069068	0.000000	0.000000
20	0.003841	0.941010	0.055149	0.000000	0.000000
25	0.004717	0.959769	0.035515	0.000000	0.000000
30	0.006943	0.969089	0.023969	0.000000	0.000000
35	0.011195	0.970124	0.018681	0.000000	0.000000
40	0.016421	0.969423	0.014156	0.000000	0.000000
45	0.023472	0.966923	0.009604	0.000000	0.000000
50	0.032285	0.959546	0.008169	0.000000	0.000000
55	0.046454	0.946558	0.006989	0.000000	0.000000
60	0.064449	0.927557	0.007994	0.000000	0.000000
65	0.099752	0.892744	0.007504	0.000000	0.000000
70	0.148000	0.843577	0.008422	0.000000	0.000000
75	0.234596	0.758812	0.006592	0.000000	0.000000
80	0.351822	0.645776	0.002402	0.000000	0.000000
85	1.000000	0.000000	0.000000	0.000000	0.000000

region n -> s

age	death	migration from n -> s to s -> s	s -> n	n -> s	n -> n
0	0.026080	0.000000	0.000000	0.740360	0.233560
5	0.002089	0.000000	0.000000	0.801482	0.196429
10	0.001704	0.000000	0.000000	0.841508	0.156787
15	0.003156	0.000000	0.000000	0.795963	0.200881
20	0.003772	0.000000	0.000000	0.721279	0.274949
25	0.004642	0.000000	0.000000	0.777616	0.217742
30	0.006845	0.000000	0.000000	0.830833	0.162321
35	0.011069	0.000000	0.000000	0.861339	0.127592
40	0.016330	0.000000	0.000000	0.888331	0.095339
45	0.023373	0.000000	0.000000	0.911002	0.065625
50	0.032212	0.000000	0.000000	0.910253	0.057535
55	0.046390	0.000000	0.000000	0.903825	0.049785
60	0.064464	0.000000	0.000000	0.881348	0.054188
65	0.099752	0.000000	0.000000	0.848494	0.051754
70	0.148212	0.000000	0.000000	0.793739	0.058049
75	0.234869	0.000000	0.000000	0.719607	0.045524
80	0.351960	0.000000	0.000000	0.631334	0.016706
85	1.000000	0.000000	0.000000	0.000000	0.000000

region s -> n

age	death	migration from s -> n to s -> s	s -> n	n -> s	n -> n
0	0.024503	0.182255	0.793243	0.000000	0.000000
5	0.001832	0.148470	0.849698	0.000000	0.000000
10	0.001413	0.108392	0.890195	0.000000	0.000000
15	0.002825	0.111811	0.885363	0.000000	0.000000
20	0.003317	0.129964	0.866718	0.000000	0.000000
25	0.003931	0.104743	0.891326	0.000000	0.000000
30	0.005591	0.079343	0.915066	0.000000	0.000000
35	0.009154	0.064592	0.926254	0.000000	0.000000
40	0.014053	0.052284	0.933663	0.000000	0.000000
45	0.020618	0.039815	0.939568	0.000000	0.000000
50	0.030365	0.040155	0.929480	0.000000	0.000000
55	0.044326	0.052180	0.903494	0.000000	0.000000
60	0.064592	0.065837	0.869570	0.000000	0.000000
65	0.100257	0.047782	0.851961	0.000000	0.000000
70	0.156924	0.033653	0.809422	0.000000	0.000000
75	0.248239	0.024708	0.727053	0.000000	0.000000
80	0.365827	0.008648	0.625525	0.000000	0.000000
85	1.000000	0.000000	0.000000	0.000000	0.000000

region n -> n

age	death	migration from n -> n to s -> s	s -> n	n -> s	n -> n
0	0.024345	0.000000	0.000000	0.018225	0.957431
5	0.001820	0.000000	0.000000	0.013677	0.984504
10	0.001405	0.000000	0.000000	0.015551	0.983045
15	0.002816	0.000000	0.000000	0.033466	0.963718
20	0.003289	0.000000	0.000000	0.026254	0.970457
25	0.003894	0.000000	0.000000	0.019603	0.976504
30	0.005542	0.000000	0.000000	0.014505	0.979954
35	0.009093	0.000000	0.000000	0.012177	0.978730
40	0.014002	0.000000	0.000000	0.010518	0.975480
45	0.020567	0.000000	0.000000	0.008406	0.971027
50	0.030338	0.000000	0.000000	0.010714	0.958948
55	0.044285	0.000000	0.000000	0.015047	0.940667
60	0.064601	0.000000	0.000000	0.020006	0.915393
65	0.100253	0.000000	0.000000	0.013959	0.885788
70	0.157038	0.000000	0.000000	0.009155	0.833807
75	0.248387	0.000000	0.000000	0.006763	0.744851
80	0.365884	0.000000	0.000000	0.002395	0.631721
85	1.000000	0.000000	0.000000	0.000000	0.000000

APPENDIX D.2: Native-Dependent Multistate Life Table: Life Expectancies, 1968

initial region of cohort s -> s

age	total	s -> s	s -> n	n -> s	n -> n
0	74.14005	63.18850	10.95154	0.00000	0.00000
5	71.07285	59.92465	11.14820	0.00000	0.00000
10	66.21751	55.28968	10.92784	0.00000	0.00000
15	61.32692	50.72458	10.60235	0.00000	0.00000
20	56.51323	46.41336	10.09986	0.00000	0.00000
25	51.71765	42.32948	9.38817	0.00000	0.00000
30	46.94445	38.37098	8.57347	0.00000	0.00000
35	42.24437	34.51814	7.72622	0.00000	0.00000
40	37.67913	30.79958	6.87955	0.00000	0.00000
45	33.25034	27.20755	6.04279	0.00000	0.00000
50	28.97207	23.74648	5.22559	0.00000	0.00000
55	24.84492	20.41054	4.43438	0.00000	0.00000
60	20.92360	17.23384	3.68977	0.00000	0.00000
65	17.19334	14.19163	3.00172	0.00000	0.00000
70	13.82308	11.42644	2.39663	0.00000	0.00000
75	10.81459	8.95461	1.85998	0.00000	0.00000
80	8.39719	6.97299	1.42419	0.00000	0.00000
85	6.63259	5.53472	1.09787	0.00000	0.00000

