MIGRATION AND SETTLEMENT:
15. FRANCE

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FOREWORD

Interest in human settlement systems and policies has been a central part of urban-related work at the International Institute for Applied Systems Analysis (IIASA) from the outset. From 1975 through 1978, this interest was manifested in the work of the Migration and Settlement Task, which was formally concluded in November 1978. Since then, attention has turned to dissemination of the Task's results and to the conclusion of its comparative study, which, under the leadership of Dr. Frans Willekens, is focusing on a comparative quantitative assessment of recent migration patterns and spatial population dynamics in all of IIASA's 17 National Member Organization countries.

The comparative analysis of national patterns of interregional migration and spatial population growth is being carried out by an international network of scholars who are using methodology and computer programs developed at IIASA.

In this report the authors discuss the historical trends of population redistribution in France and go on to analyze current migration patterns. Much of the data used were unpublished and presented problems for which the authors created innovative solutions. The empirical results of the study are insightfully analyzed and contribute to the literature on internal migration in France.

Reports summarizing previous work on migration and settlement at IIASA are listed at the end of this report.

Andrei Rogers
Chairman
Human Settlements
and Services Area

ACKNOWLEDGMENTS

This report owes much to Andrei Rogers who not only pioneered the development of multiregional mathematical demography but also provided stimulating remarks during the process that led to the report's completion. Comments and suggestions offered by Philip Rees and Marc Termote are also most gratefully acknowledged. Nevertheless, the authors solely are to be held responsible for the contents of this report and the errors it certainly contains.

Jacques Ledent wishes to thank Ms. Jacqueline Hecht of the Institut National d'Etudes Démographiques (INED), Paris, for arranging a one week's stay at that institute, which enabled him to collect the data used in this study and to write a preliminary draft of the policy section. He also acknowledges the help of François Cazin of the Institut National de la Statistique et des Etudes Economiques (INSEE), Paris, for guiding him in his search for recent data on regional mortality, fertility, and migration. In addition, he is grateful to Luis Castro and Frans Willekens for their neatly written computer programs that he used, without encountering any problems, to carry out the numerical calculations appearing at the end of section 2 (model migration schedules) and in section 3 (multiregional population analysis).

Last but not least, the authors wish to express recognition of the competent work accomplished by Maria Rogers, Susanne Stock, and Rosemary Flory. Ms. Rogers has diligently and carefully edited a particularly long report; Ms. Stock has cheerfully and skillfully typed an especially difficult hand-written manuscript as well as several subsequent revisions; and Ms. Flory has added her talents for accuracy and style to the final typeset version.

CONTENTS

1 INTRODUCTION

The spatial pattern of population change in France has long been of interest to demographers, but their work has generally been limited to the description and understanding of either regional differentials in fertility and mortality patterns or rural–urban migration flows. It is only recently that some researchers (Courgeau 1970, 1978; Tugault 1973) have thoroughly examined French internal migration patterns and reviewed their temporal and spatial evolution.

1.1 General Considerations

Building on those previous research efforts, this report provides a comprehensive picture of the spatial distribution of population in France with a particular emphasis on the issues and policy aspects of geographical mobility. The study is a part of the Comparative Migration and Settlement Study undertaken by the Human Settlements and Services Area at IIASA for its 17 member countries (Rogers 1976b, Willekens 1978). It not only applies methods conventionally used to describe spatial population change but also takes advantage of the new mathematical techniques developed by Rogers (1968, 1975a, 1979) and his collaborators (Rogers and Ledent 1976, Willekens and Rogers 1978, and Rogers et al. 1978), which have been elaborated at IIASA. The use of model migration schedules provides an improved understanding of the age patterns of interregional migration. Moreover, and foremost, the application of the methods and models of multiregional demography – which offer an explicit treatment of the interdependency between study areas – enables greater insights into changes in the spatial distribution of the national population.

Section 2 examines the current patterns of geographical population change, particularly interregional migration patterns. Mostly based on traditional descriptive methods, this analysis culminates with the fitting of model migration schedules (Rogers et al. 1978). Section 3 presents the additional findings obtained by applying the techniques of multiregional mathematical demography. It gives the synthetic demographic information that results from (1) using the multiregional life table (Rogers 1973, 1975a); (2) applying the mortality, fertility, and mobility analysis proposed by Rogers (1975b); and (3) carrying out a multiregional population projection (Rogers 1975a). Finally, section 4 discusses the government policies that may have affected the redistribution of population over the last 25 years. Specifically, since the French government does not actively promote any direct migration policies, it reviews the evolution of *aménagement du territoire* (territorial planning), especially focusing on its ability to affect population redistribution.

In the remainder of this section, after a brief discussion of the data sources and the delineation of the study regions, we present an overview of the broad historical patterns of spatial population change.

DATA SOURCES

Virtually all the data used in this study come either directly or indirectly from the Institut National de la Statistique et des Etudes Economiques (INSEE). Most of the data have been compiled from documents published by INSEE itself. They include

(a) various issues of its annual statistical yearbooks (INSEE 1966 and selected years)
(b) a statistical abstract of various demographic tables prepared by Croze (1976, 1979)
(c) various publications reporting on the results of the last three censuses taken in 1962, 1968, and 1975, especially those dealing with intercensal migration (Schiray and Elie 1970, Desplanques 1975)
(d) some specialized publications presenting detailed regional data on fertility and mortality (Labat and Viseur 1973)

Additional results and statistics were taken from various sources that cited data provided by INSEE: for example, the special volume on the Population of France published by the Institut National d'Etudes Démographiques (INED 1974) and articles published in recent years in INED's journal, *Population.*

The most recent data – those particularly needed for the application of the multiregional population analysis of section 3 – had not yet been released in printed form at the time this study was initiated. Nevertheless, INSEE's Bureau of Population Movements made prepublications of regional fertility and mortality data for 1975 available to us, while INSEE's Economic Observatory of Paris provided us with microfiche of interregional migration data relating to the last intercensal period 1968–1975. In both cases, the data were obtained for France's system of 22 programming regions finalized in 1970 (see subsection 4.3) and thus had to be spatially aggregated to yield the desired fertility, mortality, and mobility data for the geographical units retained in this study.

THE STUDY REGIONS

Our analysis of spatial population change focuses on geographical redistribution patterns in relation to a partition of the French territory into eight geographic areas, the *Zones d'Etude et d'Aménagement du Territoire* (ZEATs).

These areas were originally defined for the regionalization of the Sixth Plan (see section 4) on the basis of their geographical orientation as the name of six of them (North, East, West, Southwest, Middle East, and Mediterranean) suggests. The remaining two reflect the role of Paris in the spatial development of France; they are the Paris Region and the Paris Basin, composed of all of the programming regions that surround the Paris Region. Figure 1 shows the delineation of the 8 ZEATs, which also constitute the first level of territorial units according to the nomenclature of the European Communities (Eurostat 1976). It also depicts levels II and III of the territorial units: 22 programming regions and 95 departments.

The eight ZEATs rather than the 22 programming regions have been chosen as the primary aggregation for this study since the ensuing partitioning of the French territory allows extensive computing simplifications* while involving a minimal loss of insights into the spatial interaction patterns; *86 percent of the observed migrants who moved between programming regions over the period 1968–1975 changed ZEATs.*

Nevertheless, the choice of such large units as ZEATs seriously limits the insights that the more traditional analysis presented in this section and in section 2 can provide. It is likely to conceal important variations in the evolution of the population across the territory and, in particular, to bypass the analysis of patterns linked to rural–urban transfers. In practice, the traditional demographic analysis should be extended to an examination of population change at the department level and of changing urbanization patterns. Thus observations of the historical evolution of these two dimensions are provided in section 1 whenever possible. Their current trends will be discussed in a separate work by Courgeau.

1.2 Broad Historical Trends of Spatial Population Change

To more easily understand the current patterns of spatial population change in France, a brief overview of the broad historical trends, from the middle of last century to the recent past, is provided.

SPATIAL POPULATION DISTRIBUTION

Tables 1 and 2 set out the breakdown of France's population by ZEATs in absolute numbers and percentage shares, respectively, for selected years between 1861 and 1975; Figure 2 plots the percentage shares on a graph against the relevant year.

*The complexity of the calculations increases with roughly the square of the number of study areas.

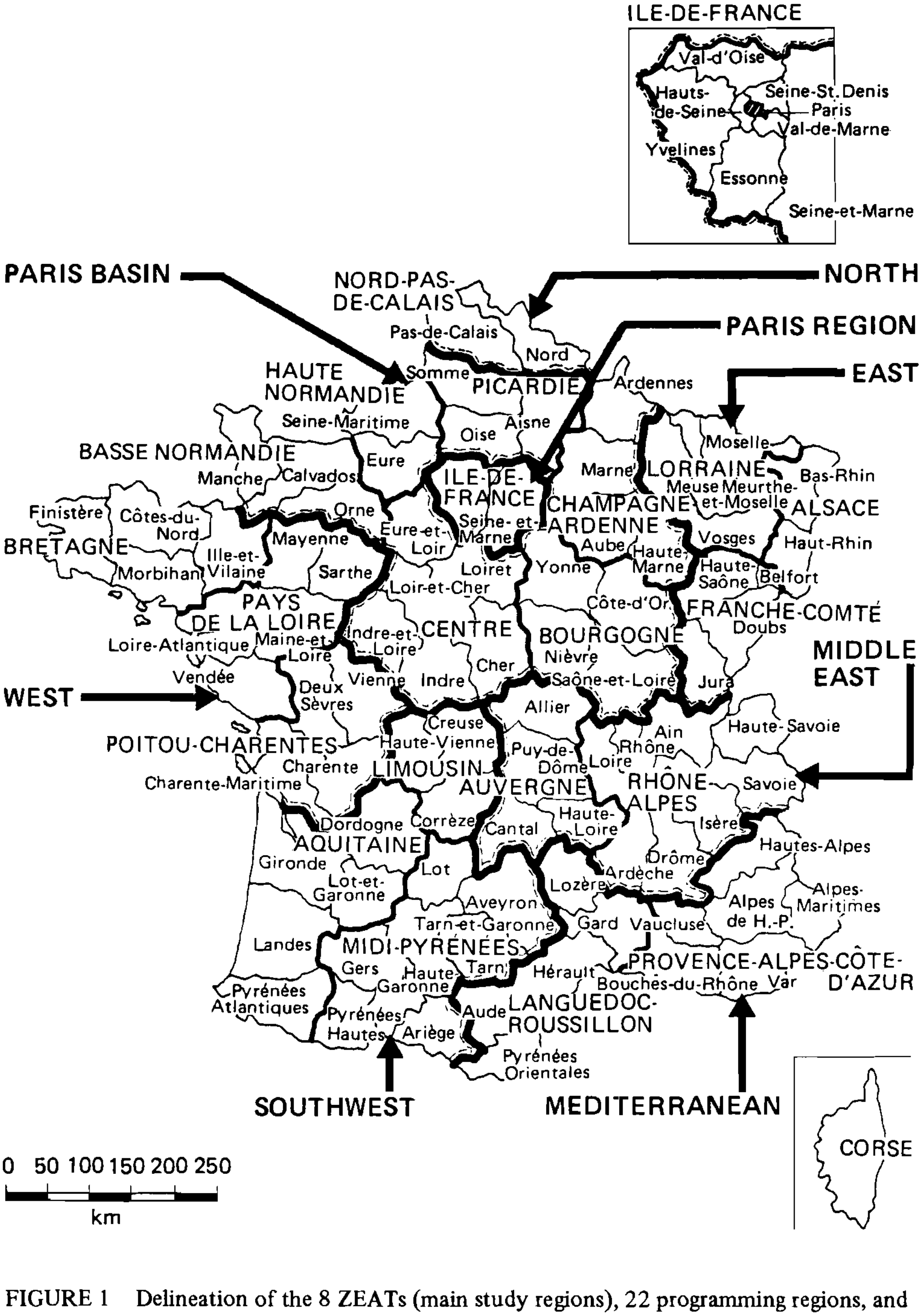

FIGURE 1 Delineation of the 8 ZEATs (main study regions), 22 programming regions, and 95 departments. Source: Redrawn from INSEE 1977.

TABLE 1 Population of the eight ZEATs (in thousands): selected years between 1861 and 1975.

ZEAT	Year 1861	1911	1931	1954	1975[a]
Paris Region	2 818	5 355	6 706	7 317	9 879
Paris Basin	8 956	8 485	7 941	8 091	9 641
North	2 027	3 030	3 235	3 375	3 914
East	3 601	4 062[b]	3 938	4 030	4 909
West	6 182	6 403	5 879	6 052	6 891
Southwest	5 693	5 358	4 916	4 924	5 557
Middle East	4 865	5 040	4 976	4 877	6 111
Mediterranean	3 244	3 765	4 240	4 111	5 755
France	37 386	41 479	41 829	42 777	52 656

[a]The 1975 figures are not strictly comparable with those for earlier years owing to a change in enumeration in 1962.
[b]This figure includes the population of the area that was then a part of Germany.
SOURCES: The figures for 1861 are from INSEE 1966; those for 1911, 1931, and 1954 are from Croze 1976, Table 10, p. 17; and those for 1975 are from Croze 1976, Table 2, p. 13.

TABLE 2 Percentage shares of the national population by ZEAT: selected years between 1861 and 1975.

ZEAT	Year 1861	1911	1931	1954	1975
Paris Region	7.54	12.86	16.03	17.11	18.76
Paris Basin	23.96	20.46	18.98	18.92	18.31
North	5.42	7.30	7.73	7.89	7.43
East	9.63	9.79	9.41	9.42	9.32
West	16.54	15.44	14.05	14.15	13.09
Southwest	15.23	12.92	11.75	11.51	10.55
Middle East	13.01	12.15	11.90	11.40	11.61
Mediterranean	8.67	9.08	10.14	9.61	10.93
France	100.00	100.00	100.00	100.00	100.00

Observe that the Paris Region, which in 1861 ranked only seventh in size (with 7.5 percent of the national population), grew more or less steadily to become in 1962/1963 the most populated ZEAT. In 1975, it had 9.88 million inhabitants, i.e., 18.8 percent of the French population.

