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Aging in place, age specific migration and natural decrease

Richard L. Morrill

Department of Geography, University of Washington, Seattle, WA 98195, USA

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Abstract. This analysis of regional demographic change evaluates the roles of "aging in place" and of age-specific migration on the geographic pattern of the advent of natural decrease in the United States. The spread of natural decrease is projected on the basis of recent births and deaths, in the absence of migration. Age-specific migration data for Oregon and Washington are used to develop a typology of counties that can be used in turn to modify the probable timing of natural decrease.

Introduction

The demographic mosaic of the United States is complex and fascinating. Studies of the regional variation in the components of the demographic equation – births, deaths and migration, reveal that the nation is far from convergence to single national values, either across ethnic groups or across regions (O'Connell 1981; Morrill 1989, 1993; Bouvier 1991). One of the long term demographic trends of greatest national interest is the aging of the population (Wattenberg 1987; Wiseman 1978). Assuming no drastic changes in the risk of birth or death, or even change in the volume and characteristics of immigrants, the nation has been projected to reach a balance of births and deaths, or national natural decrease (sometimes popularly called "zero population growth") around 2025–2030, because by then the very large baby-boomer cohort of 1945–1960 will be in their older years (>70), while fertility of women will have been at or below replacement rates for at least 50 years[1] (Johnson 1991).

This paper examines the geographic patterns of the time at which natural decrease might be expected to occur, taking into account two processes – "aging

[1] Life is uncertain! The Census Bureau, in December 1992, published revised forecasts, reflecting the likelihood of higher fertility and of higher immigration, together raising population projections and postponing national natural decrease to probably 2040–2050.

in place" and "age-specific migration", as suggested by Rogers and Woodward (1988). Aging in place describes those persons, at a given scale of analysis such as the county, who have not moved. For this part of the population, the critical variable is the likelihood of death. But at least half the American population does not die in the same county in which they had been born. Migration changes the location of their deaths, and thus the geographic pattern of where natural decrease might occur. Age-specific migration – that is, numbers and rates of in- and out-migration by age – can rejuvenate or hasten the aging of different areas, particularly those losing or gaining younger or older people (Clifford 1987; Rogers 1992).

To be more complete and accurate, four factors will influence the timing of natural decrease: First the existing age structure, and thus the expected numbers of births and deaths; second, any regional differences in the risk of dying at any given age; third, any regional differences in the number of births due to variation in fertility; fourth, age-specific migration which changes the (1) age structure, (2) the risk of dying or (3) fertility.

For any area, the balance between births and deaths, for any period, is the consequence of existing age structure, differential mortality, fertility and prior migration. A high ratio of deaths to births implies an elderly population and perhaps low fertility or higher mortality; while a high ratio of births to deaths implies a youthful age structure and perhaps higher fertility or lower mortality. Net out-migration of the young or net in-migration of the elderly will increase deaths and reduce births, while net in-migration of the young or net out-migration of the elderly will increase births and reduce deaths. Since migration plays so large a role, it is obvious that no place exists where the age structure, fertility and mortality are just the result of aging in place, but rather they are the consequences of decades of age-specific migration imbalances as well.

The most obvious cases, or polar opposites, are counties with stagnant or declining economic opportunities, that have had long term net out-migration of the young, and aging in place of those that remain, despite net out-migration of the elderly as well, leading to an aging age structure, and even natural decrease, vis a vis counties with economic growth, in which there has been long term net in-migration of the young, leading to a youthful age structure. Examples of the former are counties in the Great Plains wheat belt, of the latter, suburban counties recently added to metropolitan areas.

A third well publicized group are those areas which, for amenity reasons, have attracted large-scale elderly in-migration, aging the population and leading to natural decrease. The classical examples are the resort and retirement communities of Florida. However, studies of economic restructuring and population redistribution in recent decades, or the back to back decadal changes in metropolitan and non-metropolitan fortunes, warn us of at least two other important categories: areas which were economic growth centers fairly recently, that have shifted to economic decline, but still have a youthful age structure; and areas which were characterized by long term decline but that have enjoyed recent growth and rejuvenation (Alonso 1980; Greenwood 1988; Plane 1989). Examples of the former are communities with closed military bases, and of the latter, exurban areas now attractive to long distance commuters or spillover of economic growth.

Finally a major group likely to be forgotten in an emphasis on the deviant cases are the perhaps many areas which are "average" – which grow too slowly in economic opportunities or retirement populations to attract lots of in-migrants, but fast enough to avoid many out-migrants – they may be close to a migration balance across most age groups. The group includes a great many older metropolitan areas, but also near metropolitan areas in which rural decline is off-set by metropolitan spillover. For this group, aging in place will be the operative process, whereas for the others, the likelihood of net older or younger in- or out-migration may be expected to hasten or retard the time of natural decrease on the basis of aging in place.

The first section of analysis concerns the spread of natural decrease, as a result of aging in place, utilizing data on births and deaths by US counties. The second section will examine age-specific migration in just Oregon and Washington, and the last part will inquire into the likely effects of such migration on the spread of natural decrease.

The spread of natural decrease

Figure 1 depicts the classification of counties by their 1980 to 1986 *ratios of births to deaths*, and these ratios in turn are interpreted to forecast an expected time at which natural increase will give way to natural decrease, as deaths exceed births. The classification reflects the strong statistical relation among several variables:

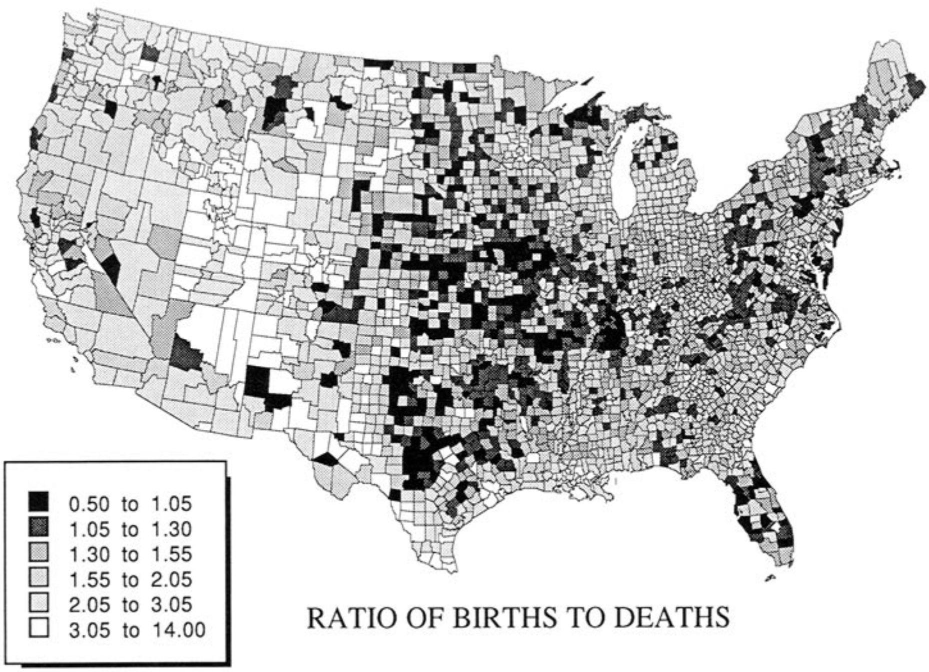


Fig. 1.

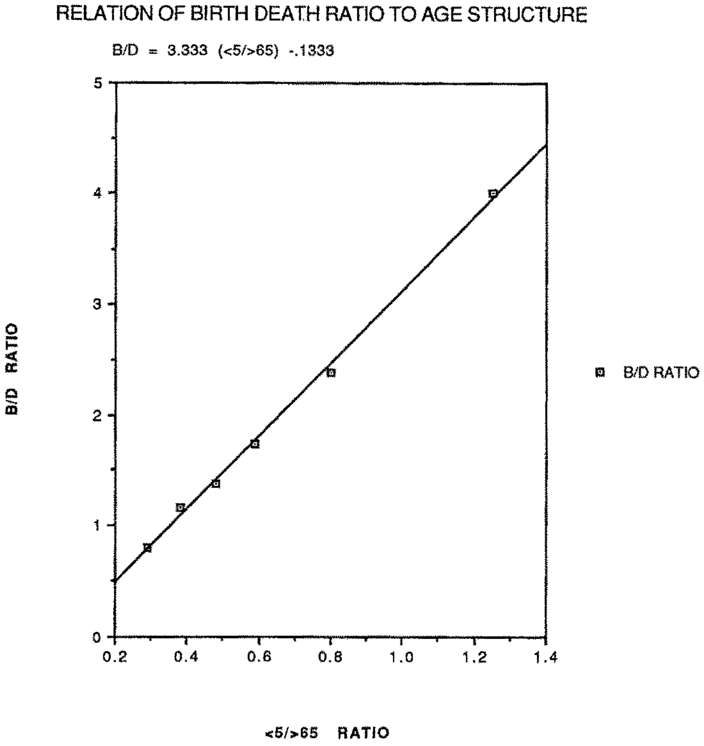


Fig. 2.

median age, the proportion over 65, the proportion under 5, the ratio of births to deaths, and the ratio of 'older' to 'younger', i.e., of the under 5 to the over 65.