initial region of cohort n -> s

age	total	s -> s	s -> n	n -> s	n -> n
0	74.24090	0.00000	0.00000	25.41264	48.82825
5	71.16196	0.00000	0.00000	21.62573	49.53624
10	66.30126	0.00000	0.00000	18.23078	48.07048
15	61.40276	0.00000	0.00000	15.41447	45.98829
20	56.57965	0.00000	0.00000	13.06390	43.51575
25	51.76950	0.00000	0.00000	11.19910	40.57040
30	46.97432	0.00000	0.00000	9.74482	37.22949
35	42.23798	0.00000	0.00000	8.53261	33.70537
40	37.62153	0.00000	0.00000	7.48109	30.14044
45	33.13837	0.00000	0.00000	6.54067	26.59770
50	28.79987	0.00000	0.00000	5.67831	23.12156
55	24.63294	0.00000	0.00000	4.87541	19.75753
60	20.66832	0.00000	0.00000	4.11519	16.55312
65	16.92252	0.00000	0.00000	3.37896	13.54356
70	13.52774	0.00000	0.00000	2.69510	10.83264
75	10.55460	0.00000	0.00000	2.10008	8.45453
80	8.17843	0.00000	0.00000	1.63872	6.53971
85	6.41651	0.00000	0.00000	1.31095	5.10556

initial region of cohort s -> n

age	total	s -> s	s -> n	n -> s	n -> n
0	74.38078	36.62362	37.75716	0.00000	0.00000
5	71.18633	37.07647	34.10985	0.00000	0.00000
10	66.31605	35.92097	30.39507	0.00000	0.00000
15	61.41255	34.29254	27.12001	0.00000	0.00000
20	56.58736	32.43096	24.15640	0.00000	0.00000
25	51.77921	30.33603	21.44319	0.00000	0.00000
30	46.99195	28.02473	18.96721	0.00000	0.00000
35	42.27297	25.59182	16.68114	0.00000	0.00000
40	37.68459	23.12437	14.56021	0.00000	0.00000
45	33.23359	20.65763	12.57596	0.00000	0.00000
50	28.93270	18.22321	10.70948	0.00000	0.00000
55	24.79180	15.83815	8.95365	0.00000	0.00000
60	20.85652	13.52005	7.33647	0.00000	0.00000
65	17.12225	11.24400	5.87825	0.00000	0.00000
70	13.74583	9.12206	4.62376	0.00000	0.00000
75	10.74843	7.20269	3.54574	0.00000	0.00000
80	8.34301	5.64732	2.69569	0.00000	0.00000
85	6.58009	4.50800	2.07209	0.00000	0.00000

initial region of cohort n -> n

age	total	s -> s	s -> n	n -> s	n -> n
0	74.44974	0.00000	0.00000	5.49861	68.95113
5	71.24503	0.00000	0.00000	5.58911	65.65591
10	66.37069	0.00000	0.00000	5.48144	60.88926
15	61.46108	0.00000	0.00000	5.32023	56.14085
20	56.62837	0.00000	0.00000	5.07865	51.54972
25	51.80863	0.00000	0.00000	4.75990	47.04873
30	47.00400	0.00000	0.00000	4.41807	42.58593
35	42.25630	0.00000	0.00000	4.07144	38.18485
40	37.62709	0.00000	0.00000	3.72945	33.89764
45	33.13234	0.00000	0.00000	3.39240	29.73995
50	28.78265	0.00000	0.00000	3.06050	25.72215
55	24.60922	0.00000	0.00000	2.73158	21.87764
60	20.63810	0.00000	0.00000	2.39260	18.24550
65	16.89049	0.00000	0.00000	2.02643	14.86406
70	13.49295	0.00000	0.00000	1.65340	11.83956
75	10.52485	0.00000	0.00000	1.31133	9.21352
80	8.15384	0.00000	0.00000	1.03641	7.11743
85	6.39218	0.00000	0.00000	0.83589	5.55630

APPENDIX D.3: Native-Dependent Multistate Projection; Growth Matrix, 1968

region s -> s

age	first row s -> s	s -> n	n -> s	n -> n
0	0.000000	0.000000	0.000000	0.000000
5	0.001846	0.000037	0.000002	0.000020
10	0.092669	0.001843	0.000303	0.002985
15	0.275558	0.005480	0.001066	0.010490
20	0.333269	0.006628	0.000707	0.006954
25	0.224945	0.004473	0.000255	0.002506
30	0.118359	0.002354	0.000091	0.000893
35	0.050870	0.001012	0.000019	0.000183
40	0.011881	0.000236	0.000001	0.000008
45	0.000714	0.000014	0.000000	0.000000
50	0.000000	0.000000	0.000000	0.000000
55	0.000000	0.000000	0.000000	0.000000
60	0.000000	0.000000	0.000000	0.000000
65	0.000000	0.000000	0.000000	0.000000
70	0.000000	0.000000	0.000000	0.000000
75	0.000000	0.000000	0.000000	0.000000
80	0.000000	0.000000	0.000000	0.000000

age	survivorship proportions s -> s	s -> n	n -> s	n -> n
0	0.952905	0.032724	0.000000	0.000000
5	0.970381	0.027694	0.000000	0.000000
10	0.948549	0.048993	0.000000	0.000000
15	0.934461	0.062030	0.000000	0.000000
20	0.949700	0.046026	0.000000	0.000000
25	0.964085	0.030094	0.000000	0.000000
30	0.969504	0.021439	0.000000	0.000000
35	0.969718	0.016490	0.000000	0.000000
40	0.968146	0.011938	0.000000	0.000000
45	0.963298	0.008873	0.000000	0.000000
50	0.953213	0.007535	0.000000	0.000000
55	0.937345	0.007414	0.000000	0.000000
60	0.910767	0.007719	0.000000	0.000000
65	0.869526	0.007846	0.000000	0.000000
70	0.804772	0.007377	0.000000	0.000000
75	0.710013	0.004564	0.000000	0.000000
80	1.047918	0.004523	0.000000	0.000000

region s -> n

age	first row s -> s	s -> n	n -> s	n -> n
0	0.000000	0.000000	0.000000	0.000000
5	0.000247	0.000005	0.000063	0.000621
10	0.010412	0.000207	0.005578	0.054884
15	0.023237	0.000462	0.021252	0.209105
20	0.017634	0.000351	0.030661	0.301684
25	0.007403	0.000147	0.022991	0.226210
30	0.002894	0.000058	0.012358	0.121590
35	0.000656	0.000013	0.005283	0.051982
40	0.000033	0.000001	0.001193	0.011739
45	0.000000	0.000000	0.000068	0.000664
50	0.000000	0.000000	0.000000	0.000000
55	0.000000	0.000000	0.000000	0.000000
60	0.000000	0.000000	0.000000	0.000000
65	0.000000	0.000000	0.000000	0.000000
70	0.000000	0.000000	0.000000	0.000000
75	0.000000	0.000000	0.000000	0.000000
80	0.000000	0.000000	0.000000	0.000000