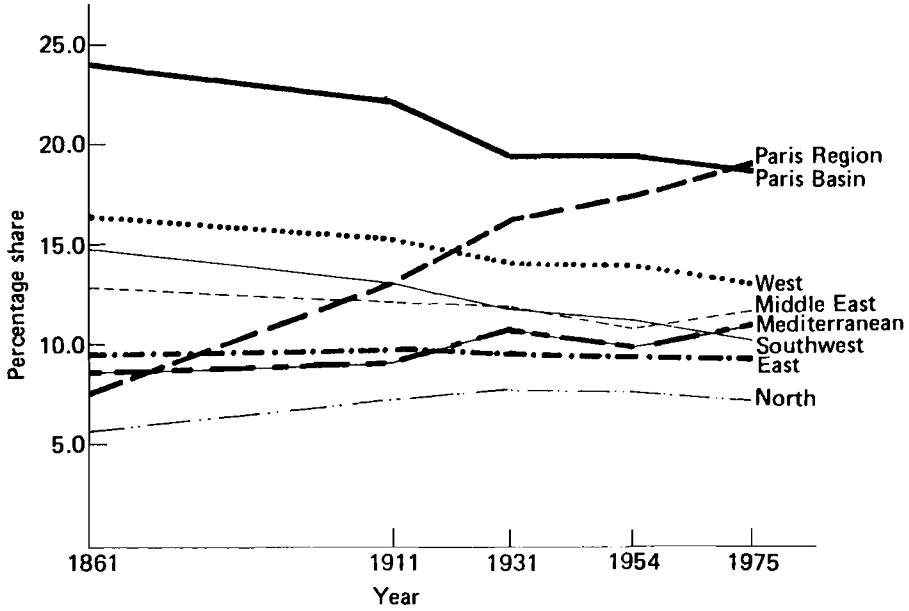

FIGURE 2 Evolution of the spatial distribution of the national population: ZEATs, 1861–1975.

This population concentration in the Paris Region has occurred essentially at the expense of the three predominantly rural ZEATs: the Paris Basin, the West, and the Southwest, where population shares dropped from 24.0, 16.5, and 15.2 percent in 1861 to 18.3, 13.1, and 10.6 percent, respectively, in 1975. In absolute terms, the population of these three ZEATs has evolved similarly; it decreased until the end of the Second World War but since then has been increasing at a rate that is substantially lower than the national rate of increase (see Table 3). Nevertheless, in 1975 the Paris Basin and the West ZEATs had more inhabitants than in 1861, having exceeded their 1861 level in the late sixties and late fifties, respectively, whereas the Southwest ZEAT was only 136000 inhabitants short of its 1861 mark.

By contrast, the other four ZEATs have not exhibited as clear a pattern of change. Industrialization caused the North ZEAT to grow rapidly in the second half of the nineteenth century; its share increased from 5.4 percent in 1861 to 7.3 percent in 1911. Thereafter this share grew slightly for about half a century before slowly decreasing because of the decline of its traditional industries (coal mining, steel manufacturing, and textiles). The East ZEAT, which experienced a slight population loss between 1911 and 1931, has exhibited a rather stationary population share since. The Middle East ZEAT, where population increased sharply until the First World War, and the Mediterranean ZEAT, where growth was steady until 1931, saw their populations diminish from the thirties until

TABLE 3 Average annual growth rates (per thousand) for the eight ZEATs: selected periods between 1861 and 1975.

	Period			
ZEAT	1861–1911	1911–1931	1931–1954	1954–1975
Paris Region	12.8	11.4	3.8	14.3
Paris Basin	–1.1	–3.3	0.8	8.3
North	8.0	3.3	1.8	7.1
East	2.4	–1.6	1.0	9.4
West	0.7	–4.3	1.3	6.2
Southwest	–1.2	–4.3	0.1	5.8
Middle East	0.7	–0.6	–0.9	10.7
Mediterranean	3.0	5.9	–1.3	16.0
France	2.1	0.4	1.0	9.9

about the mid-fifties. Thereafter, they experienced a strong revival leading to an increase in population share, which was moderate in the case of the Middle East ZEAT and more substantial in the case of the Mediterranean ZEAT.

Note that the population shifts among ZEATs just described took place over the years across a background of largely continuous national and regional population growth (see Table 3). Only a few decreases, which affected the predominantly rural ZEATs between 1861 and 1911 and the southeastern part of the country (Middle East and Mediterranean ZEATs) between the two wars, can be observed.

In the recent past (1954–1975), population growth was generally rapid, taking place at an unprecedented rate in all ZEATs except the Paris Region and the North ZEAT (i.e., the two ZEATs that grew relatively more rapidly in the second half of the nineteenth century). Toward the end of the period, however, in all ZEATs there was a definite slowing down of population growth except in the Paris Basin where the medium-sized cities, located about 100 kilometers from Paris, were experiencing a strong revival.

The distribution of the French population across ZEATs has always been uneven, with two ZEATs (the Paris Region and the North ZEAT) having a substantially higher population density than the national average (see Table 4). Of course, the temporal evolution of the ratio of each ZEAT-specific density to the national density follows the evolution of the corresponding population share so that the relative density rise of the Paris Region and, to a lesser degree of the North and Mediterranean ZEATs, is hardly surprising. Note that the population densities of the Paris Region and the North ZEATs in 1975 were 824 and 312 inhabitants per square kilometer, respectively (versus a national density of 97), whereas the East ZEAT exhibited a density (102) similar to the national average, and the other ZEATs were more sparsely populated, especially the Southwest ZEAT (53).

TABLE 4 Population density (number of inhabitants per square kilometer) by ZEAT: selected years between 1861 and 1975.

ZEAT	Area (km^2)	Year 1861	1911	1931	1954	1975
Paris Region	11984	235	445	560	611	824
Paris Basin	145588	62	58	55	56	66
North	12542	162	242	258	269	312
East	48059	75	84	82	84	102
West	85047	73	75	69	71	81
Southwest	103978	55	52	47	47	53
Middle East	69937	70	72	71	70	87
Mediterranean	67544	48	56	63	61	85
France	544681	69	76	77	79	97

SOURCE: The statistics for the area were taken from Eurostat 1976, p. 144.

As already mentioned, a partitioning of France into eight large regions attenuates somewhat the wide variations observed in the historical evolution of the population across the territory. These variations, however, can be quickly appreciated with the help of Figure 3, which shows the population change within the departments between 1861 and 1975.

During this 115-year interval, 52 out of 87 "departments" (some have been aggregated because of data considerations, see note to Figure 3) gained population. Among these, only 24 experienced a population growth higher than that of the whole of France (40.8 percent and over); they include all the departments of the Paris Region and the North ZEATs, six departments of the East ZEAT that border on the frontier, three central departments of the Middle East ZEAT, and five departments of the Mediterranean ZEAT that border on the Mediterranean Sea. In those departments, population appears to have grown continuously (except in the Haute-Garonne, Isère, and Hérault departments) with an acceleration after the Second World War.

Twenty-eight "departments" with positive population change had growth rates less than those of France as a whole. They are located essentially in the Paris Basin (8 departments) and West ZEATs (10 departments). In virtually all these "departments" population decreased in size until 1946 but increased again thereafter so that by 1975 it surpassed its 1861 level in most instances.

Finally, the 35 remaining "departments", which experienced a negative population change between 1861 and 1975, are mostly found at the outer edge of the Paris Basin (10 departments) and in the Southwest ZEAT (12 departments). In general, their population decreased continuously, in some instances by almost half (for example, Lot, Creuse, Lozère, Ariège, and Gers), in spite of high fertility levels.

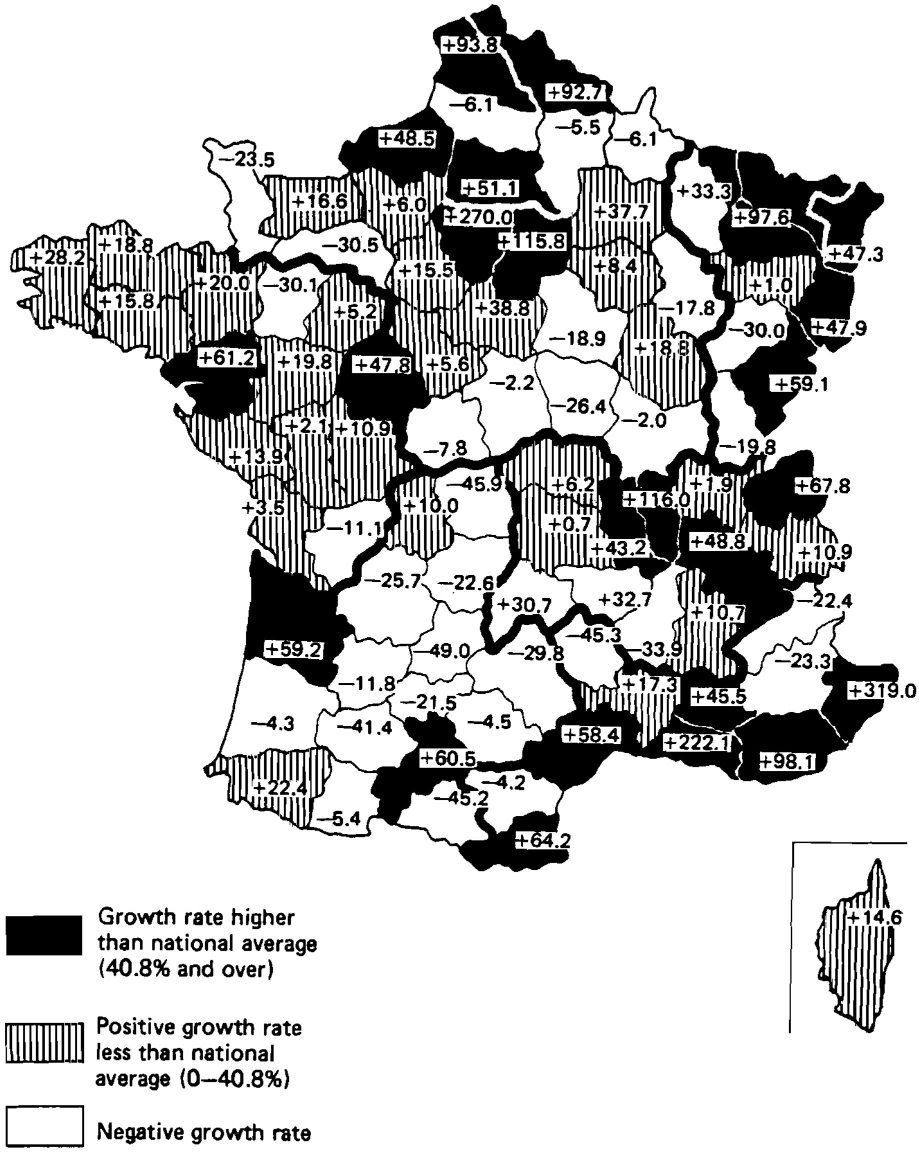

FIGURE 3 Evolution of the population of the departments between 1861 and 1975. Note: This map relates to a partitioning into 87 "departments" since (a) the departments of the Paris Region (Ile-de-France), except the Seine-et-Marne department, are considered here as a single department; (b) Moselle and Meurthe-et-Moselle are also considered as a single department; and (c) the Belfort territory is included in the Haut-Rhin department. Source: Data taken from Levy 1977, Table 1.

In light of the above, the evolution of the population in the three predominantly rural ZEATs now becomes clear. First, the small population growth of the Paris Basin resulted from the combination of a growing population in departments near the Paris Region and a decreasing population in the departments at the outer edge. Second, the population of the Southwest ZEAT decreased as long as the gains of the largely urbanized departments (Gironde and Haute-Garonne) were not able to outnumber the losses of the other departments. Finally, the population of the West ZEAT, which is more homogeneous, evolved like that of most of its departments: a decrease until 1946 and then an increase.

The above changes in the spatial distribution of the population are largely linked to the urbanization process, which has taken place since the beginning of the nineteenth century. (Figure 4 shows the evolution of the proportion of the total population that is urban.) Between 1861 and 1975, the most urbanized

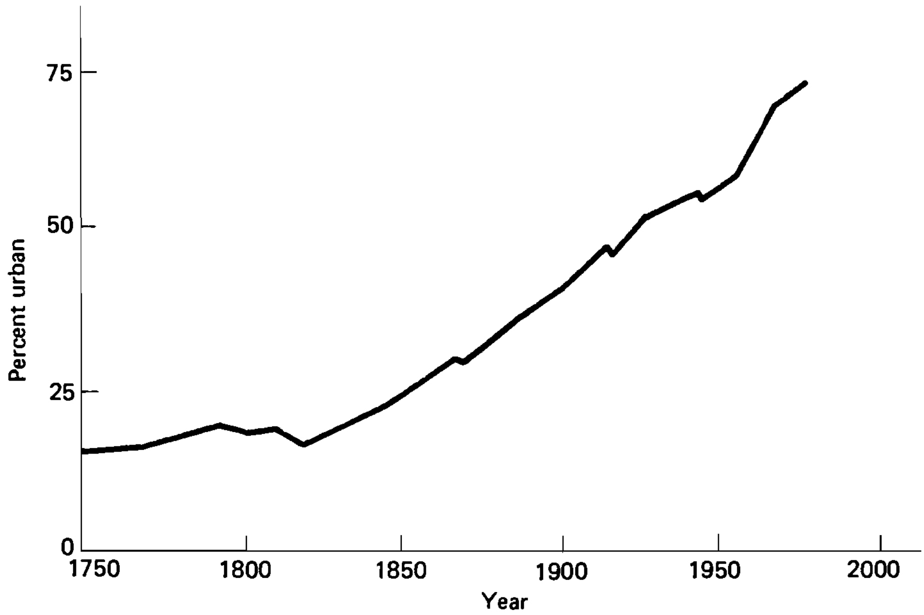

FIGURE 4 Evolution of the proportion of the total population that is urban. Source: INED 1979, p. 1253.

departments (those 75 percent urban or more in 1936) tripled in population, thus augmenting their share of the national population from 13.7 to 29.5 percent. The highly urbanized part of the Paris Region (the entire region except the Seine-et-Marne department) registered a population increase of 270 percent, increasing its share of the national population from 6.6 to 17.3 percent. Furthermore, the departments that exhibited a population growth higher than the national average contain the 24 largest agglomerations of France except two (Rennes in the West ZEAT and Clermont-Ferrand in the Middle East ZEAT), whereas those that experienced a relative population decline (a population growth less than the national average growth) do not have any strong center of attraction. (The figures given in this paragraph are drawn from Levy 1977, p. 1.)