The strongest relation (1980–1986 data) is a very simple linear one:

$$\text{Ratio births/deaths} = 3.3333\,[\text{ratio} < 5/ > 65] - 0.13333$$

$$R^2 = 0.89\,(n = 3100) \text{ (see Fig. 2).}$$

The expected time at which deaths will exceed births is derived from use of standard cohort survival analyses of actual states or large counties with the average characteristics of each of six classes (see Table 1) – first *assuming no migration*, as if everyone remained in the same county of birth. That is, for five-year periods into the future, births are a function of the current fertility and the numbers of women of childbearing age, and deaths a function of standard age-specific death rates and the number of persons in each 5-year age cohort. The class breaks are arbitrary, but logical, in that they were chosen to correlate with the particular dates at which, given their present profiles, the birth/death ratio would reach 1.0. The range of dates within each class reflects variation in fertility and age structure among areas with similar ratios. The effect of differential age-specific migration will be incorporated in the last section of the paper.

The assumption of a continuation of 1980s standard survival rates is very conservative. If those analysts who believe that life expectancy will continue to rise, as to levels of 85 by 2020, are correct, the dates of natural decrease will be pushed back, as they would be if large scale immigration of higher fertility populations or a new baby-boom were to occur. On the other hand, if AIDS vaccines are not found, or if immigration were severely restricted, or if fertility were to fall to European levels (< 1.5 births per woman), some of the dates could be earlier. A rise of life expectancy from medical advances or a fall because of less medical intervention would retard or hasten natural decrease everywhere, unless there were state to state differences in health policy or access. A new babyboom would tend to postpone natural decrease everywhere, but increased or decreased AIDS mortality or higher or lower immigration would differentially impact large metropolitan areas and the southwest.

The geographic pattern is not surprising, but it is dramatic. Natural decrease occurs already in two kinds of areas: Florida and other selected retirement areas with high in-migration of the elderly, in selected mining areas, as in Eastern Pennsylvania, and especially in the non-metropolitan great plains and Ozarks, with high out-migration of the young over long periods. Over the next twenty years, much of the rest of the Atlantic coastal Florida, and of the east coast from North Carolina to Maine and of the plains and central midwest, will probably experience natural decrease. Indeed, many counties already have for occasional years, especially 1973–77 and 1985–89 (Johnson 1993). However, note that many of these areas are fairly close to growing metropolitan areas – e.g., in Texas and Virginia, and could be subject to rejuvenation. For example, now 'young' counties in the Atlanta commuter-shed had a much older profile in 1960–65. Also, many counties have cycled from natural increase, to decrease, to increase, and perhaps some back to decrease (Beale and Johnson 1992). For example, many mining counties with post world-war II natural increase faded to natural decrease by 1970, returned to natural increase in the early 1980s, and back to natural decrease by 1990. The largest set of counties, those with births from 1.5 to 2 times deaths now, will have natural decrease about 2025, as the very large postwar-babyboom generation reaches very old age – extending the process to much of the south, the east central states and even parts of the west. Even so, when the country as a whole may well experience natural decrease, many suburban, small metropolitan and military areas in the east, and probably the majority of the west, and especially areas with Hispanic and Indian populations, will still enjoy natural increase.

One basis for this exercise is that the relatively low average fertility of American women that has prevailed since the early 1970s will not be reversed. The dramatic decrease in US fertility from the postwar babyboom to the 1970s and since has been associated with increased metropolitanization, the availability of contraception and abortion, the increase in divorce, economic restructuring and the relative decline of manufacturing, and the increased status and labor force participation of women. Since all these processes have also varied geographically (Morrill 1993), fertility remains highly variable across regions as well.

Thus the absolute number of births will continue to cycle in response to the smaller birth cohort of 1930–1945 coinciding with lower fertility, and the larger birth cohort of 1945–1965, coinciding with higher fertility [the "baby boom"], again a smaller birth cohort, 1965–1980, in response to falling fertility and a smaller parental cohort [the "Baby Bust"], the "baby boom echo" of 1980–1995, and so on. Similarly, the absolute number of deaths cycles, with relative peaks 1980–2005 – those born 1915–1930, and again in 2025–2040, when the mortality from the sheer size of the early postwar babyboom reaching old age simply overwhelms the lesser fertility even from a larger base (Wattenberg 1987). Aging will "slow" around 2010–2020, as the fairly small 1930–1945 cohort reaches old-age.

The geographic pattern of change is striking, and the process of transition quite slow, despite the dominance of national structural changes in fertility. This reflects the present marked diversity in birth rates, death rates, age structure and even fertility across the United States (Morrill 1989, 1993), which is depicted dramatically on the map and revealed as well in Table 1, which shows a five-fold difference in ratios of births to deaths across the six classes – from an average of 0.8 to 4! Without attempting a definitive explanation of this remarkable demographic diversity here, the main underlying factors are first age structure, which in turn is a reflection of historic patterns of unequal economic opportunities and resulting age-selective migration, as well as of differential fertility and mortality (O'Connell 1981); second, racial and ethnic composition of the population, and religious persuasion – for example, areas dominated by those of Mexican origin or by the Mormon religion continue to have higher fertility; third, location within a metropolitan region, from inner city ghettos, to older inner city areas, older and newer suburbs, and reflecting life cycle and time of settlement differences; fourth, differential attractiveness of areas to elderly migrants; and fifth, remaining substantial regional differences in age and race adjusted fertility and mortality, reflecting such diverse factors as income, rural-urban preferences and opportunities for women, environmental conditions, access to health and prenatal care, and cultural history and practices – including age of marriage, attitudes toward divorce, abortion, and homosexuality, and the like (Bouvier 1991).

While there is a large literature, especially in Europe, on the consequences of aging, and the perceived threat of population decline, much of the discussion is at a national level (Davis et al. 1987). Less analysis has been done concerning future internal variation within the US, except in relation to the elderly. Rogerson (1984) observes that flows to metropolitan areas are younger than flows from

Table 1. Profile of classes of US counties by birth and death ratios

Class	n	%>65	%>75	%<5	Birth/death	5/>65	Med. age	Trans. date
A	210	21	>8	6	0.8	0.29	39	1985
B	371	18	6+	7	1.15	0.38	34.5	1990–2005
C	625	16.4	5+	7.8	1.38	0.48	32.5	2005–2020
D	1061	14	4+	8.2	1.73	0.59	30	2020–2035
E	668	11	3+	9	2.38	0.8	28.4	2035–2050
F	252	8	2+	10.1	4	1.25	26	>2050

Cutoffs between classes are at birth/death ratios of 1, 1.25, 1.5, 2, and 3.
Births and deaths, 1980–1986

them, supporting a faster transition in non-metropolitan areas. Serow and Spar (1982) forecast that, despite the likelihood of more older migrants as the pool of young falls, a marked polarization will occur, with unfavorable age structures and population loss in much of the north, compared to the south and west. Besides Rogers and Woodward (1988), several scholars have analyzed the components of population change (aging and migration), especially with respect to the elderly (Clifford et al. 1983; Lichter et al. 1981; Morrison 1984). Biggar (1984) examines the aging of amenity areas through elderly migration. Wiseman (1978) provided a broad discussion of the geography of aging, and Warnes (1982) brought together a number of contributions to the topic. Johnson (1991, 1992, 1993) has done the most closely related work. Johnson (1993) provided an excellent discussion of the timing and geographic incidence of natural decrease, including useful maps, and emphasized the dominance of age-structure distortions brought on by protracted age-specific out-migration of the young. He noted that one-third of US counties have experienced at least one year of natural decrease.