age	survivorship proportions s -> s	s -> n	n -> s	n -> n
0	0.169317	0.817454	0.000000	0.000000
5	0.129917	0.868458	0.000000	0.000000
10	0.108810	0.889071	0.000000	0.000000
15	0.120724	0.876200	0.000000	0.000000
20	0.118955	0.877412	0.000000	0.000000
25	0.093050	0.902175	0.000000	0.000000
30	0.072320	0.920298	0.000000	0.000000
35	0.058664	0.929738	0.000000	0.000000
40	0.046230	0.936451	0.000000	0.000000
45	0.039902	0.934666	0.000000	0.000000
50	0.045809	0.916951	0.000000	0.000000
55	0.058394	0.887408	0.000000	0.000000
60	0.056805	0.861372	0.000000	0.000000
65	0.040613	0.832407	0.000000	0.000000
70	0.028797	0.772561	0.000000	0.000000
75	0.017028	0.684281	0.000000	0.000000
80	0.016774	0.969646	0.000000	0.000000

APPENDIX D.3: Native-Dependent Multistate Projection: Growth Matrix, 1968, continued.

region n -> s

age	first row s -> s	s -> n	n -> s	n -> n
0	0.000000	0.000000	0.000000	0.000000
5	0.001402	0.000188	0.000001	0.000140
10	0.072404	0.009717	0.000109	0.011711
15	0.218049	0.029263	0.000402	0.043198
20	0.272323	0.036546	0.000386	0.041486
25	0.190591	0.025578	0.000164	0.017610
30	0.101947	0.013681	0.000062	0.006660
35	0.044793	0.006011	0.000013	0.001365
40	0.010651	0.001429	0.000001	0.000059
45	0.000646	0.000087	0.000000	0.000000
50	0.000000	0.000000	0.000000	0.000000
55	0.000000	0.000000	0.000000	0.000000
60	0.000000	0.000000	0.000000	0.000000
65	0.000000	0.000000	0.000000	0.000000
70	0.000000	0.000000	0.000000	0.000000
75	0.000000	0.000000	0.000000	0.000000
80	0.000000	0.000000	0.000000	0.000000

age	survivorship proportions s -> s	s -> n	n -> s	n -> n
0	0.000000	0.000000	0.766006	0.219649
5	0.000000	0.000000	0.819376	0.178729
10	0.000000	0.000000	0.821482	0.176091
15	0.000000	0.000000	0.762531	0.234013
20	0.000000	0.000000	0.744276	0.251539
25	0.000000	0.000000	0.800543	0.193751
30	0.000000	0.000000	0.844562	0.146519
35	0.000000	0.000000	0.873766	0.112561
40	0.000000	0.000000	0.898939	0.081251
45	0.000000	0.000000	0.910685	0.061558
50	0.000000	0.000000	0.907257	0.053562
55	0.000000	0.000000	0.893223	0.051534
60	0.000000	0.000000	0.865871	0.052603
65	0.000000	0.000000	0.823295	0.053871
70	0.000000	0.000000	0.760900	0.050938
75	0.000000	0.000000	0.682606	0.031749
80	0.000000	0.000000	1.019620	0.031410

region n -> n

age	first row s -> s	s -> n	n -> s	n -> n
0	0.000000	0.000000	0.000000	0.000000
5	0.000025	0.000003	0.000007	0.000769
10	0.002085	0.000280	0.000610	0.065536
15	0.005059	0.000679	0.002282	0.245143
20	0.003123	0.000419	0.003213	0.345069
25	0.001244	0.000167	0.002363	0.253808
30	0.000485	0.000065	0.001261	0.135400
35	0.000115	0.000015	0.000534	0.057309
40	0.000006	0.000001	0.000120	0.012838
45	0.000000	0.000000	0.000007	0.000727
50	0.000000	0.000000	0.000000	0.000000
55	0.000000	0.000000	0.000000	0.000000
60	0.000000	0.000000	0.000000	0.000000
65	0.000000	0.000000	0.000000	0.000000
70	0.000000	0.000000	0.000000	0.000000
75	0.000000	0.000000	0.000000	0.000000
80	0.000000	0.000000	0.000000	0.000000

age	survivorship proportions s -> s	s -> n	n -> s	n -> n
0	0.000000	0.000000	0.016331	0.970457
5	0.000000	0.000000	0.014759	0.983629
10	0.000000	0.000000	0.024232	0.973658
15	0.000000	0.000000	0.029224	0.967723
20	0.000000	0.000000	0.023422	0.972985
25	0.000000	0.000000	0.017384	0.977897
30	0.000000	0.000000	0.013476	0.979210
35	0.000000	0.000000	0.011446	0.977017
40	0.000000	0.000000	0.009539	0.973198
45	0.000000	0.000000	0.009541	0.965059
50	0.000000	0.000000	0.012816	0.949979
55	0.000000	0.000000	0.017359	0.928437
60	0.000000	0.000000	0.016935	0.901235
65	0.000000	0.000000	0.011484	0.861402
70	0.000000	0.000000	0.007861	0.793333
75	0.000000	0.000000	0.004699	0.696499
80	0.000000	0.000000	0.004638	0.981125

APPENDIX D.4: Native-Dependent Multistate Projection: 1998

population

age	total	s -> s	s -> n	n -> s	n -> n	south	north
0	11196813.	3459609.	123621.	121584.	7491999.	3581193.	7615620.
5	11336667.	3352658.	217972.	224193.	7541845.	3576850.	7759817.
10	11526699.	3349397.	288225.	301517.	7587560.	3650914.	7875785.
15	10918060.	3104168.	405434.	407530.	7000927.	3511699.	7406361.
20	9664265.	2668703.	493979.	455106.	6046477.	3123810.	6540456.
25	8365127.	2267579.	484798.	417376.	5195374.	2684954.	5680172.
30	10472025.	2613974.	654084.	564914.	6639054.	3178888.	7293137.
35	11122760.	2796649.	718683.	598967.	7008460.	3395617.	7727144.
40	10165524.	2624486.	690665.	545279.	6305094.	3169765.	6995759.
45	8538368.	2256039.	615889.	462802.	5203638.	2718841.	5819527.
50	6708972.	1839828.	540732.	357586.	3970826.	2197415.	4511558.
55	5522848.	1581665.	463757.	299359.	3178067.	1881023.	3641824.
60	5470592.	1552931.	430268.	331373.	3156020.	1884304.	3586288.
65	4943313.	1413890.	374535.	327847.	2827041.	1741737.	3201576.
70	4501860.	1250901.	318541.	313722.	2618696.	1564623.	2937237.
75	3750827.	1033038.	266129.	261182.	2190478.	1294220.	2456607.
80	2258369.	661776.	150538.	154037.	1292018.	815813.	1442556.
85	2146821.	667762.	140846.	144875.	1193338.	812637.	1334184.
total	138609888.	38495044.	7378696.	6289250.	86446904.	44784300.	93825616.