Thus the evolution of the spatial distribution of the French population since the middle of the nineteenth century reflects a concentration into a small number of urbanized departments accompanied by a relative decline of all the other departments. The process of urban concentration, however, is currently in its final phase; the growth of urban areas, which was still relatively high between 1954 and 1968, lessened significantly during the period 1968–1975.

Figure 5, which shows the recent evolution of the annual population growth rate in the various urban and rural categories (defined in 1975), indicates

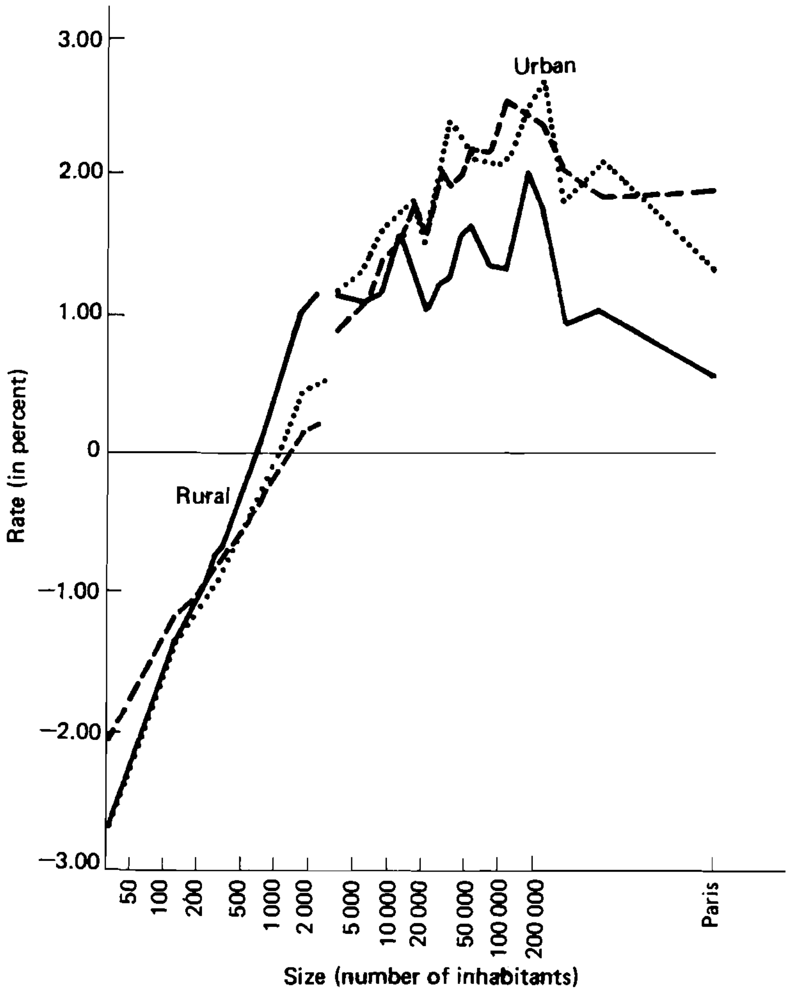

FIGURE 5 Annual urban and rural growth rates for the intercensal periods 1954–1962 (– – –), 1962–1968 (······), and 1968–1975 (——). Source: Redrawn from INSEE 1977.

a slowing down of the growth of urban units of all sizes as well as a reversal in the growth of the rural communes of 500 inhabitants and over: negative between 1954 and 1968 but positive between 1968 and 1975. Actually, supplementary data, not shown here, suggest that the latter communes are primarily located in the vicinity of urban units; that is, they belong to the so-called ZPIU (*Zones de Peuplement Industriel et Urbain*). Thus, the main characteristic of the urbanization process in the recent past in France is the extension of urban zones. But this is accompanied by population losses in urban centers. For example, the city of Paris registered a substantial loss of population because of migration, whereas the Paris Region exhibited a population increase.

We now turn to an examination of the components of change that have been responsible for the evolution of the spatial distribution of the French population just described, starting with the case of fertility.

SPATIAL FERTILITY DIFFERENTIALS

The fertility index used here is the gross reproduction rate (GRR), which gives the number of daughters born to a cohort of 100 women submitted to the fertility regime of a given point in time. It is a true index of fertility in that it eliminates the effect of mortality.

Figure 6, which contrasts the values of the GRR by department in 1860–1862 and 1967–1969, suggests an important change in the fertility differentials across the territory. In 1860–1862, the zones of high GRRs were located in Brittany, in the central part of France (except for the Creuse and Puy-de-Dôme departments), in Alsace, in what is today Nord-Pas-de-Calais, and in Provence-Alpes-Côte-d'Azur (see Figure 1). With the exception of Nord-Pas-de-Calais – which is also the North ZEAT – all these areas are among the low-fertility zones for the period 1967–1969.

Actually, the modification of the picture of regional fertility disparities just noted results from an evolution that essentially took place in the second half of the nineteenth century. The current fertility map shows a "fertile crescent" around all but the southern side of the Paris Region, which was already apparent as early as the beginning of this century.

To clarify the role of the urban zones in the above evolution of fertility, let us distinguish between the "old" Seine department* (more or less the agglomeration of Paris), the next five most urbanized departments (Alpes-Maritimes (Nice), Bouches-du-Rhône (Marseille), Nord (Lille), Rhône (Lyons), and Seine-et-Oise** (department abutting on the Seine department on the western side)), and the rest of France. Figure 7 displays the evolution of the GRR in these departments and in France as a whole. It indicates that the Seine always had

*The "old" Seine department coincided, although not exactly, with six current departments (Paris, Essonne, Hauts-de-Seine, Seine-St. Denis, Val-de-Marne, and Val-d'Oise).

**The Seine-et-Oise department essentially consisted of what is today the Yvelines.

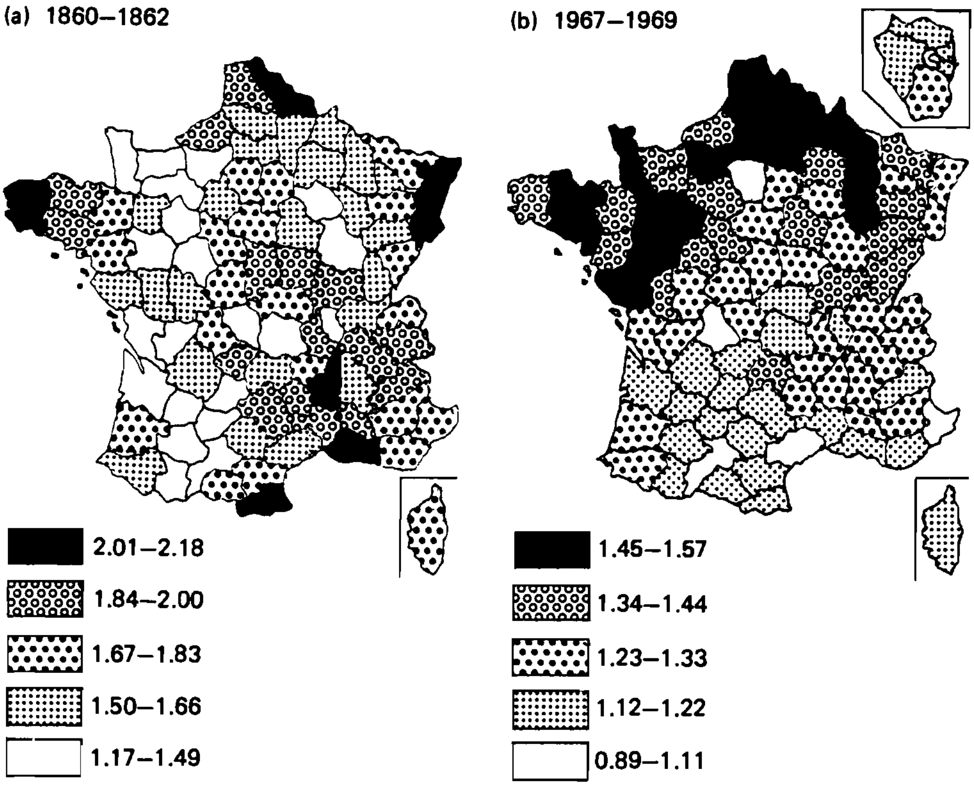

FIGURE 6 Gross reproduction rates: departments 1860–1862 and 1967–1969. Sources: Pressat 1974, p. 14 and Longone 1974a, p. 2.

much lower fertility than the rest of France, whereas the other five urbanized departments had higher fertility until the end of the nineteenth century, at which time a rapid reversal took place. Note that, since the beginning of this century, the evolution of fertility in the five urbanized departments has followed a trajectory intermediate and parallel to those of the Seine and the rest of France.

The data of a retrospective survey conducted in 1962 allow one to compare the fertility of urban areas according to the size of communes (Tugault 1975). This survey gives the average number of children after 10 years of marriage for those married between 1925 and 1951 and residing in predetermined categories of communes in 1962. The results show that (1) for each marriage cohort, the larger the commune, the lower the level of fertility, and (2) the temporal evolution of fertility observed for the nation also applied to the various categories of communes so that the fertility differentials according to size were maintained across the various marriage cohorts (Table 5).

Thus, the growth of the urban population of France in this century cannot be explained by its fertility behavior; the cities with the largest population increase are also those with the lowest fertility levels.

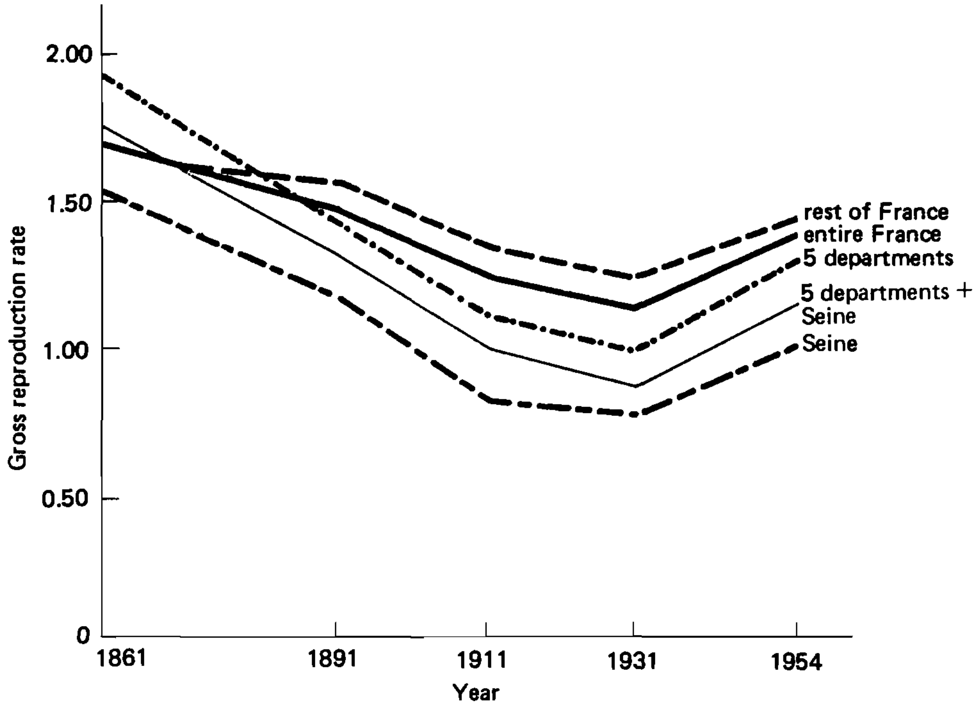

FIGURE 7 Gross reproduction rates: France and selected areas, 1861–1954. Source: Tugault 1975, p. 26.

TABLE 5 Fertility according to type of residence: average number of children after 10 years of marriage for various marriage cohorts.

Marriage cohort	Rural communes	Urban communes: Less than 20000 inhabitants	From 20000 to 100000 inhabitants	More than 100000 inhabitants	Agglomeration of Paris	France
1925–1929	2.12	1.85	1.70	1.67	1.34	1.83
1930–1934	2.10	1.82	1.66	1.67	1.37	1.82
1935–1939	2.16	1.92	1.80	1.81	1.49	1.90
1940–1944	2.56	2.31	2.20	2.19	1.84	2.29
1945–1949	2.49	2.28	2.22	2.17	1.85	2.26

SOURCE: Tugault 1975, p. 60.

In the recent past, the nation's gross reproduction rate, after reaching a maximum in 1964, decreased substantially to finally stabilize (since 1976) at a level well below the replacement level. The fertility of the departments and communes (regardless of their size) also experienced such fertility decline but, in the process, the differentials existing between departments or between communes of different size significantly diminished. In 1975, not only did the fertile crescent not come out as sharply as before, but the Paris Region also had a fertility level similar to that of the departments surrounding it (INED 1979, pp. 1235, 1236).

Finally, it appears that, since the middle of the last century, local fertility change in France has followed a twofold logic:

(a) a geographic path characterized by the transformation of the fertility map into nearly its negative during the second half of the nineteenth century and the preservation of the latter map since
(b) an urban/rural path characterized by the passage, in the late nineteenth century, of fertility in urban areas (with the exception of Paris, which for a long time had a low fertility rate) from a higher to a lower level than in rural areas

However, in the recent past, the rural/urban path appears to have become secondary with regard to the geographic path: large cities located in high-fertility departments have often a higher gross reproduction rate than the rural zones of the low-fertility departments (Longone 1974a).

SPATIAL MORTALITY DIFFERENTIALS

Demographers have paid much less attention to regional mortality differentials than to those of fertility, although the necessary data exist. The recent results obtained by Preston and Van de Walle (1978), however, provide us with a rough assessment of such mortality differentials for the distant past. Their study suggests the existence of high mortality in urban areas, in the nineteenth century, compared with the rest of the country. Such a result, which has also been observed in England, Germany, Sweden, and the United States for the same period, can be reasonably attributed to the unfavorable sanitary conditions prevailing in urban areas.

Toward the end of the nineteenth century, however, the mortality gap between the urban areas and the rest of the country started to decline, thus indicating a certain diminution of the urban–rural mortality differentials.