Regional decline, mainly of mining and agricultural areas is, of course, of long standing, but discussion has typically concerned the consequences of selective out-migration of young adults. At least after 2020, wide areas [the D as well as the A, B and C zones] will begin to experience decline, even in the absence of net out-migration, even of the young. Still, some regions will have to cope sooner than others with effects of a smaller labor force, and fewer consumers. The economic and demographic theorists remain divided as to the capacity of peoples and of the market system to adjust to the prospect of outright population decline (Davis et al. 1987). Several European countries have very low current fertility, and in some actual population decline is opening a serious debate on the consequences of extreme aging.[2]

It is obvious from the discussion that age-specific migration must dramatically affect the transition to natural decrease. The ratio of births to deaths, as a function of the ratio of the elderly to the very young, does implicitly assume a continuation of the very patterns of age-specific migration that produced that age, natality and mortality structure. What the ratio, calculated from 1980–1986 data, does not take into account is the possibility of some areas in the vicinity of growing metropolitan areas to rejuvenate and of additional areas becoming attractive to elderly retirees, of other areas going into sudden decline, or of the effects of decades of net in- or out-migration of the young or the old. So I'll now turn to the role of migration. For purposes of illustration, this analysis is limited to Oregon and Washington.

Age-specific migration in Washington and Oregon, 1980–1990

The demographic fate – growth or decline, age structure and dependency – of areas is a direct function of natural increase (or decrease) and of migration. To

2 Personally, I believe the market system will prove able to adjust to population decline and apparent high dependency. After all, the wealth of the elderly will work for them, and enhance the productivity of the young. More controversial is the likelihood of immigration of surplus young people from other cultures, and their long term effect on population composition.

a considerable degree the pattern of age-specific migration is likely to be correlated with the demographic structure of areas. Indeed age-specific migration is a simple mathematical function of change in age structure over time and age-specific cohort survival, and can be estimated after the fact.

Expectations

The generalization that the more net in-migration the greater the growth, and the more net out-migration, the slower the growth and the greater the likelihood of population decline is obvious to self-evident, but growth and decline and migration are much more complex and interesting than that. The geographic patterns of population growth and decline are well publicized and researched. The broad patterns of American age-specific migration are also reasonably well-known to specialists; indeed projections of future populations are based on extrapolations of prior age-specific migration (Plane 1989; Plane and Rogerson 1991). Very heavy flows of elderly migrants to favored areas, especially Florida, results in strong net in-migration and growth, despite a high crude death rate and even natural decrease. In such areas, high elderly in-migration is associated with growth and with an elderly age structure. Similarly many areas in the Great Plains have had a pattern of heavy net out-migration of young adults, owing to the absence of job opportunities, associated with slow growth, or population losses, and again with a relatively elderly age structure.

Many scholars have recently examined the impact of elderly migration on population redistribution; e.g., Flynn (1985); Frey (1986); Heaton (1983); Litwak and Longino (1987); Rogers and Watkins (1987); Golant (1987); Rogers (1992) and Serow (1987). The elderly are not homogeneous; for example, the more affluent are likely to move farther and to concentrate in selected areas; the very old are likely to move shorter distances or to return to areas of earlier residence (Rogers 1987).

On the other hand, suburban to exurban areas tend to attract fairly heavy net in-migration of young adults, often with children, for reasons of housing availability, perceived social environment and the like, and this is associated with rapid growth and a youthful age structure. Much of the young migration to the suburbs presumably came via out-migration from the central cities; thus net out-migration of the young in metropolitan cores should be associated with low growth or decline and an elderly age structure, similar to that of much non-metropolitan territory. Likewise it may be hypothesized that any faster growing area, metropolitan or not, with job opportunities, will tend differentially to attract younger migrants, often with children, associating more rapid growth with a youthful age structure.

Then there are areas which had been growing, and have a youthful age structure, but which have experienced rapid decline and net out-migration of the young, and other areas which had been in long term decline, and have an older age structure, but have been rejuvenating, as by exurban development. Thus, as a kind of giant residual, it is logical to expect that moderately slow growth, with very low net in- or out-migration, will be associated with an 'average' age struc-

Table 2. Some expected patterns of migration, growth, natural increase and age

Population change	Age structure	Nat. Increase	Dominant migration pattern	Location
1 Decline	Old	Low	Out of young	Central cities Nonmetro resource
1 A Decline	Old	Low	Out of young	Nonmetro resource
1 B Stagnant or slow	Ave to Old	Ave	Out young, in old	Small metro, city some amenity
2 Grow	Young	High	In of young, esp.	Suburbs. Mex. border military
2 B Grow	Ave to young	Ave	In of young, but esp. of old	Growing metro other areas + amenity
2 C Grow	Young	Ave to high	In generally	Growing metro + other
3 A Grow	Old	Low	In of old, esp.	High amenity
3 B Mod. Grow	Ave to old	Ave	In of old, mod.	Amenity + exurban
4 Decline or slow	Young to ave	High	Out of young, esp.	Econ. decline
5 Grow	Ave-old	Ave	In of young	Econ resurgence Spillover, amenity
6 Stable, slow	Average	Ave	Balance	Var, med. metro
	Younger	Mod. high	Out general	Hi fertility area
	Older	Mod. low	In generally	Low fertility areas
7 Stable?	Young adult	var.	In young, out mid	Colleges, prisons

ture, neither unusually young or old, the presumption being that opportunities are sufficient to 'hold' the working-aged population – to provide jobs for those entering the local labor force. Admittedly these are just the most obvious patterns of what is expected to be a more complex and subtle structure of relationships. For example, some areas fairly stable in population could have high natural increase and a youthful age structure, but general net out-migration; while others could have low natural increase and an old age structure, but decline is warded off by general net in-migration. Areas with universities, military bases or other institutions will have high mobility and distinctive migration patterns.

Some expected patterns of migration, growth, natural increase and age are shown in Table 2. Type 1, 1 A and 1 B are hypothesized as areas of decline or slow growth with net out-migration of the young, 1 A and 1 B less severely than 1; for 1 B net out-migration of the young is somewhat offset by elderly net in-migration. Types 2, 2 B and 2 C are areas of high growth and net in-migration – type 2, especially of the young, 2 B generally, but especially of the old, and 2 C across all ages. Types 3 A and 3 B are amenity areas attracting elderly net in-migration, 3 B less strongly than 3 A. Type 4 are areas turning from growth to decline and net out-migration for economic reasons. Type 5 areas are turning from slower to faster growth and greater net in-migration for economic and amenity reasons. Type 6 are areas with moderate growth and balanced in- and out-migration. Type 7 areas with colleges or prisons and high net in-migration of youth and net out-migration of young adults.

Methodology

The remaining analysis is in four parts. First, age-specific migration rates, for 1980–1990, are estimated for the counties of the Pacific Northwest. Second, these are mapped and discussed, third, cluster analysis is used to group the counties into sets with distinctive profiles of net migration rates, and the resulting classification compared to the proposed typology, and fourth, the age-specific migration findings are used to reinterpret the likely spread of natural decrease.

There are unavoidable problems, even in this seemingly straightforward set of procedures. There are questions with respect to units of analysis, the definition or measure of migration, the time period for analysis, the appropriate age groups, and whether to separate by gender.

Counties are not ideal units of analysis, because of great variation is population size (2000 to 1500000) and excess internal variability of settlement character, especially in larger counties. The counties in these two states are too large to distinguish metropolitan central city out-migration. But only county boundaries are stable enough to permit calculation of migration rates. There is really no choice.

The definition of migration in the United States is arbitrary and unsatisfactory – that a person resides in a different county in 1990 than five years earlier in 1985. The main problem is that there is no way to distinguish longer distance migration involving a likely change in jobs with local 'migration' across a county line but within a job market. Another problem is that most migration flow data cover internal migration only, although the demography of many areas may be greatly affected by immigration and emigration.