percentage distribution

age	total	s -> s	s -> n	n -> s	n -> n	south	north
0	8.0779	8.9872	1.6754	1.9332	8.6666	7.9965	8.1168
5	8.1788	8.7093	2.9541	3.5647	8.7243	7.9868	8.2705
10	8.3159	8.7009	3.9062	4.7942	8.7771	8.1522	8.3941
15	7.8768	8.0638	5.4947	6.4798	8.0985	7.8414	7.8938
20	6.9723	6.9326	6.6947	7.2363	6.9944	6.9752	6.9709
25	6.0350	5.8906	6.5702	6.6363	6.0099	5.9953	6.0540
30	7.5550	6.7904	8.8645	8.9822	7.6799	7.0982	7.7731
35	8.0245	7.2650	9.7400	9.5237	8.1072	7.5822	8.2356
40	7.3339	6.8177	9.3603	8.6700	7.2936	7.0778	7.4561
45	6.1600	5.8606	8.3469	7.3586	6.0195	6.0710	6.2025
50	4.8402	4.7794	7.3283	5.6857	4.5934	4.9067	4.8084
55	3.9845	4.1087	6.2851	4.7598	3.6763	4.2002	3.8815
60	3.9468	4.0341	5.8312	5.2689	3.6508	4.2075	3.8223
65	3.5663	3.6729	5.0759	5.2128	3.2703	3.8892	3.4123
70	3.2479	3.2495	4.3170	4.9882	3.0293	3.4937	3.1305
75	2.7060	2.6836	3.6067	4.1528	2.5339	2.8899	2.6183
80	1.6293	1.7191	2.0402	2.4492	1.4946	1.8216	1.5375
85	1.5488	1.7347	1.9088	2.3035	1.3804	1.8146	1.4220
total	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000
m.ag	34.8266	34.4130	43.3132	42.5775	33.7225	35.5595	34.4768
sha	200.0000	27.7722	5.3234	4.5374	62.3671	32.3096	67.6904
lam	1.040731	1.036608	1.026943	1.063249	1.042165	1.040268	1.040952
r	0.007985	0.007191	0.005317	0.012266	0.008260	0.007896	0.008027

APPENDIX D.5: Native-Dependent Multistate Projection:
Stable Equivalent Population

stable equivalent to original population

age	total	s -> s	s -> n	n -> s	n -> n	south	north
0	10093513.	3099809.	110375.	107086.	6776243.	3206895.	6886618.
5	9741735.	2908414.	187531.	188533.	6457257.	3096947.	6644789.
10	9515354.	2785250.	238160.	244395.	6247549.	3029645.	6485708.
15	9289493.	2610332.	340689.	344562.	5993911.	2954893.	6334599.
20	9060114.	2426895.	450501.	428461.	5754257.	2855356.	6204758.
25	8831009.	2307557.	496042.	443888.	5583522.	2751445.	6079564.
30	8596857.	2221869.	505812.	442661.	5426515.	2664530.	5932327.
35	8345431.	2143451.	502067.	437342.	5262571.	2580793.	5764639.
40	8065594.	2062540.	491309.	432833.	5078910.	2495373.	5570220.
45	7748977.	1976005.	474258.	428104.	4870610.	2404109.	5344867.
50	7383601.	1880951.	450870.	426929.	4624851.	2307880.	5075721.
55	6950989.	1774493.	418377.	436977.	4321141.	2211470.	4739519.
60	6430207.	1651348.	376137.	455294.	3947427.	2106642.	4323564.
65	5777358.	1492467.	329480.	451132.	3504278.	1943599.	3833758.
70	4942713.	1282848.	279805.	402781.	2977279.	1685629.	3257084.
75	3892667.	1018021.	220764.	322768.	2331114.	1340789.	2551879.
80	2688178.	710900.	152353.	226291.	1598634.	937191.	1750987.
85	2653692.	731401.	147689.	233010.	1541592.	964411.	1689281.
total	130007496.	35084556.	6172220.	6453048.	82297664.	41537600.	88469880.

percentage distribution

age	total	s -> s	s -> n	n -> s	n -> n	south	north
0	7.7638	8.8353	1.7883	1.6595	8.2338	7.7205	7.7841
5	7.4932	8.2897	3.0383	2.9216	7.8462	7.4558	7.5108
10	7.3191	7.9387	3.8586	3.7873	7.5914	7.2937	7.3310
15	7.1454	7.4401	5.5197	5.3395	7.2832	7.1138	7.1602
20	6.9689	6.9173	7.2988	6.6397	6.9920	6.8741	7.0134
25	6.7927	6.5771	8.0367	6.8787	6.7845	6.6240	6.8719
30	6.6126	6.3329	8.1950	6.8597	6.5938	6.4147	6.7055
35	6.4192	6.1094	8.1343	6.7773	6.3946	6.2131	6.5159
40	6.2039	5.8788	7.9600	6.7074	6.1714	6.0075	6.2962
45	5.9604	5.6321	7.6837	6.6341	5.9183	5.7878	6.0415
50	5.6794	5.3612	7.3048	6.6159	5.6197	5.5561	5.7372
55	5.3466	5.0578	6.7784	6.7716	5.2506	5.3240	5.3572
60	4.9460	4.7068	6.0940	7.0555	4.7965	5.0717	4.8870
65	4.4439	4.2539	5.3381	6.9910	4.2581	4.6791	4.3334
70	3.8019	3.6564	4.5333	6.2417	3.6177	4.0581	3.6816
75	2.9942	2.9016	3.5767	5.0018	2.8325	3.2279	2.8845
80	2.0677	2.0262	2.4684	3.5067	1.9425	2.2562	1.9792
85	2.0412	2.0847	2.3928	3.6109	1.8732	2.3218	1.9094
total	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000
m.ag	37.0971	35.9564	43.6530	46.7766	36.3328	37.6374	36.8435
sha	200.0000	26.9866	4.7476	4.9636	63.3022	31.9502	68.0498
lam	1.022039	1.022039	1.022039	1.022039	1.022039	1.022039	1.022039
r	0.004360	0.004360	0.004360	0.004360	0.004360	0.004360	0.004360

APPENDIX D.6: Native-Dependent Multistate Projection: Computer Program

The native-dependent projections presented in Appendices D.4 and D.5 were generated by a modified version of the standard IIASA programs for spatial population analysis published in Willekens and Rogers (1978). The modifications are identified with comment cards in the program listing presented below.