Actually, with the removal of the factors accounting for the past high mortality rates in urban areas (poor sanitary conditions, risks of contagion, etc.), today's urban areas do not appear to have significantly different mortality patterns (see Labat and Viseur 1973). The factors that influence these patterns in urban areas are those that affect mortality in the geographical regions in which the urban areas are located (INED 1977, pp. 305, 306). Thus mortality appears to have shifted from a preponderantly urban/rural path in the nineteenth century to a predominantly geographic path in the twentieth century.

Figure 8, which shows the average duration of life for males in each department in 1967–1969, indicates the existence of a zone of higher mortality that coincides more or less with the fertile crescent, to which we must add the southern part of the Massif Central and a part of the Alps. Can those regional variations

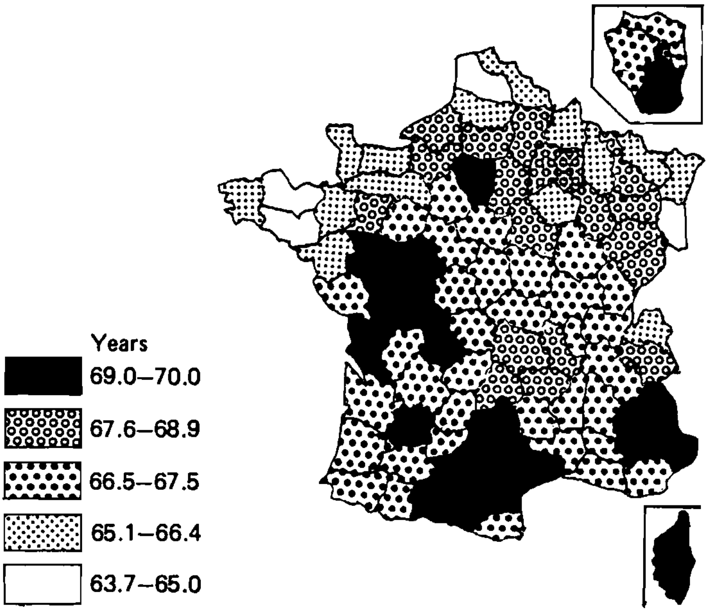

FIGURE 8 Average duration of life: males, 1967–1969. Source: Longone 1974b, p. 3.

be explained? According to Nizard and Prioux (1975), alcoholism (and related causes) account for excessive mortality in the northern part of France. Other specific causes include suicides in Brittany, heart illnesses in the North ZEAT, and respiratory illnesses in the mining areas (North ZEAT and, to a lesser degree, Alsace). Munoz-Perez (1978) contends that regional mortality differences cannot be explained either by differences in socioprofessional composition or by variations in the level of health services. She argues that those differences reflect a cultural problem; living conditions, food habits, and attitudes toward illnesses are, according to her, the factors constituting regional mortality peculiarities.

As in the case of fertility, the recent evolution of mortality patterns is characterized by a reduction of the variations across departments although this reduction appears to be slow. Between 1954 and 1968, the difference in life expectancy at birth for males observed between the departments of highest and lowest mortality has declined from 7.2 to 6.2 years. Clearly, the inequalities according to the geographical location remain large.

INTERNAL MIGRATION PATTERNS

Since the middle of last century, migrants from other countries have generally settled in urban rather than rural areas; in 1975, around 90 percent of the foreigners living in France resided in urban areas as against 68.7 percent for the total population. Nevertheless, international migration has contributed much less to the modification of the population's spatial distribution than has internal migration. We therefore limit our review to the evolution of internal migration patterns only.

Lifetime migration data, available at the department level for each census year between 1861 and 1946, indicate the fundamental role played by internal migration in accounting for urban development. As one could expect, the urban departments have registered the largest influx of migrants and the rural departments the smallest influx. (For a complete evolution of this proportion by department between 1861 and 1946, see the first volume of the 1911 census report and the second volume of the 1946 census report.)

The evolution of the proportion of lifetime in-migrants by department allows one to distinguish the departments in which the largest part of the influx took place. Thus as early as 1861, the population of the Seine department consisted of 57 percent lifetime migrants, a percentage that increased to 64 percent in 1872 and then decreased continuously to reach 52.6 percent in 1946. A similar evolution was registered in the Rhône department where the proportion of lifetime migrants (28 percent in 1861) increased to 41.8 percent in 1928 before slowly decreasing. By contrast, a continuous increase was observed from 1861 to 1946 in the two departments with the next highest proportions of lifetime migrants in 1861, that is, the Seine-et-Oise department (from 24 to 65 percent) and the Bouches-du-Rhône department (from 18 to 33 percent).

The above identification of the urbanized departments as those that have benefited the most from population influx must be supplemented by a similar identification of the departments that have been the suppliers of population. The proportion of the natives of each department who, at the time of each census, resided in another department, suggests the existence of large regions of out-migration: the Paris Basin, which suffered from the attraction of the Paris agglomeration, the poor regions of the Alps and the Massif Central, and Brittany, whose losses, however, appear to have been important only in absolute values. (In relative values the losses were much smaller because of a large population and a high fertility level.)

A net balance of either in-migrants or out-migrants appears with the consolidation of the migration out of and into each department. Figure 9 shows the exchange between population suppliers and demanders in 1946, classifying the departments into four categories according to the sign and the importance of their net balance of migrants. The departments with the highest net balance of in-migrants (in relative terms) are among the most urbanized departments: Seine, Seine-et-Oise, Rhône, Bouches-du-Rhône, Alpes-Maritimes as well as Gironde (Bordeaux), Haute-Garonne (Toulouse), and Var (Toulon). The

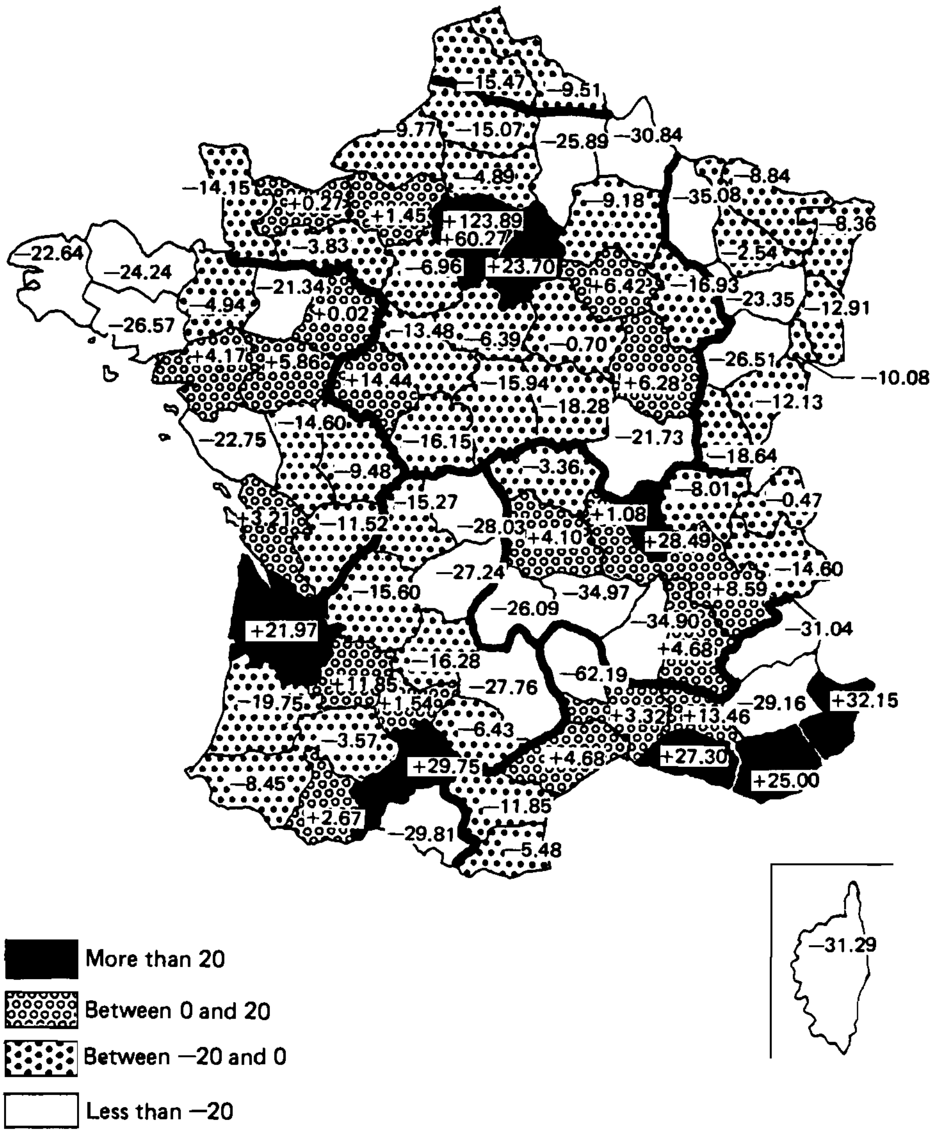

FIGURE 9 Net balance of lifetime migrants by department (in percent): 1946. Source: Data taken from the second volume of the 1946 census report.

departments with the highest net balance of out-migrants (in relative terms) include Corsica, the departments in the northwestern fringe of the Paris Basin, and most departments of Brittany, the Massif Central, and the Alps.

Although the map in Figure 9 differs little from a corresponding map drawn for 1901 (not shown here), the Seine department does show a decrease in the in-migration surplus from 114 percent in 1901 to 60 percent in 1946, whereas the Seine-et-Oise department shows an increase in in-migration from 49 to 124 percent. This reflects the spatial extension of the agglomeration of Paris, the suburbs of which in 1946 covered most of the Seine-et-Oise as well as part of the Seine-et-Marne.

An examination by Courgeau (1970) of migration flows between departments with the help of indices eliminating the size effect of the population at the origin and destination provides a more in-depth analysis of the mobility phenomenon in France until the end of the Second World War. In this study the in-migration index relating to the Seine department is divided by three when moving from the nearest zones to those located 500 kilometers away, whereas it is divided by 40 (for 1891) and 20 (for 1946) for the rural departments. This result points to the strong attraction of the Paris agglomeration, an attraction that changed little over the years 1891–1946. The out-migration index always has a smaller value than the corresponding in-migration index regardless of the distance from Paris, which indicates that Paris used to gain population from all regions of France.

In the case of the Bouches-du-Rhône and Rhône departments, the zone of strong attraction is more restricted. The in-migration index decreases more rapidly than for the Seine department, taking on at only a distance of 250 kilometers a value comparable to that reached 500 kilometers from Paris. The migration out of these departments was very similar to that of the rural zones: that is, strongly decreasing with distance. In the case of the departments with no strong attraction center, both in- and out-migration indices decrease with distance, the out-migration index being located almost always at a higher level than the corresponding in-migration index.

The modification observed in the curves that describe the in- and out-migration indices suggests an increase of mobility over time that has been substantiated by Tugault (1973). Using data on the proportion of the successive cohorts born between 1836 and 1915 and residing outside their department of birth at age 45, Tugault thus uncovered a slow but relatively constant mobility increase for the period 1881–1960 equivalent to a doubling of the propensity to migrate in about 110 years (see Figure 10).

During the war years the general mobility of the French people slowed down. But after 1946, with the acceleration of urbanization, this mobility rose once more and currently is showing no sign of abatement despite a significant slowing down of urbanization. It has been shown (Courgeau 1978) that the propensity to migrate (between communes, departments, and programming regions) has continued to increase at an accelerated rate between the 1954 and 1975

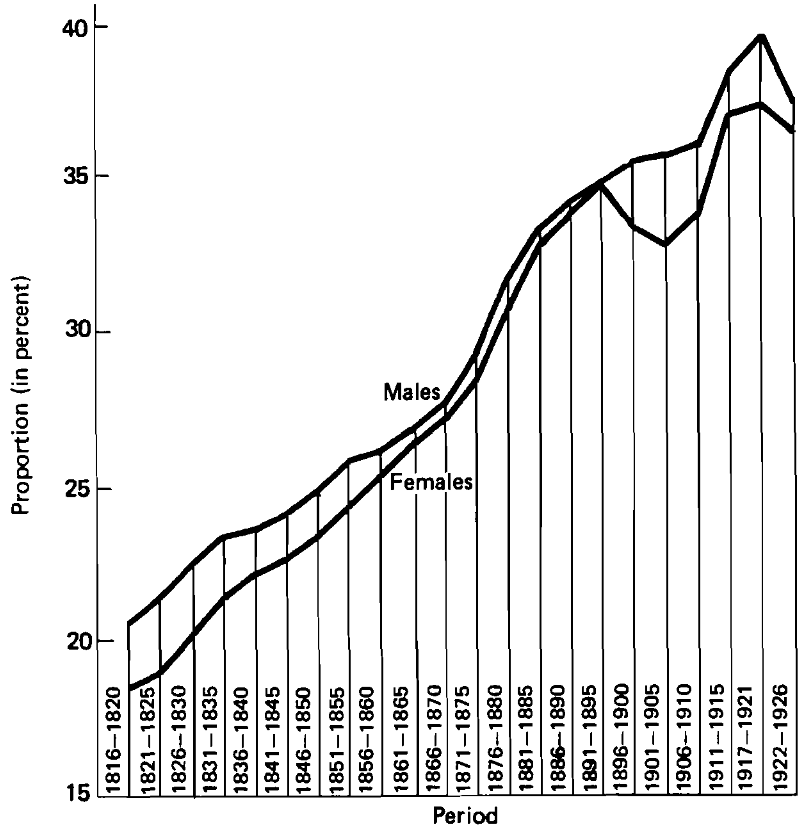

FIGURE 10 Proportion of those individuals in the cohorts 1816 to 1926 who at age 45 reside outside their department of birth. Source: Tugault 1973, p. 36.

censuses; the extrapolation of this trend suggests a doubling of the propensity to migrate (at the level of the departments) in 37 years, which represents a threefold increase with regard to the mobility increase observed by Tugault.