Two time periods were originally considered, the 1980–1990 decade and the 1985–1990 5-year period, for which migration data are reported in the 1990 Census. The 1980–1990 decade was chosen for the following reasons: the decade is statistically desirable because the estimates of migration can be anchored in quite reliable decadal census data for age, and because the ten-year period tends to coincide with the actual cycle of 'boom to bust to boom to bust' the region experienced. Unfortunately, the only period for which actual in- and out-migration flows are reported is for 1985–1990, but these data were not yet available for this analysis, and, as noted above, they do not capture emigration at all, or immigration by age. As a consequence, only residual estimates of net migration are realistically possible. This creates a major methodological problem for demographic projection. Applying net migration rates to age cohorts over time creates an increasing likelihood that population stocks become out of balance. Ideally, it would be desirable to use age-specific in- and out-migration for each county. I could by model invent plausible values of in- and out-migration rates, but I feel that this would introduce as much error or uncertainty as using the net migration rates. However, the main defense of relying on net migration rates is that a full demographic projection is simply not feasible from known data. Rather the analysis should be treated as a hypothetical estimation. No projections or estimates are presented for specific areas. Since the purpose is to suggest plausible adjustment to a quite generalized geographic and temporal mapping of natural decrease, the net migration data should suffice.

It would also be preferable to distinguish male and female migration profiles, since, for example, women outlive men and peak female migration rates occur earlier than for males (Rogers 1991). This was not done, for reasons of avoiding even more complexity, and because this distinction is not likely to affect the broad geography or timing of natural decrease.

Procedure

On the basis of the number of persons by age groups for 1980 and 1990, and estimates of the numbers of births and deaths by year during the decade, estimates of the net migration by age group can be derived for the decade. Age-specific migration numbers and rates are estimated for Washington and Oregon counties, for the entire 1980–1990 decade, by a cohort survival approach which produces residual estimates of net migration. Five year age cohorts (and 1980–1990 births) from 1980 were survived to produce expected numbers by age for 1990. Washington and Oregon specific survival tables were used for all counties, but minor adjustments were needed to equalize enumerated and estimated deaths by county. Net migration numbers were differences between enumerated counts for 1990 and the cohort 10 years younger in 1980 survived to 1990. Net migration numbers were expressed as rates or proportions of the 1980 population shares. For example, the net migration rate for the 10–24 year interval was simply the difference in the size of the 1980 0–14 cohort, less expected deaths to the cohort, 1980 to 1990, and the 1990 10–24 cohort, as a proportion of the 1980 0–14 base. Although estimates were derived for all 5-year cohorts, 0–85 and 85+, values were combined into the following useful intervals for further analyses.

1980 Base Pop	Ages in 1990
Births (80–90)	0–9
0–14	10–24
15–24	25–34
25–34	35–44
35–44	45–54
45–54	55–64
55–64	65–74
>65	>75

Cluster analysis was used to group counties on the basis of these eight age-specific net-migration rates. The groups were verified through discriminant analysis. For the resulting clusters, values on selected other variables are also reported: natural increase, growth, and proportions of the 1980 population in selected age groups – 0–24, 25–44, 45–64, and over 65.

For the later analyses of how age-specific migration variability might affect the timing of natural decrease, a similar methodology was used. For representative counties for the groups (counties with particular migration profiles), populations as of 1990 were survived into the future in 5-year increments. The procedure was to apply age-specific net migration and survival rates to each cohort, based on the population at the start of the period, yielding migration and survival components of growth and a new estimate of population by age for each 5-year period. Births were estimated as a constant ratio of births to the changing population 20–34, that is, as actually experienced, 1985–1990. An estimation problem arose, as noted above, through the use of net migration rates, but perusal of the values to 2050, suggest no implausible or extreme results.

Patterns of age-specific migration in Oregon and Washington

Maps of net migration

Maps are presented for overlapping sets of ages, to illustrate different facets Net Migration 10–34; (Fig. 3a). This wider youth-young adult group probably best captures the relative pattern of economic vigor in the 1980s, with far more losing than gaining areas, with the highest in-migration in the metropolitan zones of job growth (King, Snohomish, Kitsap, Washington, Clark), but with spillover into other metropolitan and non-metropolitan areas and growth in a very few amenity areas (Deschutes, Curry, Lincoln, San Juan). Net migration 10–24 (Fig. 3b) is similar, but brings out the special cases of counties with colleges and prisons.

The maps of net migration 25–44 and 35–54 (Fig. 4a, b) tell a very similar story of change at the main working ages, with in-migration radiating outward from the Puget Sound and Portland areas, supplemented by modest in-migration in Oregon amenity areas and in some parts of central and eastern Washington, perhaps a spillover from the 'congested' core.

Similarly, maps of net migration 45–64 and for just 55–64 (Fig. 5a, b) are quite interesting because they show positive but lower in-migration in the core metropolitan regions, and a much wider zone of spillover of migration to peripheral, often amenity areas, and not all of which can be cases of early retirement! Indeed, with the exception of southern and central Oregon amenity areas, the 55–64 in-migration is usually much larger than that over 65.

In contrast to younger ages, there was actual net out-migration from the core metropolitan counties of Portland and Seattle for age cohorts over 65 (Fig. 6), despite the areas' superior health and related services. Net in-migration over 65 is particularly prominent in southwestern and east central Oregon, amenity areas attracting large numbers of California retirees; and in far northwestern Washington, the destination of both local metropolitan retirees, but also of military retirees who had served at local military bases.

Cluster and discriminant analysis were used to derive groups of counties with a similar pattern of age-specific net migration rates for 1980–1990.[3]

[3] Rogers (1990) points out the risks of using net migration rates for statistical purposes, since similar patterns of rates may reflect different migration and growth regimes. Unfortunately in- and out-migration flows for counties were not available for this analysis. Fortunately, an examination of every county in each group indicated that in all but a few cases, counties were very homogeneous in age structure, growth and natural increase, and in geographic situation, as well as in net migration rates. In any event the main purpose of the cluster analysis was to evaluate the typology of migration patterns, and illustrate the diversity of migration experience even within a modest region.