The program requires an additional input file containing only two cards. The first specifies values for two additional parameters, NS and ND, read in with format 2I2:

NS	ND	
2	≠ Ø	native-dependent projection
2	Ø	native-independent projection
Ø	~	no states (changes in the program are disregarded)

Note that when NS = 2 and ND ≠ Ø, NR = 4; when NS = 2 and ND = Ø, then NR = 2. In the latter case the value of NR is changed to 4 after the estimation of the multistate (Leslie) projection matrix in subroutine GROW.FTN. In both cases, the subroutine PROJ.FTN changes NR to 6, to give results for the state-aggregated two-region projections.

The names of the six regions are given by the second card of the newly-specified input file (to be read in with format 9A8).

```
c ********************************************************************
c
c  main program for spatial population analysis
c
c  international institute for applied systems analysis  (iiasa)
c
c  attention    zero = 0
c
c ********************************************************************
c
      dimension ratfze(18,7)
      common /c1/ pop(18,7)
      common /cnag/ nage(18)
      common /cgrow/ br(18,8,8),popr(18,10)
      common /crate/ ratd(18,7),ratm(18,7,7),ratf(18,7)
      integer x
      npr=1
      ihist=0
      ilif=0
      iproj=0
      call datas (npr,na,ny,zfny,nr,xzb,xzd,xzo,iprob,
     lneig)
      call probsc (na,zfny,nr,iprob)
c ---------------------------------------------
c  multistate demographic projection
c  (added and changed)
c ---------------------------------------------
      read(4,999)ns,nd
999   format(2i2)
      if(ns.ne.0.and.ns.ne.2) ns=0
      call growth (na,zfny,nr,ilif,ns,nd)
      do 10 i=1,10
      do 10 x=1,na
10    popr(x,i)=0.
      l=1
      if(nd.ne.0.or.ns.eq.0) l=nr
      do 11 k=1,l
      do 11 x=1,na
11    popr(x,k)=pop(x,k)
      do 12 x=1,na
      if(ns.eq.2.and.nd.eq.0) popr(x,4)=pop(x,2)
12    continue
      call projec (na,ny,zfny,nr,zlamdk,iproj,ns)
      print 33
  33  format (1x//)
      stop
      end
```

```
      subroutine growth (na,zfny,nr,ilif,ns,nd)
      common /cnag/ nage(18)
      common /cgrow/ br(18,8,8),popr(18,10)
      common /cinv/ cc(12,12)
      common /cmul/ al(12,12),b(12,12),c(12,12)
      common /cpq/ p(18,7,7)
      common /crate/ ratd(18,7),ratm(18,7,7),ratf(18,7)
      common /creg/ reg(13)
      common /crmla/ rmla(7,7)
      common /ctit/ tit(20)
      common /csu/ su(18,8,8)
      double precision reg
      integer x,xx
      real l
      naa=na-1
      zz=zfny*0.25
      zfny2=zfny*0.5
c ---------------------------------------------------------
c compute survivorship proportions if ilif=0
c ---------------------------------------------------------
      if (ilif.ne.0) go to 50
c  added
          do 60 x=1,na
          do 60 i=1,8
          do 60 j=1,8
          su(x,i,j)=0.
  60      br(x,j,i)=0.
c  was  added
      do 30 x=1,naa
      xx=x+1
      do 21 i=1,nr
      cc(i,i)=1.+p(x,i,i)
      do 21 j=1,nr
      if (i.ne.j) cc(j,i)=p(x,j,i)
  21  continue
      call invert (nr)
      do 22 i=1,nr
      do 22 j=1,nr
      al(j,i)=p(x,j,i)
  22  b(j,i)=cc(j,i)
      call multip (nr,nr,nr)
      if (x.eq.naa) go to 44
      do 23 i=1,nr
      al(i,i)=1.+p(xx,i,i)
      do 23 j=1,nr
      if (i.ne.j) al(j,i)=p(xx,j,i)
  23  b(j,i)=c(j,i)
      call multip (nr,nr,nr)
      go to 25
  44  do 26 i=1,nr
      do 26 j=1,nr
  26  cc(j,i)=rmla(j,i)
      call invert (nr)
      do 27 i=1,nr
      do 27 j=1,nr
      al(j,i)=cc(j,i)/zfny2
  27  b(j,i)=c(j,i)
      call multip (nr,nr,nr)
  25  do 28 i=1,nr
      do 28 j=1,nr
```

```
   28  su(x,i,j)=c(j,i)
   30  continue
   50  continue
c ---------------------------------------------------------
c compute first row of generalized leslie matrix
c ---------------------------------------------------------
       do 4 x=1,naa
       xx=x+1
       do 3 i=1,nr
       do 3 j=1,nr
       if(i.eq.j) al(j,i)=ratf(xx,i)
       if(i.ne.j) al(j,i)=0.
    3  b(j,i)=su(x,i,j)
       call multip (nr,nr,nr)
       do 5 i=1,nr
       do 5 j=1,nr
       if (i.eq.j) b(j,i)=ratf(x,i)+c(j,i)
    5  if (i.ne.j) b(j,i)=c(j,i)
       do 7 i=1,nr
       do 7 j=1,nr
       if (i.eq.j) al(j,i)=zz*(p(1,j,i)+1.)
       if (i.ne.j) al(j,i)=zz*p(1,j,i)
    7  continue
       call multip (nr,nr,nr)
       do 8 i=1,nr
       do 8 j=1,nr
    8  br(x,j,i)=c(j,i)
    4  continue
c   ------------------------------------------------------
c   added:  compute multistate generalized leslie matrix
c   ------------------------------------------------------
          if(ns.eq.0) goto 52
       if(nd.ne.0) goto 61
c   the "do 51" loop brings