SUMMARY

The above review of the evolution of France's spatial population distribution has shown some important modifications since the middle of last century: substantial changes in regional fertility and mortality patterns and, more importantly, amplification of internal mobility leading to a concentration of the population in a small number of urbanized departments. Clearly, the present French settlement system reflects, in a large part, the past urbanization process associated with industrialization. Today, however, as the traditional patterns of urbanization are gradually being replaced by new forms of urban concentration, this settlement system appears to be dominated by a geographic path rather than an urban/rural path.

2 CURRENT PATTERNS OF SPATIAL POPULATION CHANGE

As mentioned earlier, the analysis of the spatial distribution of the population during the third quarter of this century is based on a partitioning of France into eight ZEATs.

2.1 Population Change, 1950–1975

Immediately after the Second World War, the total population of France rose sharply, once again reaching its 1931 level of 41.8 million by 1950. Between 1931 and 1950, however, the geographic distribution of the population was slightly modified with the Paris Region and West ZEATs having gained population at the expense of the Middle East and Mediterranean ZEATs. (To see this, compare the first column of Table 6 with the third column of Table 1.)

TABLE 6 Average population of the eight ZEATs (in thousands): 1950–1975 at 5-year intervals.

	Year						
ZEAT	1950	1955	1960	1960	1965	1970	1975[a]
Paris Region	6 947	7 527	8 225	8 242	8 979	9 460	9 906
Paris Basin	7 943	8 201	8 494	8 502	8 913	9 307	9 667
North	3 293	3 438	3 594	3 609	3 779	3 855	3 919
East	3 887	4 103	4 364	4 348	4 649	4 768	4 918
West	6 016	6 114	6 255	6 271	6 471	6 666	6 909
Southwest	4 943	4 972	5 084	5 075	5 348	5 450	5 564
Middle East	4 828	4 955	5 209	5 203	5 584	5 870	6 128
Mediterranean	3 973	4 117	4 457	4 436	5 037	5 381	5 706
France	41 829	43 428	45 684	45 684	48 758	50756	52 715

[a]The numbers in this column differ from those shown in the last column of Table 1, because they are taken from different sources.
NOTE: The numbers on each side of the dashed vertical line are not entirely comparable due to a change in census enumeration in 1962. 1960 data on both sides of the vertical line relate to the old and new census enumerations.
SOURCE: Eurostat 1976, pp. 162, 163.

From 1950 on, all eight ZEATs registered a fast population increase contrasting with the sluggish evolution observed between the beginning of the First World War and the end of the Second World War. Among the various ZEATs, however, three patterns of change can be distinguished. First, the population of the Paris Region, Middle East, and Mediterranean ZEATs increased at a rate much faster than the national average (0.93 percent annually from 1950 to

1975): 1.42, 1.39, and 1.45 percent, respectively. Second, the population of the Paris Basin, North, and East ZEATs increased at a rate close to the national average: 0.79, 0.70, and 0.94 percent, respectively. Finally, the western half of the country saw its population grow at a much smaller rate (0.55 percent for the West ZEAT and 0.47 percent for the Southwest ZEAT), an observation that contrasts with the steady population decrease observed in this part of the country over the first half of the twentieth century.

Actually, the population increase of the eight ZEATs between 1950 and 1975 exhibited some wide variations around the average paths just described. First, high growth rates were registered for all ZEATs during the quinquennial period 1960–1965 owing to the massive return (in 1962–1963) of the French expatriates in Algeria. Second, the population growth of three ZEATs (Paris Region, North, and East), which experienced the fastest pre-sixties increases, slowed down substantially after 1965 (see part a of Table 7).

TABLE 7 Average annual rates of total increase, natural increase, and net migration (in percent) for the eight ZEATs: 1950–1975 by 5-year periods.

	Period				
ZEAT	1950–1955	1955–1960	1960–1965	1965–1970	1970–1975
a. Rate of total increase					
Paris Region	1.6	1.8	1.9	1.0	1.0
Paris Basin	0.6	0.7	1.0	0.9	0.8
North	0.9	0.9	1.0	0.4	0.4
East	1.1	1.3	1.4	0.5	0.7
West	0.4	0.5	0.6	0.5	0.8
Southwest	0.1	0.5	1.1	0.4	0.5
Middle East	0.5	1.0	1.4	1.0	1.0
Mediterranean	0.5	1.6	2.6	1.4	1.2
France	0.8	1.1	1.4	0.8	0.8
b. Rate of natural increase					
Paris Region	0.7	0.7	0.8	0.7	0.8
Paris Basin	0.8	0.8	0.8	0.7	0.6
North	1.1	1.0	1.0	0.8	0.8
East	0.9	1.0	1.0	0.8	0.7
West	0.8	0.8	0.7	0.6	0.6
Southwest	0.3	0.3	0.3	0.2	0.2
Middle East	0.5	0.5	0.6	0.6	0.6
Mediterranean	0.3	0.3	0.4	0.4	0.2
France	0.7	0.7	0.7	0.6	0.6

TABLE 7 *(continued).*

ZEAT	Period 1950–1955	1955–1960	1960–1965	1965–1970	1970–1975
c. Net migration rate					
Paris Region	0.9	1.1	1.1	0.3	0.2
Paris Basin	–0.2	–0.1	0.2	0.2	0.2
North	–0.2	–0.1	–0.0	–0.4	–0.4
East	0.2	0.3	0.4	–0.3	–0.0
West	–0.4	–0.3	–0.1	–0.1	0.2
Southwest	–0.2	0.2	0.8	0.2	0.3
Middle East	0.0	0.5	0.8	0.4	0.4
Mediterranean	0.2	1.3	2.2	1.0	1.0
France	0.1	0.4	0.7	0.2	0.2

SOURCE: Eurostat 1976, pp. 186, 187.

The evolution of the percentage shares of the national population (Table 8) for the most populated ZEATs in 1950 reflects the historical trends observed in section 1. Between 1950 and 1975 the percentage share of the Paris Basin, West, and Southwest ZEATs declined, exhibiting absolute losses of 0.67, 1.31, and 1.29, respectively, while that of the Paris Region (the most populated ZEAT since about 1962) increased by 2.25 percent, reaching 18.78 percent in 1975.

TABLE 8 Percentage shares of the national population by ZEAT: 1950–1975 at 5-year intervals.

ZEAT	Year 1950	1955	1960	1965	1970	1975[a]
Paris Region	16.53	17.27	17.93	18.39	18.63	18.78
Paris Basin	19.00	18.91	18.62	18.27	18.34	18.33
North	7.87	7.92	7.87	7.76	7.61	7.45
East	9.28	9.44	9.54	9.54	9.40	9.34
West	14.41	14.13	13.73	13.29	13.14	13.10
Southwest	11.86	11.48	11.16	11.00	10.75	10.57
Middle East	11.56	11.41	11.40	11.44	11.56	11.62
Mediterranean	9.50	9.46	9.74	10.31	10.58	10.80
France	100.00	100.00	100.00	100.00	100.00	100.00

[a]The figures in this column differ from those shown in the last column of Table 2 because they are taken from different sources.

In three other ZEATs, the percentage share, which for a long period beginning well before the Second World War and ending in the fifties, exhibited an evolution opposite to that set out in an earlier past, returned to its historically established trend: increase in the Middle East and especially Mediterranean ZEATs, decrease in the East ZEAT.

Finally, the percentage share of the North ZEAT, which had continuously increased in the past, peaked in the mid-fifties and slowly decreased thereafter.

2.2 Components of Population Change, 1950–1975

Table 7 also shows the evolution of the component rates of change for each ZEAT between 1950 and 1975 for 5-year periods. Part b displays the average annual rates of natural increase and part c sets out the average annual rates of net migration, derived as residuals by subtracting the natural increase rates from the corresponding total increase rates. These net migration rate values, therefore, account for international migration as well as internal migration.

First, let us observe that the variations in natural increase across the study areas are quite substantial. As suggested by Figure 11a, which relates to the 1970–1975 period, the rate of natural increase is significantly higher in the northern part of France (from 0.6 to 0.8 percent) than in the southern part (0.2 percent). In fact, such a picture of the natural increase differentials was already apparent in the early fifties. It has been more or less maintained throughout the whole period 1950–1975 owing to a uniform evolution of the regional natural increase rates: slow increase in the first three quinquennial periods and

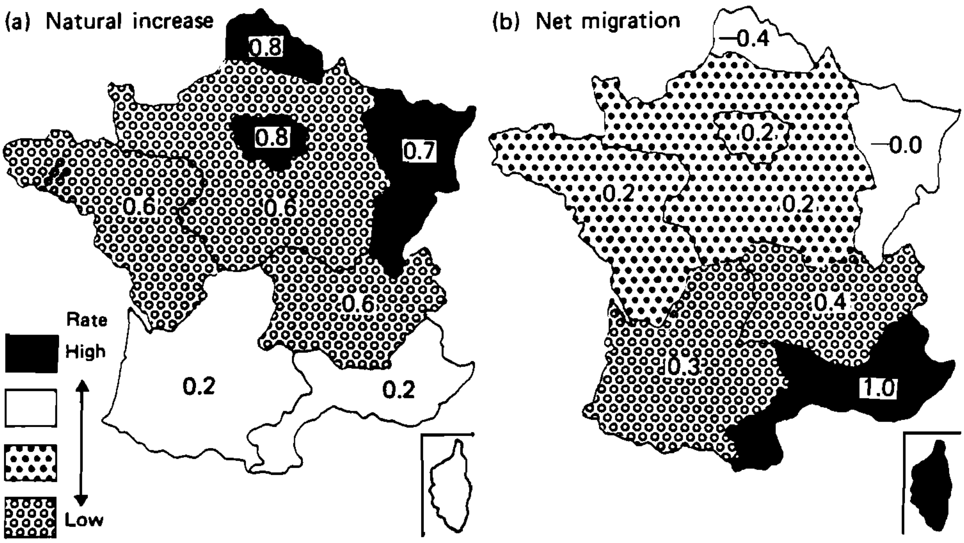

FIGURE 11 Average annual rates of natural increase and net migration (in percent): ZEATs, 1970–1975. Source: Data taken from Eurostat 1976, pp. 186, 187.

slow decrease in the last two. This pattern of change in a large part reflects the general evolution of fertility in France. Maintained at a high level after the Second World War, the fertility level declined abruptly after 1964.

Second, in the case of net migration, we again observe a background of important variations across the study areas. Figure 11b, relating to the 1970–1975 period, indicates a general increase in the net migration rate when moving southward. From a substantially negative value in the North ZEAT (–0.4 percent), this rate goes on to take on a largely positive value in the Mediterranean ZEAT (1.0 percent) after increasing in three successive steps (see Figure 11b). Such a picture of the net migration differentials between ZEATs is the result of an evolution that has seen several important modifications since 1950. First, the Paris Basin as well as the West and Southwest ZEATs, which were net losers of population in the early fifties, became net gainers in the early seventies. Second, the Paris Region, which exhibited a sustained 1.0 percent net migration rate between 1950 and 1965, saw its rate fall sharply in the late sixties. Third, the East ZEAT, a net gainer of population in the early fifties, turned into a net loser in the late sixties.

This 1970–1975 picture of net migration rates, unlike that of natural increase rates, presents a significant departure from the corresponding 1950–1955 picture, even though the net migration rate pertaining to each ZEAT seems to have followed the same pattern of change in between the two periods concerned: one that was directed initially upward and then downward before stabilizing (see Figure 12). Naturally, this result is the consequence of the differing pace at which the upward and downward trends took place in each ZEAT.

A detailed study of the evolution of the net migration rates is not necessary here. We limit our discussion to one interesting feature that follows from the comparison, for each ZEAT, of the net migration rates in the first and last quinquennial periods. This feature is simply the contrast between three ZEATs located in the northeastern half of the country – the Paris Region, North, and East ZEATs – and the other five. The three northeastern ZEATs have a net migration rate that is lower in the last period than in the first, whereas the remaining five ZEATs have a higher net migration rate in the last period than in the first.

Figure 13 plots on a time-series graph for each of the eight ZEATs the rates of total increase, natural increase, and net migration set out in Table 7. Each graph offers evidence of a contrast between the small variations of the natural increase rate and the more volatile variations of the net migration rate, which results in the close dependence of the total increase rate on the net migration rate.

As already indicated, the net migration component just described includes internal as well as international migration. In principle, the separation of these two elements simply requires knowledge of either one, since the other can then be obtained as a residual. But, rather unfortunately, neither component can be estimated meaningfully. First, there exists no adequate possibility of observing the number of movements into and out of the country so that the net balance

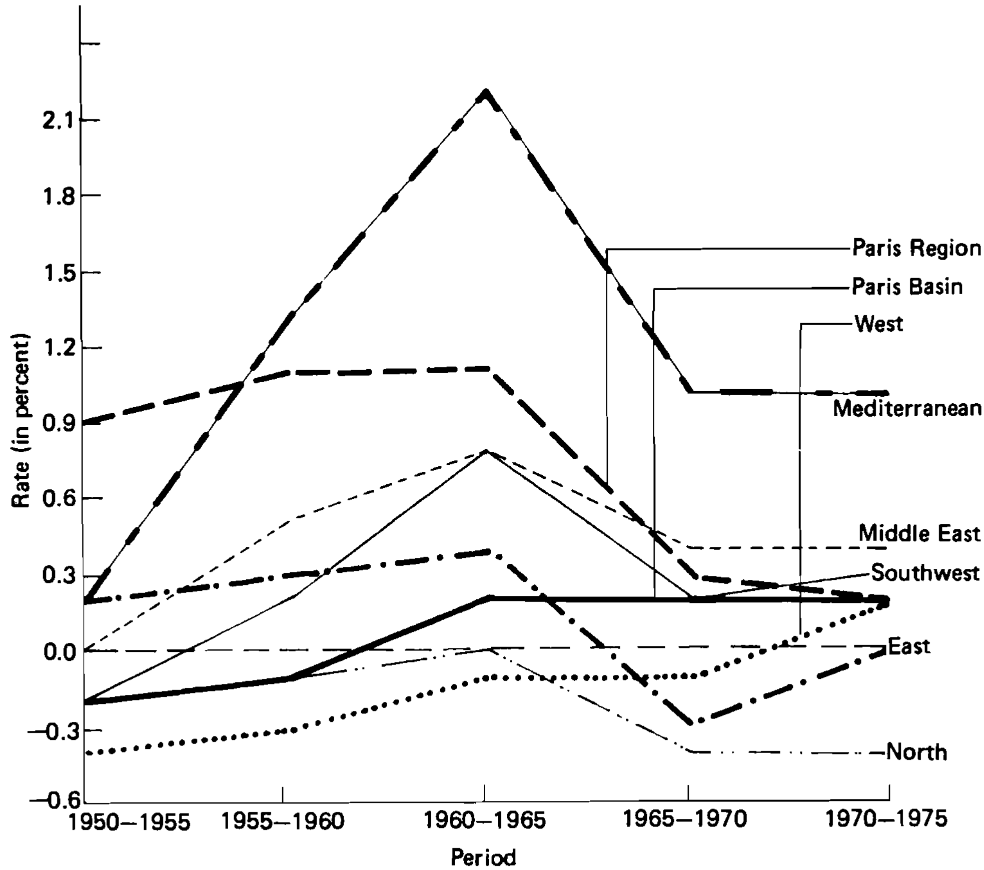

FIGURE 12 Average annual rates of net migration: ZEATs, 1950–1975 by 5-year periods. Source: Derived from Eurostat 1976, pp. 186, 187.

of international movements cannot be measured. Second, the data on internal geographic mobility available in France are not data in the form of events (or migrations) that one would normally obtain from a population register; they are data in the form of changes of residence (or migrants) that come from a population census,* and, therefore, the balance of internal migrants into and out of any area does not truly reflect the extent of internal geographic mobility during the observation (intercensal) period.** Consequently, no precise assessment of the contributions of internal and international migration to the population growth of the ZEATs can be made.