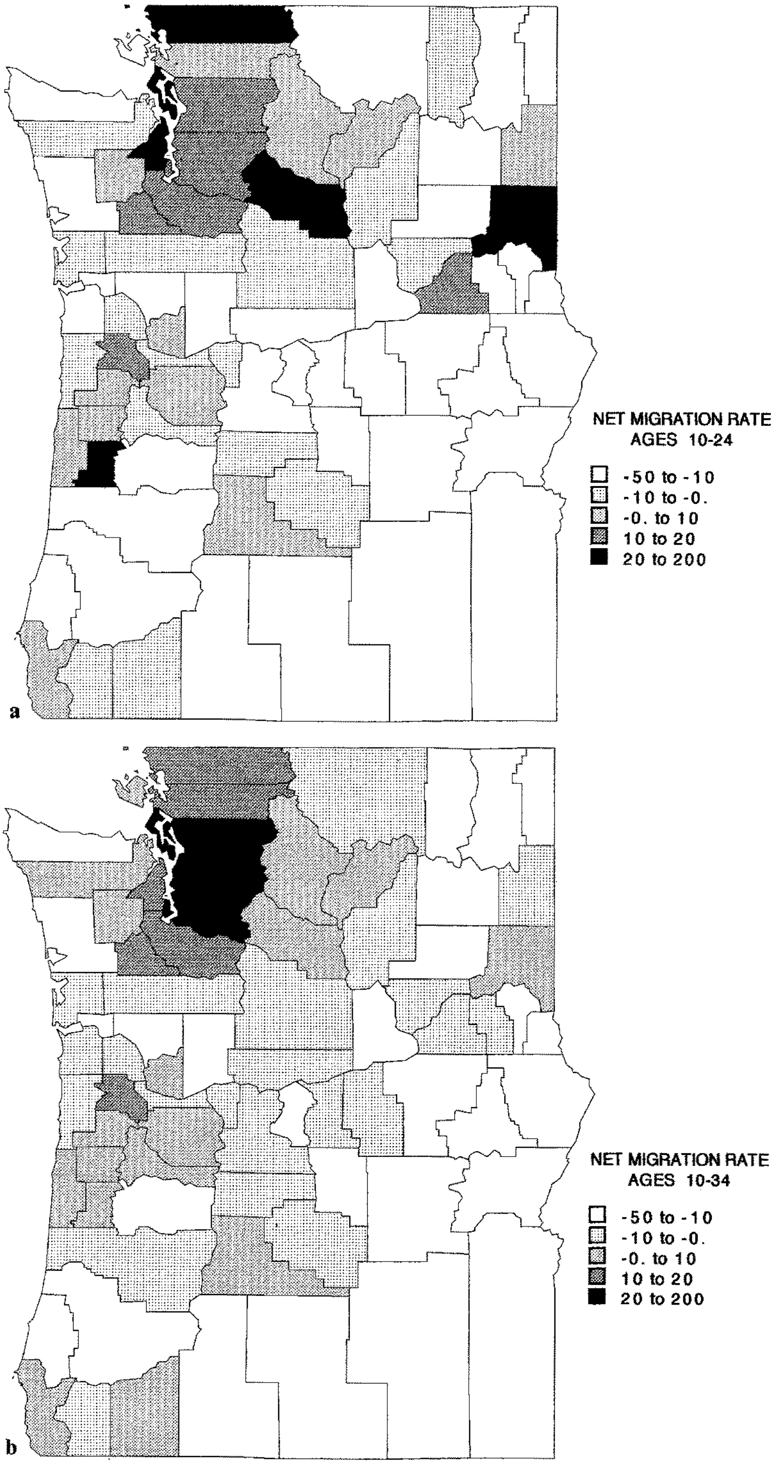
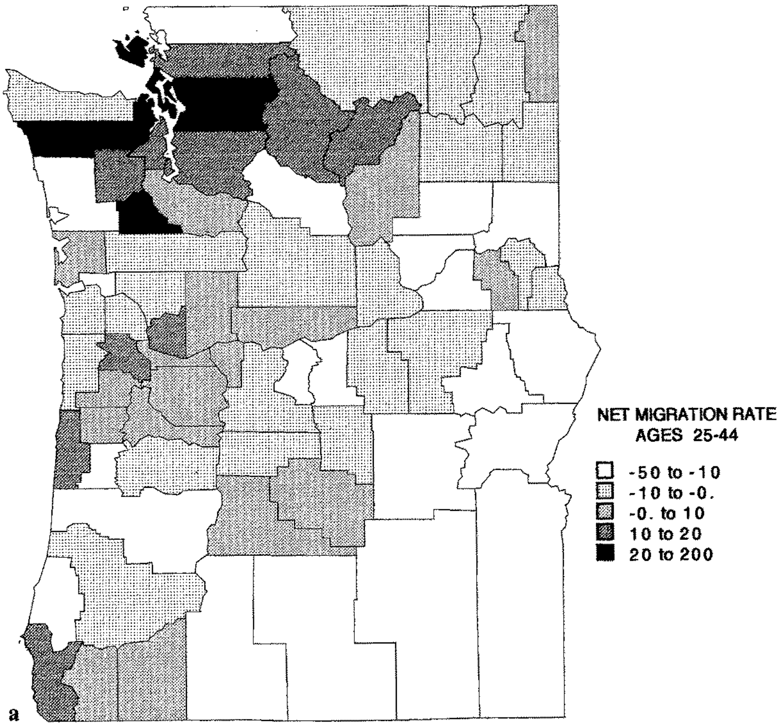

NET MIGRATION RATE
AGES 10-24
-50 to -10
-10 to -0.
-0. to 10
10 to 20
20 to 200
a
NET MIGRATION RATE
AGES 10-34
-50 to -10
-10 to -0.
-0. to 10
10 to 20
20 to 200
b

Fig. 3a, b.


a
NET MIGRATION RATE
AGES 25-44
-50 to -10
-10 to -0.
-0. to 10
10 to 20
20 to 200

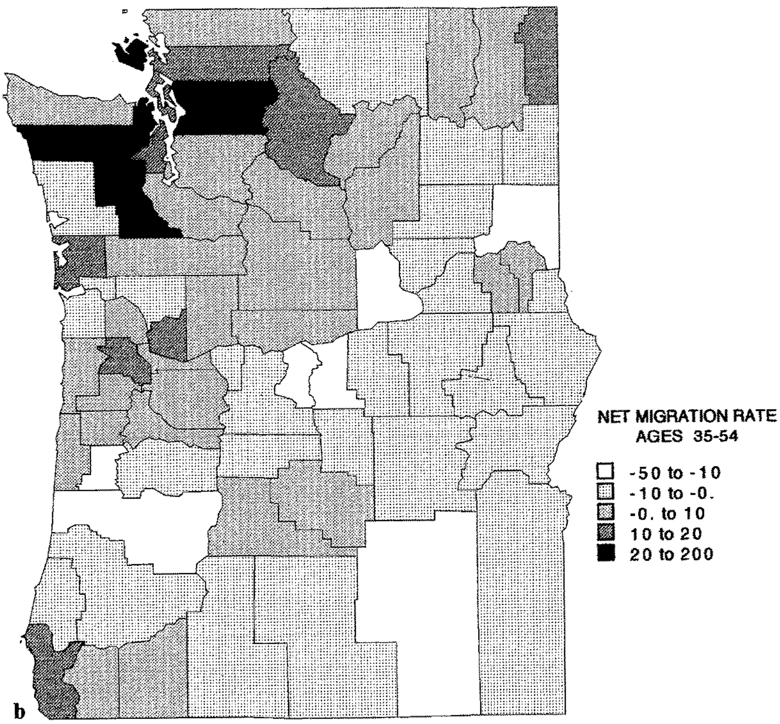
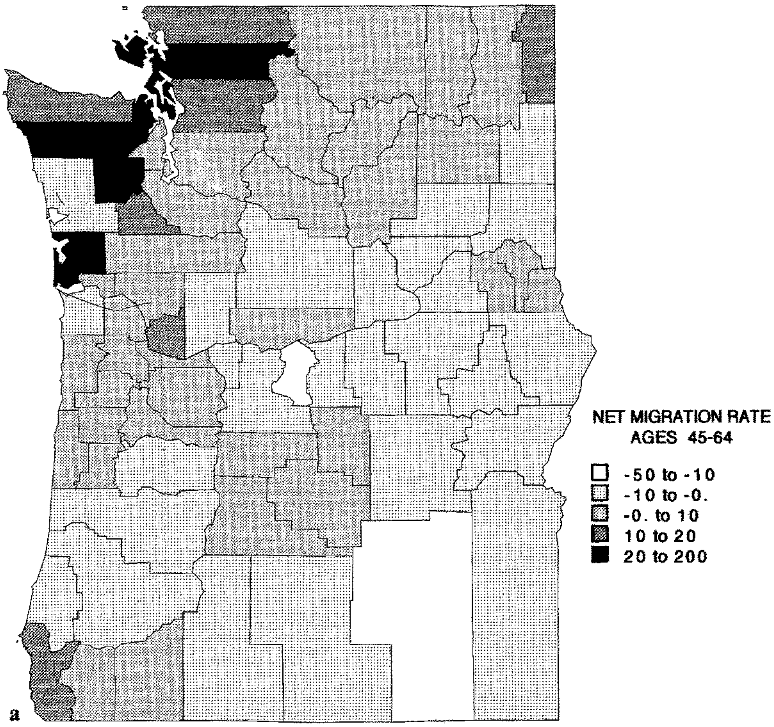

b
NET MIGRATION RATE
AGES 35-54
-50 to -10
-10 to -0.
-0. to 10
10 to 20
20 to 200

Fig. 4a, b.


NET MIGRATION RATE
AGES 45-64
-50 to -10
-10 to -0.
-0. to 10
10 to 20
20 to 200
a

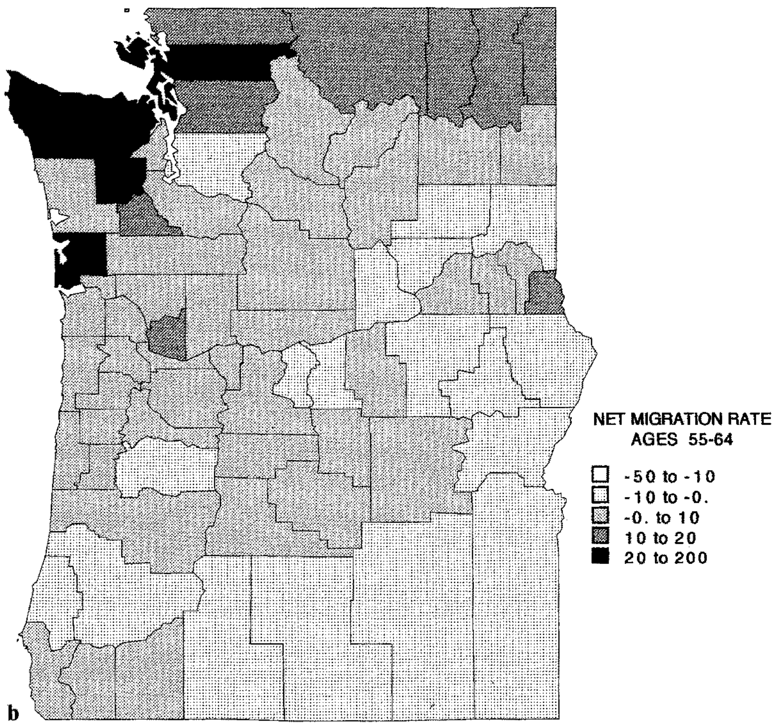

NET MIGRATION RATE
AGES 55-64
-50 to -10
-10 to -0.
-0. to 10
10 to 20
20 to 200
b

Fig. 5a, b.