c   the native-independent case
c   to the native-dependent case.
          do 51 x=1,na
          ratf(x,3)=ratf(x,1)
          do 51 i=1,2
          do 51 j=1,2
          br(x,i+2,j+2)=br(x,i,j)
          p(x,i+2,j+2)=p(x,i,j)
  51      su(x,i+2,j+2)=su(x,i,j)
61     continue
c   the "do 62" loop estimates
c   native-dependent births
c   according to equation (9).
       do 62 x=1,naa
       do 62 j=1,2
       h=ratf(x,2)
       h1=ratf(x,3)
       if(j.eq.1) h=0.
       if(j.eq.2) h1=0.
       do 62 i=1,2
       o1=1.
       o2=1.
       if(i.eq.1) o1=0.
       if(i.eq.2) o2=0.
       br(x,i+2,j)=5./4.*(su(x,j,2)*ratf(x+1,2)+h)*(o1+p(1,i,2))
       br(x,i,j+2)=5./4.*(su(x,j+2,3)*ratf(x+1,3)+h1)*(o2+p(1,i+2,3))
```

```
62     continue
c   the "do 63" loop estimates
c   native-dependent births
c   according to equation (13).
          do 63 x=1,naa
          do 63 j=1,2
          do 63 k=1,2
          br(x,j,k)=br(x,j,k)-br(x,j+2,k)
  63      br(x,j+2,k+2)=br(x,j+2,k+2)-br(x,j,k+2)
64     continue
       if(nd.eq.0)nr=nr*nr
       read(4,999)(reg(i),i=1,nr+nr/2)
999    format(9a8)
52     continue
c  was  added
c ------------------------------------------------------------
c  print growth matrix (first row and subdiagonal elements)
c -------------------------------------------------------------
       print 1, (tit(j),j=1,20)
   1   format (1h1,50x,20a4)
       print 10
  10   format (1h0,5x,48hthe discrete model of multiregional demographic
      1,6hgrowth/6x,54(1h*)/6x,54(1h*)/)
       print 11
  11   format (/5x,31hmultiregional projection matrix/5x,31(1h*))
       do 20 i=1,nr
        if (i.ne.1) print 120
 120   format (1h1,1x)
       print 12, reg(i)
  12   format (//20x,6hregion,2x,a8/20x,16(1h*))
       print 13
  13   format (/5x,3hage,8x,9hfirst row)
       print 14, (reg(j),j=1,nr)
  14   format (11x,12(2x,a8))
       print 15
  15   format (1x)
       do 16 x=1,naa
  16   print 17, nage(x),(br(x,j,i),j=1,nr)
  17   format (5x,i3,3x,12f10.6)
       print 18
  18   format (/5x,3hage,8x,24hsurvivorship proportions)
       print 14, (reg(j),j=1,nr)
       print 15
       do 19 x=1,naa
  19   print 17, nage(x),(su(x,i,j),j=1,nr)
  20   continue
       return
       end
```

```
      subroutine projec (na,ny,zfny,nr,zlamda,iproj,ns)
      dimension zminl(12),hup(12),zlamb(12),agem(12),zr(12)
      dimension perc(12),hu(12)
      dimension poptot(12)
      common /cpar/ init,nhoriz,intv,itolx,ntoll
      common /cnag/ nage(18)
      common /cgrow/ br(18,8,8),popr(18,10)
      common /cmul/ al(12,12),b(12,12),c(12,12)
      common /crate/ ratd(18,7),ratm(18,7,7),ratf(18,7)
      common /creg/ reg(13)
      common /ctit/ tit(20)
      common /csu/ su(18,8,8)
      common /ctotrat/ pct(18),ratdt(18),ratft(18),ratmt(18)
      double precision reg
      integer x,x1,x2
      data zdat1/5hm.age/,zdat2/5hsha  /,zdat3/5hlam  /,zdat4/5h   r  /
      iproj=1
      jgo=0
      iproj=0
      zll=(-1)*ntoll
      tolx=10.**(zll)
      naa=na-1
       zlaml=10.
      nyearl=init
      nyeapr=init+intv
      print 1876, (tit(j),j=1,20)
 1876 format (1h1,50x,20a4)
      print 1
    1 format (1h0,5x,35hmultiregional population projection/6x,
     135(1h*)/)
c added
         nrn=nr
         if(ns.eq.2)nrn=6
c was added
      go to 509
c -----------------------------------------------------------
c project population ny years
c -------------------------------------------------------------
 500  continue
c iproj = iteration number
c nyearl=projection year (=init + iproj*ny )
c zminl(i) = population of region i at time t-1
c zmint    = population of total system at time t-1
      iproj=iproj+1
      nyearl=nyearl+ny
      do 3 i=1,nr
      hup(i)=0.
    3 zminl(i)=poptot(i)
c added
         zminl(nr+1)=poptot(1)+poptot(3)
         zminl(nr+2)=poptot(2)+poptot(4)
c  was added
      zmint=ptota
c first age group
      do 2 x=1,na
      do 4 j=1,nr
      b(j,1)=popr(x,j)
      do 4 i=1,nr
    4 al(j,i)=br(x,j,i)
      call multip (nr,nr,1)
```

```
      do 5 j=1,nr
    5 hup(j)=hup(j)+c(j,1)
    2 continue
c other age groups
      do 6 x=1,naa
      x1=na-x
      x2=x1+1
      do 7 j=1,nr
      b(j,1)=popr(x1,j)
      do 7 i=1,nr
    7 a1(j,i)=su(x1,i,j)
      call multip (nr,nr,1)
      do 8 j=1,nr
    8 popr(x2,j)=c(j,1)
    6 continue
      do 9 j=1,nr
    9 popr(1,j)=hup(j)
  509 continue
c  compute total popul ation
      do 11 x=1,na
c added
         popr(x,nr+1)=popr(x,1)+popr(x,3)
         popr(x,nr+2)=popr(x,2)+popr(x,4)
c was added
      pct(x)=0.
      do 11 j=1,nr
   11 pct(x)=pct(x)+popr(x,j)
      do 13 j=1,nrn
      poptot(j)=0.
      do 13 x=1,na
   13 poptot(j)=poptot(j)+popr(x,j)
      ptota=0.