*For details on the difference between the concepts of migration and migrant, see Courgeau 1973 and Ledent 1980a.

**In particular, this balance, or number of net migrants, ignores the migration of the persons who died before the end of the intercensal period and, more importantly, introduces fictive migrants because it considers infants as migrants if their mother is herself a migrant.

Nevertheless, we will present the information that is available for each ZEAT concerning the internal and external elements of the migration component of population growth in the recent past. Figure 14 sets out the values of the balance of internal migrants over the last three intercensal periods for each ZEAT: 1954–1962, 1962–1968, and 1968–1975. It suggests a striking contrast between the two groups of ZEATs, which we distinguished earlier when comparing the net migration rates registered in the early fifties and early seventies. The Paris Region, North, and East ZEATs saw their balance of internal migrants (calculated on an average annual basis in each period) deteriorate between the first and last periods, whereas the others saw theirs improve. (An exception to this is the Middle East ZEAT where the balance of internal migrants went slightly down in the third period.)

Observe that the sign of the balance – which, in the last period, is negative in all ZEATs of the first group and positive in all ZEATs of the second group – was only identical in all three periods for the North, East, Middle East, and Mediterranean ZEATs. The balance of internal migrants in the Paris Basin, West, and Southwest ZEATs, which was initially negative, turned positive: in the second period for the Paris Basin but in the third period for the other two ZEATs. Finally, the balance of the Paris Region, which was positive in the first two periods, became negative in the last.

Let us now subtract for each ZEAT in each intercensal period, the balance of internal migrants shown in Figure 14 from the corresponding number of net migrations, obtained as a residual between population change and natural increase. The result of such subtractions, which we know is not correct, should nevertheless provide a rough order of magnitude about the values of the balance of international movements over the last three intercensal periods for each ZEAT.

According to the figures obtained (not shown here because they are only approximations), each ZEAT would have registered, in all three periods, a positive balance of international movements, which would have increased from the first to the second period and decreased from the second to the third. Such a common evolution is undoubtedly plausible; one must only recall the return in the early sixties of Frenchmen living in the former colonies, especially Algeria; 1962 alone saw the arrival of 710000 repatriates.

Naturally, this upward and then downward variation of the balance of international movements in all ZEATs leads us to assert that the common inverted U-shaped evolution of the net migration rate observed in Figure 12 is simply a reflection of the temporary situation that affected international migration in the early sixties.

Finally, observing the rather identical patterns of change of the natural increase and international migration components of population growth in all of the ZEATs, we conclude that the relative decline of the Paris Region and the relative improvement of the West and Southwest ZEATs is essentially the result of the evolution of internal migration. Since the mid-fifties this component has evolved consistently in the same direction in each ZEAT to the point of reversing

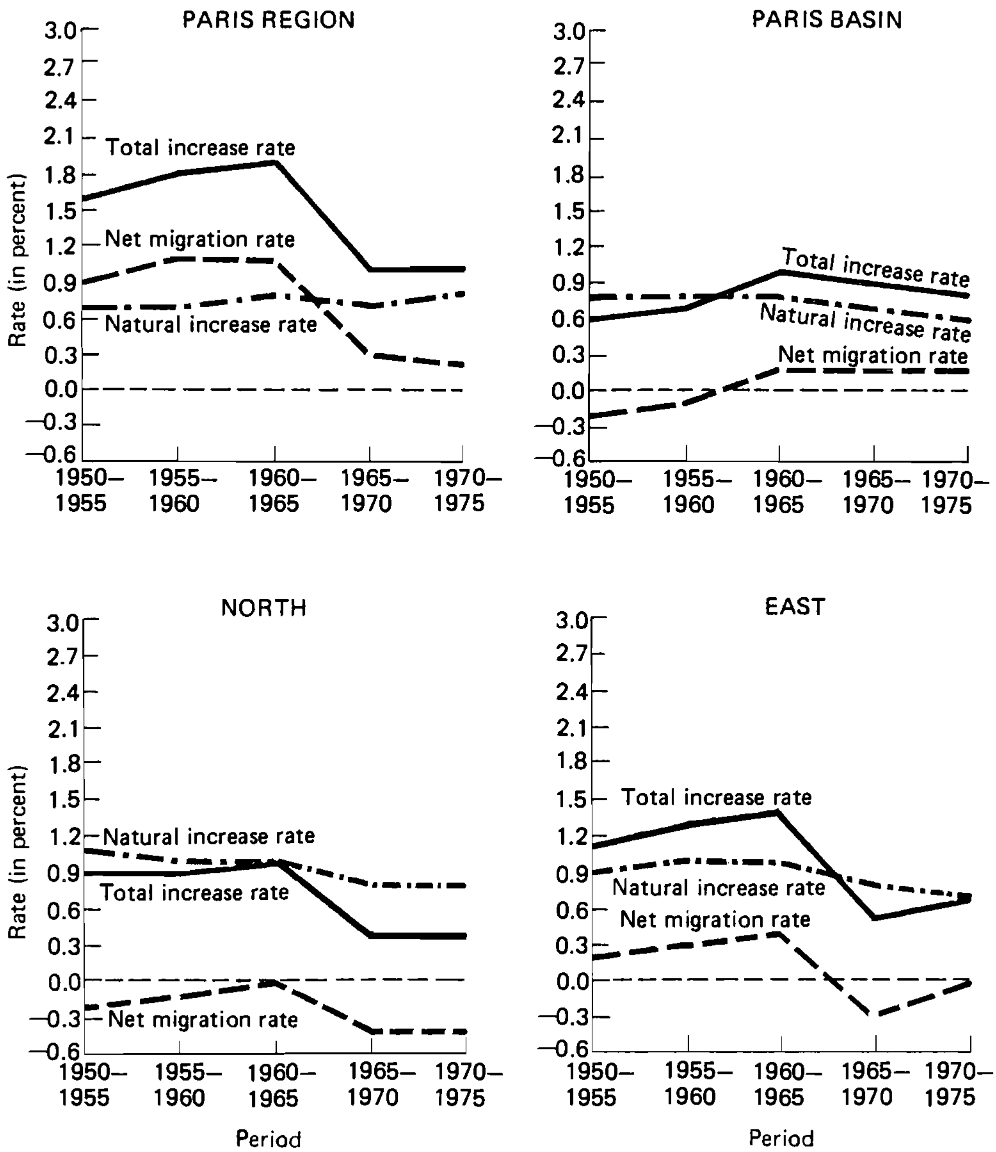

FIGURE 13 Average annual rates of total increase, natural increase, and net migration: ZEATs, 1950–1975 by 5-year periods. Source: Derived from Eurostat 1976, pp. 186, 187.

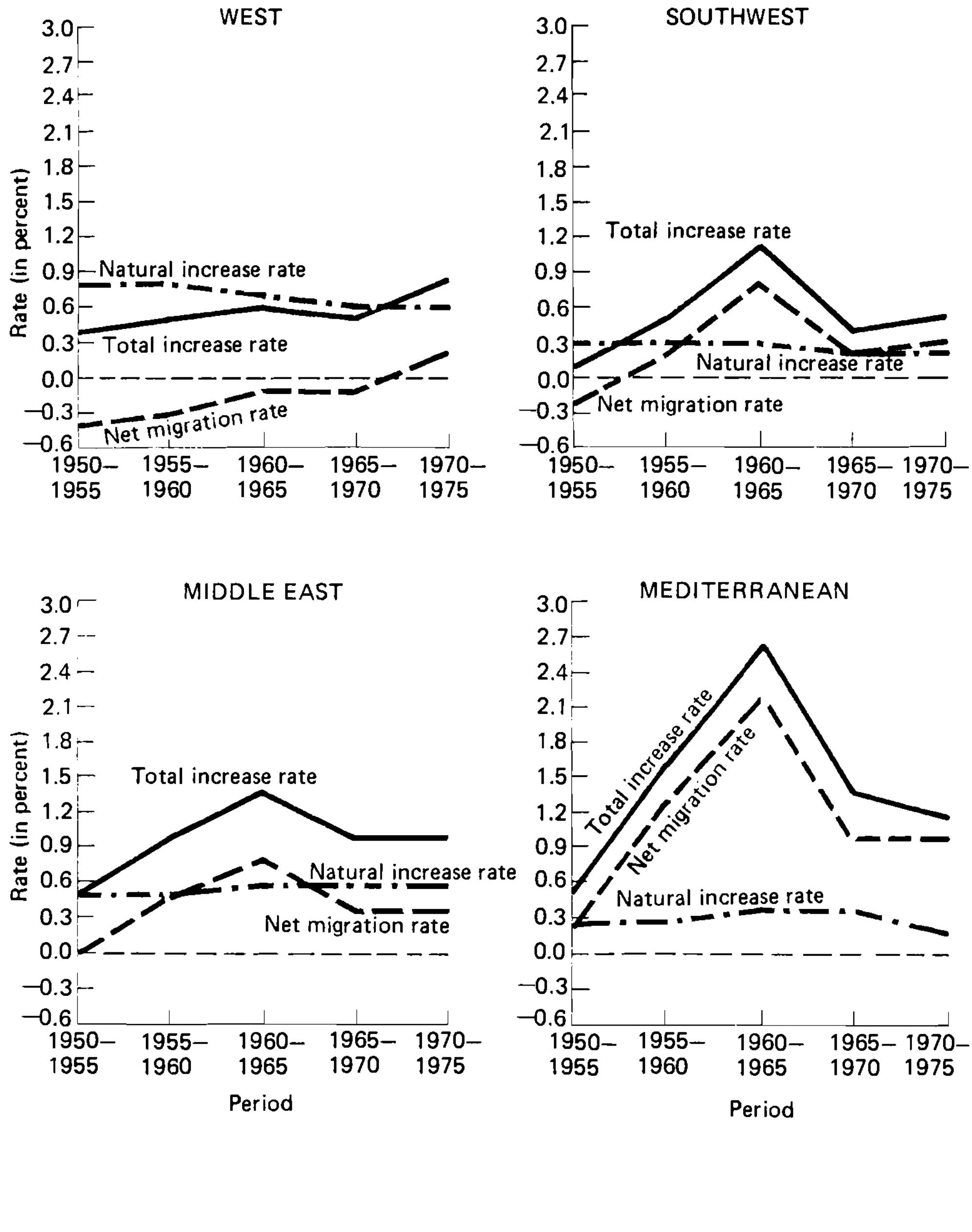

FIGURE 13 *(continued).*

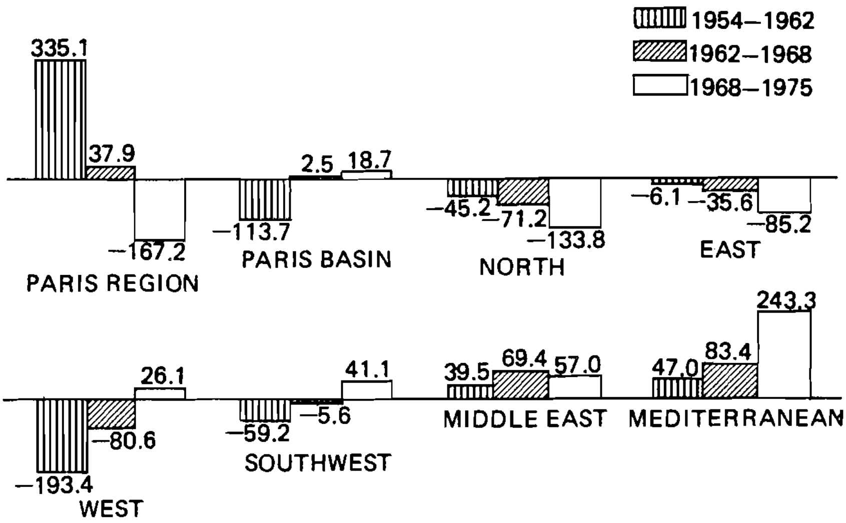

FIGURE 14 Net migrant flows (in thousands): ZEATs, 1954–1962, 1962–1968, and 1968–1975. Sources: 1954–1962 data taken from Schiray and Elie 1970, pp. 14, 15; 1962–1968 data taken from Desplanques 1975, p. 24; 1968–1975 data taken from INSEE 1977.

the sign of the balance of migrants for the Paris Region as well as the West and Southwest ZEATs. Since the late sixties and early seventies these signs are negative for the Paris Region and positive for the West and Southwest.

2.3 *Mortality*

Because there are no annual age-specific population estimates at the regional level, the only index of mortality that we can observe annually is the crude death rate. Table 9 shows that in all of the ZEATs during the period 1950–1975, the crude death rate experienced a moderate decline, which was especially

TABLE 9 Crude death rates (per thousand) for the eight ZEATs: 1950–1975 at 5-year intervals.