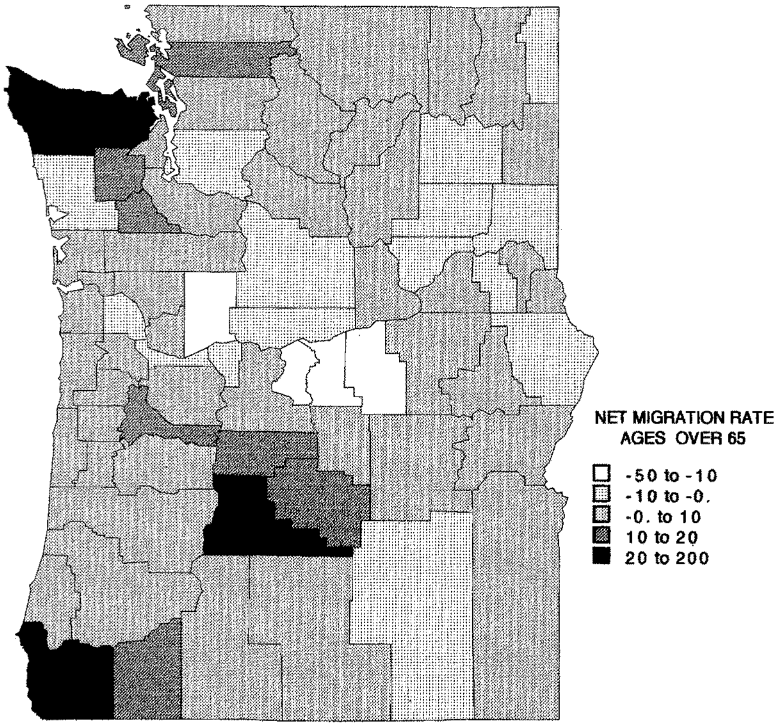


Fig. 6.

While there are many local idiosyncrasies, the counties did sort fairly well into the expected broad groups. The cluster analysis identified all the hypothesized patterns except group "5", a turnaround to faster growth. Table 3 presents the mean age-specific net migration rates, and other relevant values for groups. The groups are mapped on Fig. 7. There is a remarkable degree of geographic contiguity, considering the great complexity of settlement and economy in these states. The clustering was done only with age-specific migration rates, with Ward's criterion, via SPSS Cluster (hierarchy or aggregation method). As in any cluster analysis, there are several cases which are marginal, which share characteristics of more than one larger group, or which are truly outliers. Also, some groups are fairly similar to one another; this is recognized in the numbering system adopted. The groups from the cluster analysis were then evaluated by discriminant analysis (SPSS). This analysis indicated that all cases were correctly classified, with somewhat distinct functions distinguishing migration rates for the middle aged, for the college aged, for the very young and for the elderly. Table 3 also separates out a group 5 of 'faster growth'; the cluster analysis included them as a subgroup of group 2B and 2C.

The table values permit a general discussion of the groups with respect to the timing of natural decrease. The groups represent kinds of situation which would speed up, retard or reinforce the pattern of age structure and eventual natural de-

Table 3. Profiles of clusters of counties on age-specific migration rates, 1980 – 1

Age-specific migration rates											
Group	10 – 34	>65	All ages	0 – 9	10 – 24	25 – 34	35 – 44	45 – 54	55 – 64	65 – 74	>75
1	– 23	– 4	– 13	– 1	– 25	21	– 8	– 4	0.5	– 3	– 4
1A	– 13	2	– 8	– 7.5	14	– 13	– 7	– 5	– 1.6	2	2
1B	– 10	2	– 1	7	– 13	– 7	1	4	11	6	– 3
2	23	5	17	14	16	30	18	9	8	8	2.5
2B	12	22	16	3	8	17	17	11	10	27	17
2C	9	6	10	14	7	13	8	6	7	9	3
2all	14	10	13	11	12	17	13	9	10	13	6
3A	5	17	17	12	– 1	12	19	33	49	33	2
3B	– 1	14	4	2	– 2	1	1	0	2.5	17	10
4	– 10	– 6	– 9	– 5	– 12	– 8	– 9	– 5	– 5	– 8	– 5
5	9	7	10	6	8	12	16	11	13	12	3
6	– 1	– 1	– 1	– 1.5	– 2	– 1	1	– 1	1.5	– 0.5	– 1
7	0	1	– 3	– 0	70	– 39	– 16	– 2	0	2.5	0.4

Group	NIncr	Growth	Pop 0 – 24	Pop 25 – 44	Pop 45 – 64	Pop >65
1	2.4	– 10	37	24	23	15
1A	5.5	– 3	40	27	20	13
1B	7.6	7	42	27	19	11
2	10.5	28	41	32	18	9
2B	7	22	41	28	18	13
2C	9	20	42	29	18	10
2all	9	23	41	30	18	11
3A	4.5	22	36	27	22	15
3B	7	9	40	28	20	13
4	13	4	43	29	19	8
5	6	17	39	28	20	13
6	6	6	40	28	19	13
7	5.5	2	44	26	17	12

1 Severe out-migration of young
1A Moderate out-migration of young
1B Low out-migration of young, in-migration of old
2 High in-migration of young
2B Moderate in-migration of young, high in-migration of old
2C Moderate in-migration of young and old
3A High in-migration of middle and old
3B Moderate in-migration of old
4 Economic decline, high fertility, general out-migration
5 Accelerated growth, general in-migration (pt of 2B and 2C in cluster analysis)
6 Balanced in- and out-migration
7 Effect of institutions (10 – 44 in and out); most like 6 otherwise

crease expected on the basis of 'aging in place'. The higher the ratio of net migration for either the young or the elderly, and the more imbalanced these net flows are, the greater will age-specific migration affect the timing of the spread of natural decrease.

Group 1 counties are sparsely populated rural resource counties, with net out-migration across all age groups, and the highest overall average population loss. The most severe net out-migration was in the younger ages (10 – 34). Group 1