      do 17 j=1,nr
   17 ptota=ptota+poptot(j)
c ---------------------------------------------------------
c check whether output must be printed
c ----------------------------------------------------------
      if ((nyear1.gt.nhoriz).and.(nyear1.ne.nyeapr)) go to 501
c ----------------------------------------------------------
c print projected population
c -----------------------------------------------------------
      if (iproj.gt.0) print 51
   51 format (1h1,1x)
      print 52, nyear1
   52 format (5x,4hyear,1x,i5/5x,10(1h-)/)
       print 253
  253 format (10x,10hpopulation/10x,5(2h- )/)
  578 if (nrn.le.10) print 53, (reg(j),j=1,nrn)
   53 format (1x,3hage,2x,6x,5htotal,10(3x,a8))
      if (nrn.gt.10) print 80, (reg(j),j=1,nrn)
   80 format (1x,3hage,2x,6x,5htotal,12(1x,a8))
      print 54
   54 format (1x)
      do 55 x=1,na
      if (nrn.le.10) print 56, nage(x),pct(x),(popr(x,j),j=1,nrn)
   56 format (1x,i3,2x,11f11.0)
   55 if (nrn.gt.10) print 81, nage(x),pct(x),(popr(x,j),j=1,nrn)
   81 format (1x,i3,2x,f11.0,12f9.0)
       print 54
      if (nrn.le.10) print 57, ptota,(poptot(j),j=1,nrn)
```

```
  57   format (1x,5htotal,11f11.0)
       if (nrn.gt.10) print 82, ptota,(poptot(j),j=1,nrn)
  82   format (1x,5htotal,f11.0,12f9.0)
c  percentage distribution
       print 58
  58   format (//10x,23hpercentage distribution/10x,12(2h- )/)
       if (nrn.le.10) print 53, (reg(j),j=1,nrn)
       if (nrn.gt.10) print 80, (reg(j),j=1,nrn)
       print 54
       zhu=0.
       do 23 j=1,nrn
  23   hu(j)=0.
       do 59 x=1,na
       prct=100.*pct(x)/ptota
       zhu=zhu+prct
c added
          do 99 j=1,nrn
          if(poptot(j).eq.0.)poptot(j)=1.
  99      continue
c was added
       do 14 j=1,nrn
       perc(j)=100.*popr(x,j)/poptot(j)
  14   hu(j)=hu(j)+perc(j)
       if (nrn.le.10) print 60, nage(x),prct,(perc(j),j=1,nrn)
  60   format (1x,i3,2x,11f11.4)
  59   if (nrn.gt.10) print 84, nage(x),prct,(perc(j),j=1,nrn)
  84   format (1x,i3,2x,f11.2,12f9.2)
       if (nrn.le.10) print 761, zhu, (hu(j),j=1,nrn)
 761   format (/1x,5htotal,11f11.4)
       if (nrn.gt.10) print 85, zhu,(hu(j),j=1,nrn)
  85   format (/1x,5htotal,f11.2,12f9.2)
c  mean age
       agemt=0.
        do 21 j=1,nrn
  21   agem(j)=0.
       do 20 x=1,na
       n9=nage(x)
       a9=float(n9)+zfny*0.5
       agemt=agemt+a9*pct(x)/ptota
       do 20 j=1,nrn
  20   agem(j)=agem(j)+a9*popr(x,j)/poptot(j)
       if (nrn.le.10) print 22, zdat1,agemt,(agem(j),j=1,nrn)
  22   format (1x,a5,11f11.4)
       if (nrn.gt.10) print 86, zdat1,agemt,(agem(j),j=1,nrn)
  86   format (1x,a5,f11.4,12f9.4)
c  regional share
       z=0.
       do 16 j=1,nrn
       hup(j)=(poptot(j)/ptota)*100.
  16   z=z+hup(j)
       if (nrn.le.10) print 22, zdat2,z,(hup(j),j=1,nrn)
       if (nrn.gt.10) print 86, zdat2,z,(hup(j),j=1,nrn)
 501   continue
c growth ratio  (lam)
       if (iproj.eq.0) go to 500
       if (jgo.ge.1) go to 505
       do 62 j=1,nrn
  62   zlamb(j)=poptot(j)/zmin1(j)
        zz=ptota/zmint
       if ((nyear1.gt.nhoriz).and.(nyear1.ne.nyeapr)) go to 502
```

```
      if (nyearl.gt.nhoriz) nyeapr=nyeapr+intv
 505  continue
      if (nrn.le.10) print 64, zdat3,zz,(zlamb(j),j=1,nrn)
  64  format (1x,a5,11f11.6)
      if (nrn.gt.10) print 88, zdat3,zz,(zlamb(j),j=1,nrn)
  88  format (1x,a5,f11.6,12f9.6)
c annual growth rate
      rstab=alog(zz)/zfny
      do 27 j=1,nrn
  27  hup(j)=alog(zlamb(j))/zfny
      if (nrn.le.10) print 64, zdat4,rstab,(hup(j),j=1,nrn)
      if (nrn.gt.10) print 88, zdat4,rstab,(hup(j),j=1,nrn)
 502  continue
      if (jgo.ge.1) go to 504
c ------------------------------------------------------------
c compare growth ratio with tolerance level
c ------------------------------------------------------------
      if (itolx.eq.3) ztolx=zlamb(1)-zlaml
      if (itolx.eq.3) zlaml=zlamb(1)
      if (itolx.eq.2) ztolx=zlamb(nrn)-zlamb(1)
      ttolx=-tolx
      if ((ztolx.gt.tolx).or.(ztolx.lt.ttolx)) go to 500
      jgo=jgo+1
c zlamda = stable growth ratio
      zlamda=zz
      print 18, tolx
  18  format (1h0,1x,30htolerance level for eigenvalue,e14.4)
      print 65, iproj
  65  format (2x,39hnumber of iterations to reach stability,i7)
c -----------------------------------------------------------
c  stable equivalent
c -----------------------------------------------------------
      zs=zlamda**iproj
      do 66 j=1,nrn
      poptot(j)=poptot(j)/zs
      do 66 x=1,na
  66  popr(x,j)=popr(x,j)/zs
      do 68 x=1,na
  68  pct(x)=pct(x)/zs
      ptota=ptota/zs
      print 69
  69  format (1h1,1x,40hstable equivalent to original population/2x,
     140(1h*)/)
      go to 578
 504  continue
      return
      end
```