	ZEAT								
Year	Paris Region	Paris Basin	North	East	West	South-west	Middle East	Mediter-ranean	France
1950	10.6	13.1	12.6	12.4	13.2	13.9	13.3	12.7	12.7
1955	10.1	12.3	12.3	11.8	12.6	13.3	12.5	12.1	12.0
1960	9.6	11.6	11.4	11.2	11.7	12.9	12.0	11.9	11.4
1965	9.5	11.6	11.3	10.6	11.6	12.6	11.2	11.6	11.2
1970	9.0	11.0	11.1	10.3	11.2	12.4	10.9	11.3	10.7
1975	8.7	10.8	11.3	10.2	11.1	12.4	10.6	11.3	10.6

SOURCE: Eurostat 1976.

slow in the early sixties. Such a trend suggests that the impact of the general decline in mortality* was barely able to offset the impact of the inexorable aging of the population, especially after the mid-sixties.

Actually, the crude death rate has followed a rather parallel decline in all of the ZEATs, so that the differentials in this rate have remained relatively unchanged across ZEATs throughout the observation period. Generally, the crude death rate took on values little different from the national average in all ZEATs except two. The rate was substantially higher in the Southwest ZEAT, which has a relatively older population, and substantially lower in the Paris Region, which has a relatively younger population.

Of course, the comparison of the crude death rates across ZEATs does not provide a true picture of the mortality differentials between ZEATs. Therefore, we now turn to a comparison of the 1975 mortality age patterns, established for each ZEAT from the disaggregate death information obtained from INSEE's Bureau of Population Movement and relevant disaggregate population estimates (INSEE 1977) shown in Appendix A.

For this purpose, ordinary life tables specific to each ZEAT were constructed for males, females, and both sexes aggregated; only selected results are shown here. Appendix B gives the 1975 mortality rates (for males and females) relating to a decomposition of the population in 5-year age groups (i.e., the number of male (female) deaths in the age group divided by the number of males (females) in the age group on the census day). Table 10 shows the expected numbers of survivors, at selected ages, out of 100000 males born in each ZEAT, and Table 11 displays the corresponding expected numbers of remaining lifetime.

TABLE 10 Expected numbers of survivors at selected ages, out of 100000 males, for the eight ZEATs.

	Age				
ZEAT	0	20	40	60	80
Paris Region	100000	97178	94265	80312	32650
Paris Basin	100000	97090	93344	77610	29784
North	100000	96360	92208	71933	21119
East	100000	96628	93226	76450	26021
West	100000	97051	92986	76680	28898
Southwest	100000	97023	93852	81018	33109
Middle East	100000	97207	93915	79350	29713
Mediterranean	100000	97109	93836	80736	34956
France	100000	97016	93554	78405	30104

*Between 1950 and 1975, life expectancy at birth increased by nearly 6 years for males and 7.5 years for females.

TABLE 11 Total expectations of life at selected ages for males (in years) for the eight ZEATs.

	Age				
ZEAT	0	20	40	60	80
Paris Region	70.70	52.51	33.84	17.62	6.84
Paris Basin	69.28	51.16	32.78	16.99	6.28
North	66.07	48.37	30.01	15.11	5.77
East	68.25	50.41	31.85	16.15	6.01
West	68.83	50.73	32.47	16.84	6.13
Southwest	70.71	52.67	34.10	17.53	6.28
Middle East	69.74	51.55	32.98	16.79	6.19
Mediterranean	71.03	52.96	34.45	18.01	6.71
France	69.55	51.49	32.99	17.03	6.34

Table 12 then compares the values of the expectations of life at ages 0, 20, and 60 for males, females, and both sexes aggregated. The values obtained for the last group are used to classify the eight ZEATs in four categories *vis-à-vis* mortality behavior, given below in the order of increasing mortality.

1. Three ZEATs have a relatively low mortality level; in those ZEATs, the expectation of life at birth is about one year higher than the national average (73.48 years): i.e., 1.24 years for the Mediterranean ZEAT, 1.16 years for the Paris Region, and 0.89 year for the Southwest ZEAT.
2. Three other ZEATs have about an average mortality level: the Middle East, Paris Basin, and West ZEATs where the expectation of life at birth for both sexes aggregated is 73.63, 73.26, and 73.03 years, respectively.
3. One ZEAT has a relatively high mortality level; the expectation of life at birth in the East ZEAT is 1.23 years less than the national average.
4. One ZEAT has a significantly higher mortality level; the expectation of life at birth in the North ZEAT is 3.24 years less than the national average.

Such mortality differentials can also be observed for males and females separately. The expectation of life at birth values for males range from 66.07 to 71.03 years with a national average of 69.58 years, and for females from 74.66 to 78.43 years with a national average of 77.51 years.

Note that the difference between the lowest (North) and highest (Mediterranean) values of the expectations of life at birth equals 4.96 years in the case of the male population but only 3.77 years in the case of the female population. If the North ZEAT is set aside, these figures reduce to 2.78 and 1.99 years,

TABLE 12 Expectations of life e at birth, at 20 years, and at 60 years of age (in years) for the eight ZEATs: both sexes aggregated, males, and females, 1975.

	Both sexes aggregated			Males			Females			Female–male differential (Δ)		
ZEAT	e_0	e_{20}	e_{60}	e_0	e_{20}	e_{60}	e_0	e_{20}	e_{60}	Δe_0	Δe_{20}	Δe_{60}
Paris Region	74.64	56.28	20.49	70.70	52.51	17.62	78.35	59.76	22.76	7.64	7.25	5.14
Paris Basin	73.26	54.96	19.61	69.28	51.16	16.99	77.48	58.96	22.01	8.20	7.80	5.02
North	70.24	52.37	17.93	66.07	48.37	15.11	74.66	56.56	20.44	8.59	8.19	5.33
East	72.25	54.19	18.76	68.25	50.41	16.15	76.44	58.11	21.07	8.19	7.70	4.92
West	73.03	54.73	19.47	68.83	50.73	16.84	77.36	58.83	21.75	8.53	8.10	4.91
Southwest	74.37	56.11	20.03	70.71	52.67	17.53	78.14	59.62	22.33	7.43	6.95	4.80
Middle East	73.63	55.28	19.44	69.74	51.55	16.79	77.66	59.12	21.77	7.92	7.57	4.98
Mediterranean	74.72	56.49	20.55	71.03	52.96	18.01	78.43	59.99	22.79	7.40	7.03	4.78
France	73.48	55.24	19.68	69.58	51.49	17.03	77.51	59.04	22.00	7.96	7.53	4.97

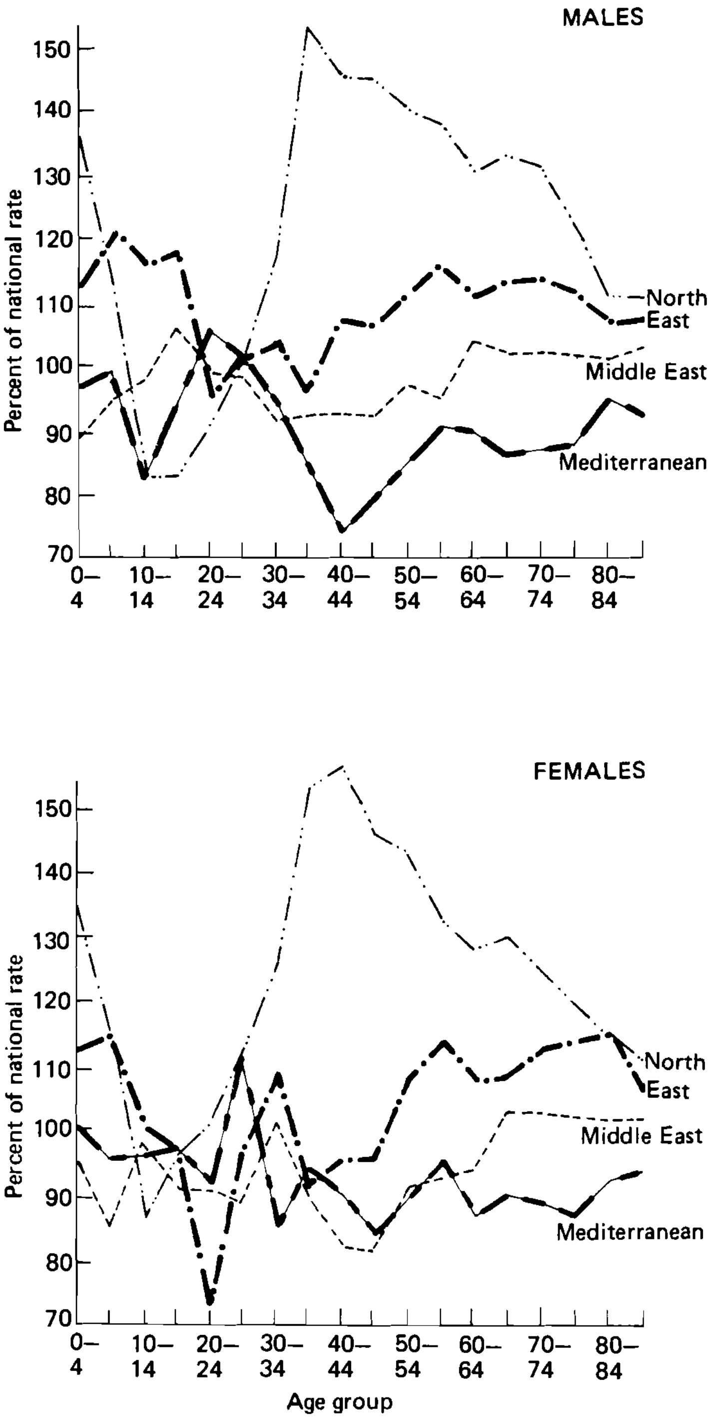

FIGURE 15 Age-specific mortality rates for selected ZEATs (as a percent of the national counterparts): males and females, 1975.

respectively. In other words, the mortality differentials across ZEATs are much larger for males than for females in absolute as well as relative terms. The difference between the male and female expectations of life at birth ranges from 7.40 years (Mediterranean) to 8.59 years (North) with a national average of 7.96 years.

Interestingly enough, the above picture of the population's mortality differentials across ZEATs broadly holds – for males as well as for females – for each age group, especially the groups with higher mortality propensities (ages 0–4 and those above age 40). Figure 15 shows for each sex the variations by age of the mortality rates (measured as a percent of its national counterpart) for four selected ZEATs (one from each of the previously mentioned mortality groups). There is, however, an anomaly in the case of the North ZEAT where juvenile mortality, for both sexes, is less than for the nation as a whole. This probably reflects the fact that causes of death for youngsters are different than those for older people. It also may well be that, for the juvenile age groups, the variations observed across ZEATs are not significant owing to the relatively small number of deaths observed.

In addition, Figure 15 reveals that the excessive mortality observed in the North ZEAT for persons of both sexes aged 30 and over is highest between ages 35 and 50, when the mortality rate is about 50 percent higher than the corresponding rate at the national level.

2.4 Fertility

We begin our analysis of fertility with an examination of the recent evolution of the crude birth rates across ZEATs, which actually is more instructive than that of the crude death rate.

Since 1950 the evolution of the crude birth rate in all of the ZEATs has been characterized by an almost continuous decline (see Figure 16). This decline was quite sharp in the early fifties but became less so in the late fifties and early sixties (when a small increase could be observed in the ZEATs with the lowest crude birth rates). After a brief recess around 1970, the rate once again accelerated downward.

Unfortunately, the above evolution of the ZEAT-specific crude birth rates does not tell the entire story of changes in fertility behavior, since it also compounds variations in age composition. Let us first compare for the whole of France, the evolution of the crude birth rate and the total fertility rate (or average number of children that a woman is expected to have over her lifetime). Figure 17, which contrasts these two rates from 1950 to 1978, shows that the indices have evolved in a similar way in the early 1950s and, more importantly in the early 1970s, thus suggesting that the declining tendency of the crude birth rate reflected a true change in fertility behavior.*

*The larger discrepancies observed in the variations of the two indices in the sixties indeed suggest for this period a large impact of age composition on the variations of the crude birth rates which can be attributed to the entry into the highest childbearing ages of the postwar cohorts.

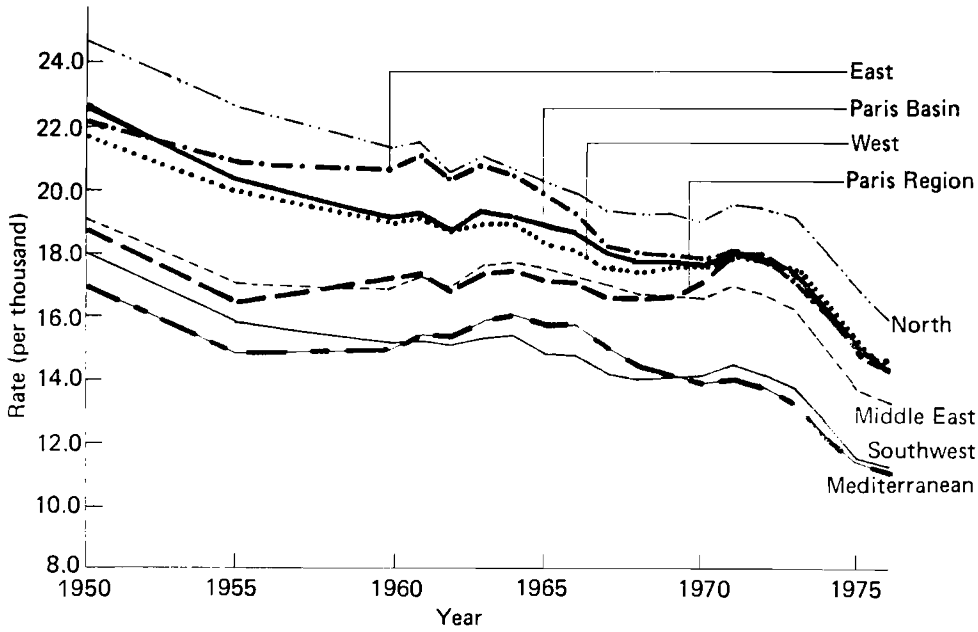

FIGURE 16 Evolution of the crude birth rate (per thousand): ZEATs, 1950–1976. Source: Derived from Eurostat 1976, pp. 162, 163.