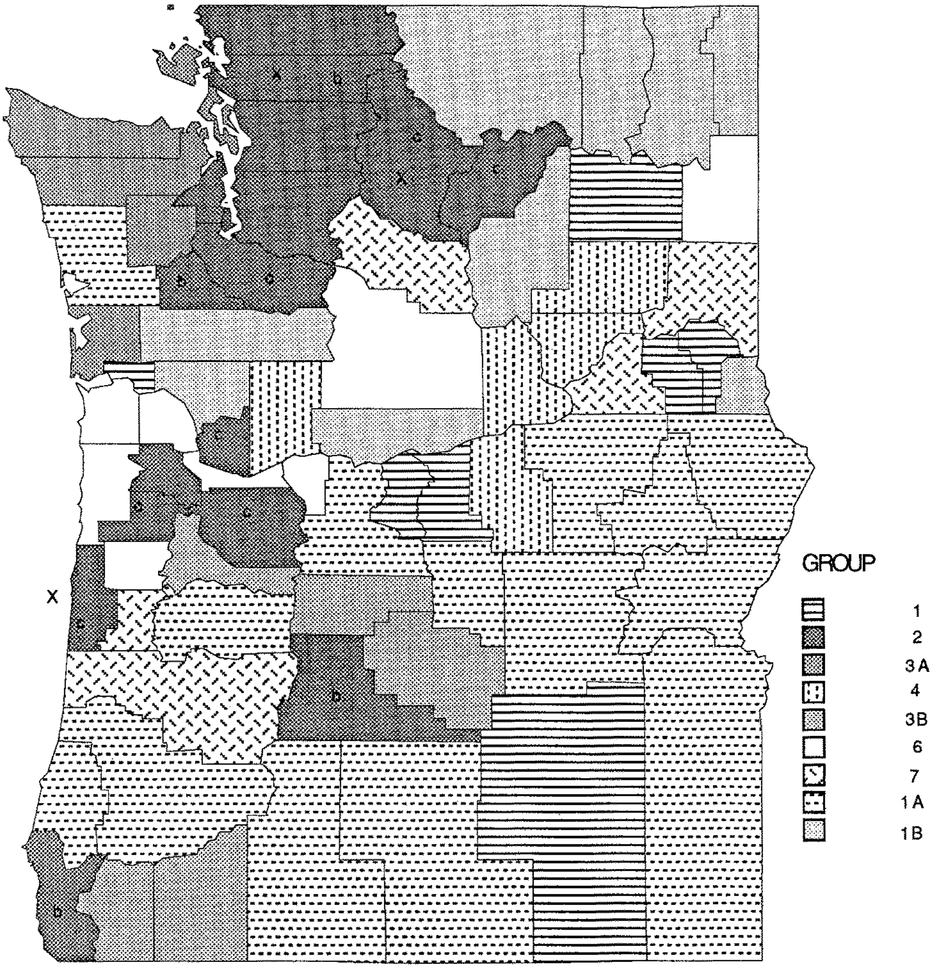


Fig. 7.

counties had low natural increase, high proportions over 65, but low proportions 15–44. These are counties, fairly few in Washington and Oregon, which have for decades experienced persistent high out-migration of the young, and are at or close to natural decrease. They actually have slight net in-migration of groups over 65, so the pattern will maintain and even deepen natural decrease into the future.

Group 1 A is a large set of counties, mainly in Oregon, which are similar to group 1 in net out-migration across all younger ages (0–64). They are all highly resource dependent, mainly on declining forest products industries. However, they experienced small, but measurable net in-migration in the population over 65, despite in many cases a fairly remote location. These counties had a lowish natural increase, and a fairly high proportion over 45. Many group 1 A counties have also experienced long term net out-migration but not so severely as the group

Fig. 8.

1 counties. They represent the quintessential pre-metropolitan American county, dominated by primary activities but with towns or small cities. Many did well in the 1960s or the 1970s, but stagnated in the 1980s.

The ratio of births to deaths in these counties averages 1.5. The effect of the migration imbalance between the young and the old, if it persists, should be to advance the timing of natural decrease about a decade, from 2010 to 2000 or even 1995. For those counties with a birth to death ratio averaging 1.25, the effect of the migration would be to move up natural decrease to the immediate 1990–1995 period from perhaps 2000; this is because the number of births drops precipitously, due to the high out-migration of those of child bearing age.

Group 1 B also had net out-migration of young adults (10–34) but these counties had quite marked net in-migration across most older ages (35–74), and especially for 55–64, in part an early retirement group. All these areas are in Washington; their better performance than the group 1 A counties may be attributed to the more vigorous growth of the Washington economy in the 1980s or to their being in the outer commuting zone of metropolitan areas (Seattle, Spokane, and Portland). These counties had a fairly high natural increase and proportions under 14, and in their parents' 35–44 cohort – those attracted by stronger growth in the 1970s rural 'turnaround'. Some of these counties have above average fertility, because of Hispanic, Native American or Mormon concentrations. The combination of slightly lower net out-migration of the young, but slightly higher net in-migration of the old should have a similar effect as for group 1 A, to advance the time of natural decrease forward about a decade, from 2015 to 2000–2005.

Group 2, 2B and 2C counties are those with significantly high growth and net in-migration across all age categories. But they differ from all other groups in their particular attractiveness to young adults 10–44, indicating that these were the areas of greatest job expansion and suburban housing development in the 1980s. The group includes all of western Washington metropolitan counties and four suburban Portland counties. Despite moderate to low fertility, they have such a youthful age structure that they average a high 2.45 ratio of births to deaths. Group 2 areas, all fast-growing metropolitan counties, had especially high in-migration 0–44; the group 2B counties included 3 non-metropolitan areas, and were marked by high in-migration of the 35 and over. Two Oregon counties, Curry and Deschutes had especially high in-migration over 65. The group 2C counties had net in-migration in all ages, but less rapid; they include some metropolitan and suburban counties and spillover to amenity areas. The turnaround counties (hypothesized group 5) were not separately identified, but the 3 counties with these characteristics were classed in the actual 2B or 2C groups (marked x on Fig. 7).

The group 2, 2B and 2C counties are quite consistent in fairly high natural increase, high proportions 10–44, and low proportions over 45, except in group 2B, which also enjoyed high elderly net in-migration. King county, containing Seattle, holds about 20% of the two-state population. It is the extreme case in the region of very high young adult in-migration, descending to net out-migration over 55. Group 2 and 2C counties are continually rejuvenating through their attractiveness to young adults from the rest of the region and nation; they totally dominate net job growth for the region. Their net migration pattern should defer the arrival of natural decrease about a decade, from 2030 to 2040 for those with birth to death ratios of 2.5, from 2020 to 2030 for King county, and others with ratios around 2.0. Thus, even if the populations of these counties continue to grow from strong net-migration, that is not enough to overcome the sheer magnitude of deaths, at least for awhile, when the babyboomers reach their eighties. Since the pattern of net in-migration for group 2B is skewed to older ages, the timing of natural decrease could be advanced from 5 to 10 years, as to 2020.

Although the Pacific Northwest does not have any counties with birth to death ratios over 3 that are also rapidly growing from in-migration of the young, many counties in the southwest do (Fig. 1). For these, if net in-migration stopped, natural decrease would probably arrive around 2040 to 2050; with migration, natural increase would probably occur indefinitely.

Group 3 counties experienced very high net in-migration of older age groups (45 – 75). Some of these also enjoy considerable spillover of growth from Central Puget Sound. A few of these group 3 counties grew only modestly because of losses in forest products and had net out-migration 10 – 34; other counties had high net in-migration across the whole spectrum except for 10 – 24, and the highest average net in-migration and growth. Group 3 counties are those with little net imigration of the young, but with high net in-migration of the elderly – the northwest's cases of the Florida or Arizona experience. Most also have very low natural increase, fairly low proportions under 24, and the very highest proportions over 55 (or 65), as expected from the high elderly net in-migration.

The larger set is divided into two subgroups and a special case. Group 3 A includes 6 counties which are like the group 1 A counties in having low natural increase and a low birth to death ratio of 1.25, but because of net elderly in-migration, not net out-migration of the young. In all cases retirement settlement increased markedly in the 1980s over the 1970s; so the expectation is for bringing natural increase much earlier, before the year 2000, even before 1995.

Group 3 B includes mainly southern Oregon counties with moderate growth and in-migration, but quite high net in-migration of older ages (over 65). This includes the Medford-Grants Pass area on the California border, and the growing amenity and retirement areas of central Oregon, both popular destinations for California migrants. Two thirds of Oregon's net in-migration was of persons over 65 by 1990. The group 3 B counties appear to be in transition. Their 1980 age structure was young, yet their strong 1990's growth was largely at the retirement age. Although the birth to death ratio was 1.65 in the 1980s, it may be expected to fall, and natural decrease brought forward 5 to 10 years. A special case, perhaps like a number of counties on the Atlantic coast and elsewhere, is Island county, WA, extremely attractive to elderly migration, especially retired military, but with higher natural increase and in-migration of the young, from the presence of the Whidbey Island Naval Air Station.

Group 4 counties also experienced on average net out-migration across all age groups, if less extremely, but again, most severely for 10 – 24; but higher natural increase offsets the net out-migration. Almost all this area is focussed on the Tri-cities of Richland-Kennewick-Pasco, where the Hanford Nuclear Reservation suffered reduced operations in the 1980s, but they are also areas of irrigation agriculture, with high fertility populations. These counties had very high natural increase and a youthful age structure. But these few group 4 counties suffered a precipitous decline in employment, after decades of growth. As it happens, these are also counties with high Hispanic and Mormon populations, with by far the highest fertility in the Pacific Northwest and a birth to death ratio of 3.0. Since the area has many attractive labor force and location attributes, it is certainly plausible that faster growth might be reestablished. The cautious conclusion would be a moderate hastening of aging, but with natural decrease still in the indefinite future.