APPENDIX E: Native-Independent Multistate Projection to Stability (r = .004361): Stayers, Returners, Old Aliens, and New Aliens

region of residence - south
****

age	total	stay	return	old.al	new.al
0	3411697.	3323213.	0.	0.	88484.
5	3281607.	3043111.	2523.	80968.	155004.
10	3204495.	2845275.	7861.	221016.	130343.
15	3118879.	2597105.	18674.	320859.	182241.
20	3021253.	2308070.	38226.	447397.	227560.
25	2940080.	2078979.	60639.	608277.	192184.
30	2874060.	1917582.	79436.	738677.	138365.
35	2801331.	1788790.	93394.	818593.	100554.
40	2719116.	1675649.	103586.	861193.	78689.
45	2624978.	1572615.	110141.	882495.	59728.
50	2522720.	1471915.	115131.	882074.	53600.
55	2417691.	1364559.	121509.	867496.	64127.
60	2299483.	1243404.	128976.	849239.	77863.
65	2118588.	1099914.	130362.	820264.	68048.
70	1839632.	928322.	120188.	749780.	41343.
75	1466969.	725095.	99888.	617987.	23999.
80	1027285.	500875.	71839.	443624.	10946.
85	1058634.	511537.	75331.	464289.	7477.
total	44748500.	30996010.	1377703.	10674229.	1700556.

percentage distribution
****

age	total	stay	return	old.al	new.al
0	7.6242	10.7214	0.0000	0.0000	5.2033
5	7.3334	9.8178	0.1832	0.7585	9.1149
10	7.1611	9.1795	0.5706	2.0706	7.6647
15	6.9698	8.3788	1.3554	3.0059	10.7165
20	6.7516	7.4463	2.7746	4.1914	13.3815
25	6.5702	6.7072	4.4014	5.6986	11.3013
30	6.4227	6.1865	5.7658	6.9202	8.1365
35	6.2602	5.7710	6.7790	7.6689	5.9130
40	6.0764	5.4060	7.5187	8.0680	4.6272
45	5.8661	5.0736	7.9945	8.2675	3.5123
50	5.6376	4.7487	8.3567	8.2636	3.1519
55	5.4028	4.4024	8.8197	8.1270	3.7709
60	5.1387	4.0115	9.3617	7.9560	4.5787
65	4.7344	3.5486	9.4622	7.6845	4.0015
70	4.1110	2.9950	8.7238	7.0242	2.4312
75	3.2783	2.3393	7.2504	5.7895	1.4112
80	2.2957	1.6159	5.2144	4.1560	0.6437
85	2.3657	1.6503	5.4678	4.3496	0.4397
m.age	37.94	32.71	56.29	51.82	31.42
share	100.00	69.27	3.08	23.85	3.80

APPENDIX E: Native-Independent Multistate Projection to Stability (r = .004361): Stayers, Returners, Old Aliens, and New Aliens, continued.

region of residence - north
****

age	total	stay	return	old.al	new.al
0	6670372.	6573470.	0.	0.	96902.
5	6448941.	6191142.	4969.	91555.	161276.
10	6299802.	5917069.	14720.	241664.	126350.
15	6159685.	5594918.	36468.	348240.	180058.
20	6028093.	5230638.	78035.	493941.	225480.
25	5880246.	4909523.	123055.	675491.	172177.
30	5712154.	4645590.	156783.	802176.	107604.
35	5533321.	4414482.	181139.	864623.	73077.
40	5335551.	4193576.	198126.	890811.	53038.
45	5112815.	3974697.	207108.	894626.	36384.
50	4849622.	3738852.	209373.	875878.	25520.
55	4522238.	3461032.	206244.	834620.	20342.
60	4120114.	3129016.	198649.	772965.	19484.
65	3649363.	2746801.	187554.	695805.	19202.
70	3095755.	2306997.	170543.	600641.	17575.
75	2421656.	1785927.	142949.	478726.	14055.
80	1659712.	1214971.	102588.	335291.	6861.
85	1599979.	1164990.	102178.	328103.	4707.
total	85099416.	71193688.	2320481.	10225156.	1360090.

percentage distribution
****

age	total	stay	return	old.al	new.al
0	7.8383	9.2332	0.0000	0.0000	7.1246
5	7.5781	8.6962	0.2141	0.8954	11.8578
10	7.4029	8.3112	0.6343	2.3634	9.2898
15	7.2382	7.8587	1.5716	3.4057	13.2387
20	7.0836	7.3471	3.3629	4.8306	16.5783
25	6.9099	6.8960	5.3030	6.6062	12.6592
30	6.7123	6.5253	6.7565	7.8451	7.9116
35	6.5022	6.2007	7.8061	8.4558	5.3730
40	6.2698	5.8904	8.5382	8.7120	3.8996
45	6.0080	5.5829	8.9252	8.7493	2.6751
50	5.6988	5.2517	9.0228	8.5659	1.8764
55	5.3141	4.8614	8.8880	8.1624	1.4956
60	4.8415	4.3951	8.5607	7.5594	1.4325
65	4.2884	3.8582	8.0826	6.8048	1.4118
70	3.6378	3.2405	7.3495	5.8741	1.2922
75	2.8457	2.5085	6.1603	4.6818	1.0334
80	1.9503	1.7066	4.4210	3.2791	0.5045
85	1.8801	1.6364	4.4033	3.2088	0.3461
m.age	36.65	34.48	53.83	49.35	25.42
share	100.00	83.66	2.73	12.02	1.60

PUBLICATIONS OF THE URBAN CHANGE SERIES

1. Luis Castro and Andrei Rogers, *Migration Age Patterns: I. Measurement and Analysis*. WP-79-16.

2. Lennart Ohlsson, *Components of Urban Industrial Employment Change in a Small Open Economy: Sweden*. WP-79-32.

3. Lennart Ohlsson, *Tracing Regional Patterns of Industrial Specialization Trends in Sweden*. WP-79-33.

4. Lennart Ohlsson, *A Conceptual Framework for an Assessment of Swedish Regional Policy*. WP-79-34.

5. Andrei Rogers and Luis Castro, *Migration Age Patterns: II. Cause-Specific Profiles*. WP-79-65.

6. Piotr Korcelli, *Urban Change: An Overview of Research and Planning Issues*. WP-80-30.

7. Jacques Ledent, *Calibrating Alonso's General Theory of Movement: The Case of Interprovincial Migration Flows in Canada*. WP-80-41.

8. Peter Gordon and Jacques Ledent, *Modeling the Dynamics of a System of Metropolitan Areas: A Demoeconomic Approach*. RR-80-8.

9. Young Kim, *Multiregional Zero Growth Populations with Changing Rates*. WP-80-46.