Similarly a few counties experienced acceleration of growth in the 1980s relative to the 1960s and 1970s, with especially higher net in-migration of the young than previously. These were a subset of the group 2B and 2C faster growing counties, but were separated here as group 5 reversals. The 5 reversal appears to be a result of a spillover of growth from perhaps congested metropolitan cores. Since the net in-migration is rather consistent across all age groups, however, the expectation is for only a moderate postponing of the time of natural decrease by about 5 to 10 years.

Group 6 counties are characterized by close to a balance in migration across most age groups, and slow to moderate overall growth. The group includes 2 slower growing Washington metropolitan areas (Spokane and Yakima), and several parts of the greater Portland area (the central counties, and Columbia river and coastal counties). Group 6 counties were generally average in natural increase, growth and age structure, except for above average proportions over 55. Group 6 counties not only were close to a migration balance overall, but consistently across all age groups. All enjoyed enough growth to be able to retain their younger population. This pattern is of rather long standing, so that it would imply that aging in place will predict natural decrease at from 2010 to 2035 (the current birth to death ratios vary from 1.4 to 2.2, depending on age structure and ethnicity).

Group 7 includes a special set of five counties with major institutions, the Universities of Oregon, Oregon State, Washington State, Central Washington, and the Washington State penitentiary, all with expected high in-migration in the 10–24 age group and then out-migration in the 25–34 cohort. As it happened in the 1980s, most of these counties had close to a balance in other age categories and very modest growth. If the 10–24 and 25–34 groups are collapsed, then the group disappears as a separate one. The counties are predictably low in the very young and high in the young adult ages. Two of the counties are unusual in also having a sizeable elderly population and in-migration at the retirement ages. Because of their institutional character and peculiar migration patterns, I did not attempt to evaluate the implications for the timing of natural decrease.

How do the clusters compare to the expected patterns of migration, growth, natural increase and age, as listed earlier? The hypothesized groups were successfully identified by the cluster analysis, with a number of marginal cases, as expected, with the exception that the 'turnaround to faster growth' group 5 counties were clustered into the group 2B and 2C faster growth counties.

Table 4 reinterprets and extends the earlier Table 1 in the light of the discussion of the role of imbalanced age-specific migration, and summarizes how distinct migration profiles may hasten or retard natural decrease.

Age-specific migration and the map of the spread of natural decrease

What does the analysis of the effects of consistent high net in- or out-migration of the young or of the old mean to the timing and spacing of natural decrease? Although the analysis was just for Oregon and Washington, the migration and birth to death ratio profiles are prevalent across the country.

Table 4. Birth to death ratios, age ratios, migration and the timing of natural decrease

B/D ratio	5/>65 ratio	Date of natural decrease		
		Migr. balance or aging in place	More old in young out	or More young in or old out
0.85	0.295	1980–1990	–	>1990
1.0	0.34	1990	–	1990–1995
1.25	0.415	1995–2000	1990–1995	2005
1.5	0.49	2010–2025	1995–2005	2015
1.74	0.565	2015–2020	2000–2010	2020–2025
2.0	0.64	2020–2025	2020–2015	2030
2.5	0.79	2030–2035	2025	2040–2050
3.0	0.94	2040–2050	2030–2040	2050+
4.0	1.24	>2050	>2040	>2060

Areas already with natural decrease, both those in the Plains and Appalachia with long term net out-migration of the young, or those of elderly net in-migration in Florida, New Mexico, the Ozarks, selected areas of the Atlantic coast, etc. will be continued in natural decrease by these migration patterns. Possibly a few areas of reversal or rejuvenation to natural increase, as in the outer metropolitan fields of Dallas-Ft Worth or San Antonio, could occur.

Areas with fairly low ratios of births to deaths, 1.0 to 1.5, are extensive in the northeast from Maine to North Carolina, in Appalachia, in the Great Plains, "Corn Belt" and in retirement areas of the west, again because of net out-migration of the young, or net in-migration of the elderly. If these migration patterns persist, Table 4 implies an accelerated spread of natural decrease by 1995 to 2005, rather than the 2000–2015 on the basis of aging in place. But some rejuvenation, and postponement of natural decrease in a few areas of metropolitan spillover of growth are possible, as in North Carolina, Texas, and other parts of the south.

Areas with moderate birth to death ratios, 1.5 to 2 or 2.5, are extensive across the metropolitan and non-metropolitan west, the rural small town south, and suburban to small city northeast and midwest. Probably half these areas have moderate growth and close to a migration balance, and aging in place adequately projects the advent of natural decrease, but in as many as a third, including many rural to small city areas of the midwest, and rural small-town, often Black areas of the south, counties have experienced economic stagnation and increased net out-migration of the young. For these natural decrease could be pushed ahead toward 2005–2015 from 2015–2025. But there are also many areas, primarily suburban, or smaller metropolitan and especially in the southeast and west, with increased in-migration of the young, with a likely pushing back of natural decrease toward 2025–2030.

Areas with higher ratios of births to deaths, over 2.5, include rapidly growing suburban zones in all regions, and many Hispanic, Mormon, Cajun, or Native American parts of the south and west, most of which will continue to have higher fertility. The suburban and Mexican border zones are continuing to grow and attract young migrants, further postponing natural decrease to 2040 or indefinitely.

However, many areas in the west (especially in the Mountain states) and the southwest experienced severe decline and out-migration in the 1980s as energy prices fell. If such a pattern were to persist, natural decrease could come sooner, as 2025–2030. However, early 1990s data suggest a return to growth in this region.

Conclusions and implications

Demography and economy are intertwined in the evolution of regions. National and global cycles and trends are powerful and may be dominant – for example, the overwhelming role of the 'babyboomer' generation in the unavoidable arrival of national natural decrease, and their influence on the space-economy in their 75 year route to that time (Easterlin 1980; Plane and Rogerson 1991). But this paper has highlighted the other side, not only the enormous variability, even within local regions, in the patterns of births, deaths and age, but also the powerful effect that differences in age-specific migration will have in reinforcing, even exaggerating that variability. The highly different migration profiles hasten the advent of natural decrease for some regions, and postpone it for others, certainly spreading out in time and space what we might otherwise mistakenly view as a fairly short national transition. It is important to reemphasize that the wider advent of natural decrease does not mean near universal population decline. Favored areas can long continue to grow on the basis of net in-migration, even if there are more deaths than births; however, it does mean that such growth would have to be at the expense of greater declines in less attractive areas. In the long run, the number of areas that can maintain growth, or rapid growth, must decline.

The important point for regional science theory is that the migration patterns both reflect very great regional difference in economic and demographic growth, structure and character, but in my view convincingly refute the idea that modernism, and global cultural and economic interchange, will lead to economic and demographic convergence. Ethnicity and race, ideology, religion and preference, environment, entrepreneurship, identification with and competition among places and regions, and individual selectivity in migration choice and destinations are among the many forces which maintain regional diversity.

The implications for regional welfare are profound. Although the proportion itself probably varies greatly by region, perhaps on average two out of three people will age in place, and about one-third will move, some long distances, as to Florida, but the majority shorter distances to nearby areas. Age-selective migration tends to dichotomize areas between younger and older with higher and with lower natural increase. As Peter Morrison (1992) observes, aging in place will create vast territories with high proportions of the elderly, inevitably causing economic and social restructuring, and a widely varying capacity to cope. As Rogers and Woodward (1988) argue, the implications are vastly different form two kinds of elderly territory, even enriching amenity areas attracting more affluent older migrants, but possibly impoverishing many areas, where aging in place dominates, or to which the less affluent may be forced, because of costs of housing or crime in their present metropolitan homes.

Meanwhile, both age-selective internal migration, and immigration of younger population will maintain the growth and youthfulness of favored areas, particularly in the west and south. But, given the inevitably increasing voting power of the elderly, as the population ages, the legislative agenda may well shift toward the needs of the majority of territory with population stagnation and decline, from a minority of territory with continuing population growth.

Neither natural decrease nor population decline are necessarily undesirable, or lead to relative income loss or a lowered quality of life; that will depend on the quality of economic and social organization. After all, the wealthiest part of the United States is the relatively slowest growing northeast. But if aging populations become segregated geographically, within metropolitan regions or over wider territories, then perhaps the risk of spatial polarization and intergenerational conflict would become greater.

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