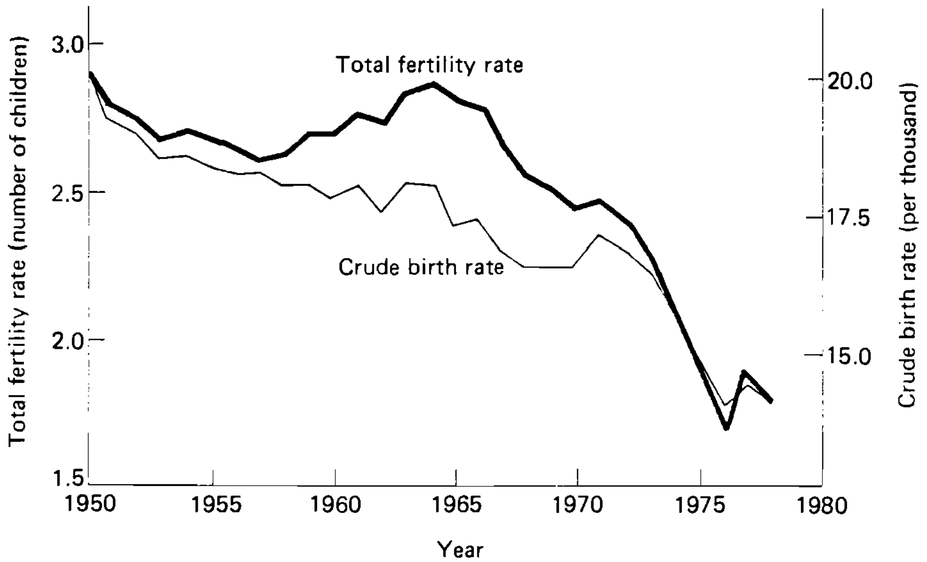

FIGURE 17 Evolution of the crude birth rate and the total fertility rate: France, 1950–1978. Sources: Crude birth rates taken from Croze 1979, p. 43; total fertility rates taken from Calot 1979, p. 1292.

Returning to Figure 16, we observe that the declining path of the crude birth rate has been roughly similar across ZEATs, at the beginning as well as at the end of the observation period. As a result, we may safely conclude that all of the ZEATs experienced a real fertility decline in the early fifties and in the early seventies. But the rather identical evolution of the crude birth rate in all ZEATs (except the Paris Region) in the recent past seems to suggest that during the last intercensal period (1968–1975) the true fertility decline was of roughly the same magnitude for all ZEATs except the Paris Region, where the fertility decline caught up with that of the other ZEATs in 1971 only.

By contrast, in the intermediate period (1955–1970) the evolution of the crude birth rate differed substantially from one ZEAT to another. As already indicated, a small increase was even observed in the early sixties for the ZEATs with the lowest values of the crude birth rate. This observation naturally accounts for the modifications of the crude birth rate differentials observed across ZEATs between 1950 and 1975:

1. In the Paris Region the crude birth rate registered an absolute decrease of 3.9 percent as against a decrease of 5.4–7.8 percent in the other ZEATs.
2. Except for the North ZEAT (which had a substantially higher crude birth rate) and the Southwest and Mediterranean ZEATs (which had a significantly lower crude birth rate) all ZEATs have gradually taken on similar crude birth rates.

To obtain a more pertinent picture of the fertility differentials across ZEATs, we now turn to a comparison of the 1975 fertility age patterns, established for each ZEAT from the disaggregate birth information obtained from INSEE's Bureau of Population Movement (shown in Appendix A) and relevant disaggregate population estimates (INSEE 1977).

Appendix B gives the age-specific fertility rates (all births to women in the age group divided by all women in the age group on the census day) for each ZEAT in 1975, as well as the gross reproduction rate (five times the sum of the female births in the age group divided by the number of women in the age group on the census day), the crude birth rate, and the mean age of childbearing. An additional rate commonly used in fertility analysis is the total fertility rate (five times the sum of the age-specific fertility rates), which can be used to categorize the fertility behavior of the eight ZEATs into four groups. In order of increasing fertility, we can distinguish:

(a) the southernmost ZEATs (i.e., Southwest and Mediterranean), where the total fertility rate (TFR) is more than 10 percent below the national average
(b) the Paris Region and Middle East ZEATs, where the TFR is less than 10 percent below the national average

(c) the Paris Basin and East ZEATs, where the TFR is less than 10 percent above the national average
(d) the West and North ZEATs, where the TFR is more than 10 percent above the national average

The resulting fertility map (see Figure 18) is in broad agreement with the traditional observation of a fertile crescent surrounding the Paris Region except on its southern side (see subsection 1.2).

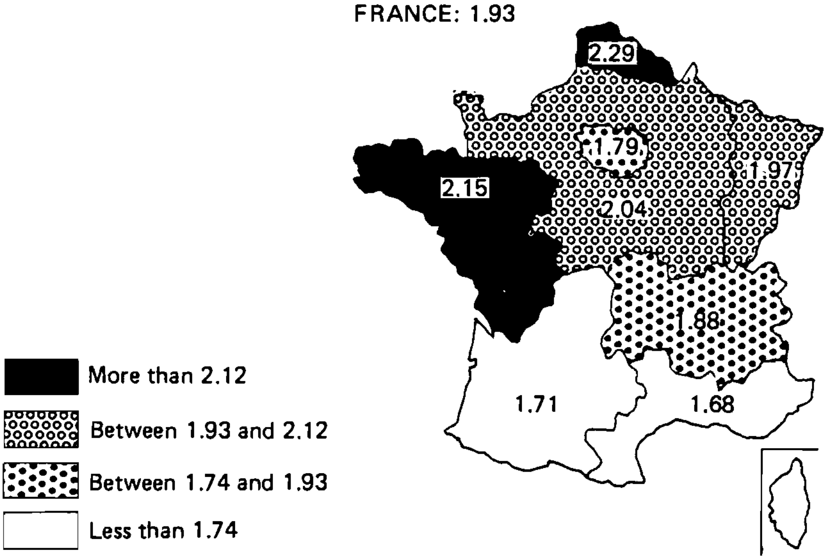

FIGURE 18 Total fertility rates: ZEATs, 1975.

In addition, note the similarity between the fertility map (Figure 18) and the mortality figures given in the first column of Table 12, a similarity that is expressed in graph form in Figure 19. In general, the lower the fertility level, the lower the mortality level; the correlation between the total fertility rate and the expectation of life at birth amounts to 0.833. As a result, the spatial fertility differentials just described are not substantially altered if the interfering role of mortality is accounted for. To see this, compare the net reproduction rates (which are affected by mortality) indicated in Figure 20 with the gross reproduction rates shown in Appendix B. Observe that in 1975 two ZEATs only – the West and especially the North – had a net reproduction rate above replacement level.

An examination of the age-specific rates in Appendix B reveals the existence of a similar pattern of spatial fertility differentials for each 5-year age group.

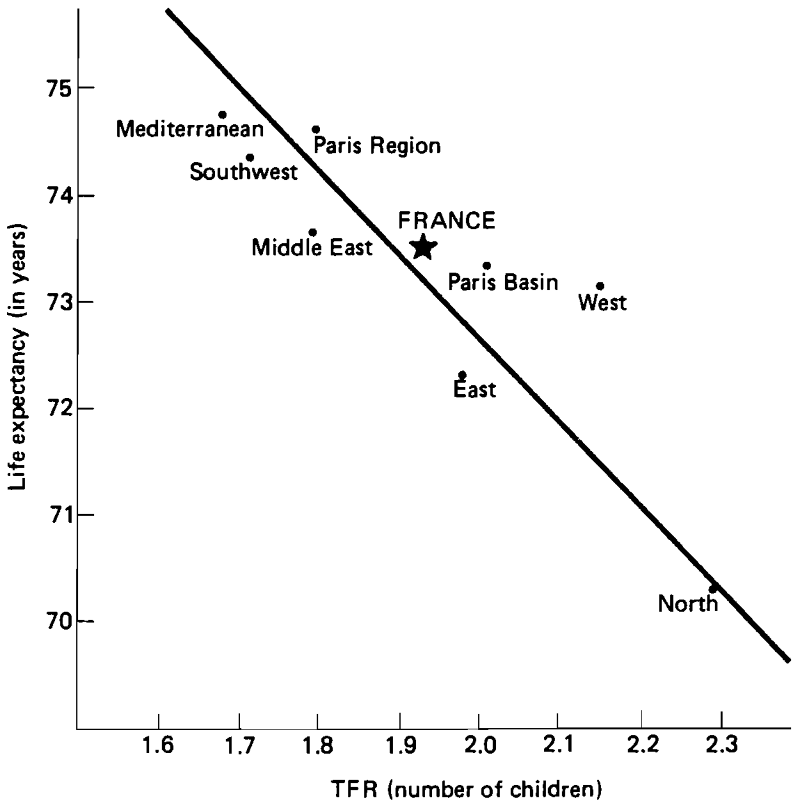

FIGURE 19 Total fertility rate and life expectancy at birth: ZEATs, 1975.

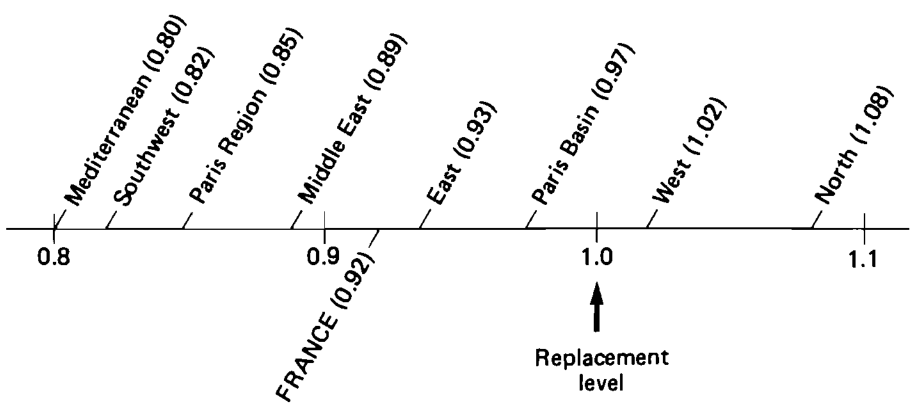

FIGURE 20 Net reproduction rates: ZEATs, 1975.

However, Figure 21, which illustrates the variations by age of each ZEAT-specific fertility rate (as a percent of the national counterpart), indicates some discrepancies. The following are the most important. First, the West ZEAT, a region of higher fertility, has a fertility rate much lower than the national average in the age group 15–19; second, the Middle East ZEAT, a region of lower fertility, has higher rates than the national average for all ages between 25 and 44.

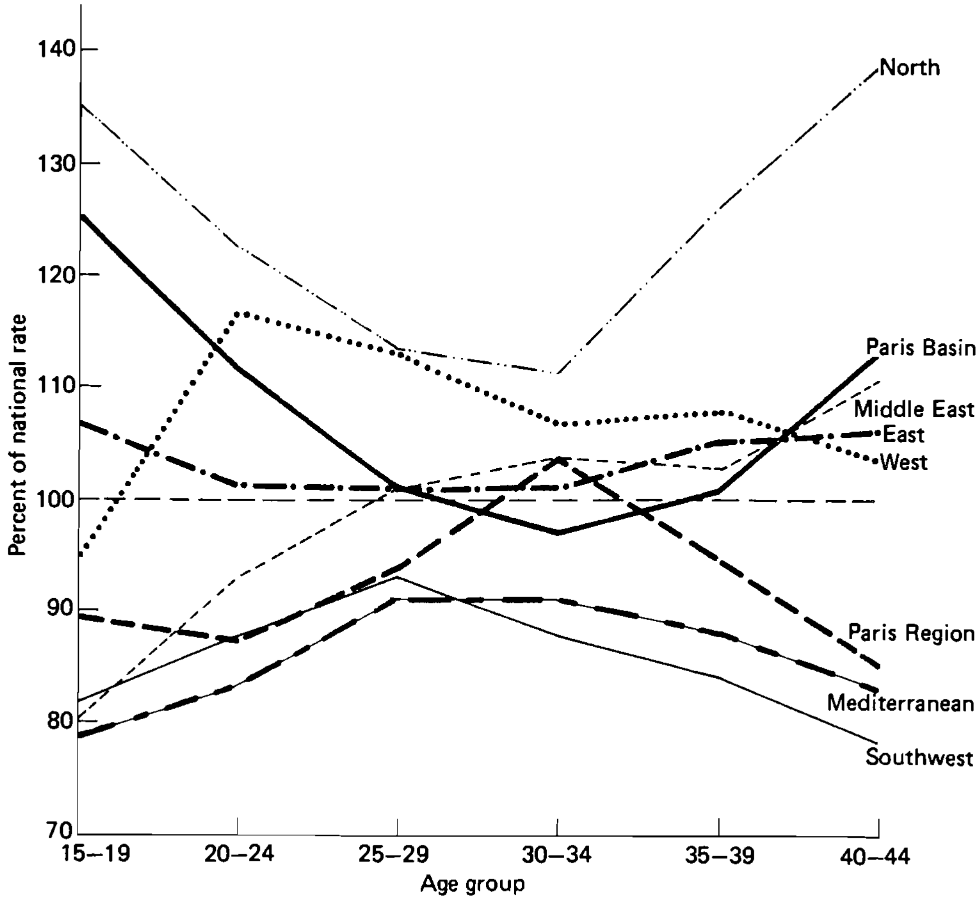

FIGURE 21 Age-specific fertility rates (as a percent of the national counterparts): ZEATs, 1975.

Additional observations on the fertility regime of the ZEATs are relevant here. For example, the age-specific fertility figures set out in Appendix B indicate that, in each ZEAT, the fertility rate is of the same magnitude in both the 20–24 and 25–29 age groups; however, the highest value occurs in the 25–29 age group in the case of the four ZEATs with less-than-average fertility and in the 20–24 age group in the case of the four ZEATs with higher-than-average fertility. Also, the observation of Figure 21 suggests the following:

1. The fertility rate is always higher in the North ZEAT than in the other ZEATs, especially at the two extremes of the childbearing ages.
2. The lowest fertility rate is to be found in the Mediterranean ZEAT for the three youngest childbearing age groups and in the Southwest ZEAT for the next three age groups.
3. The magnitude of the fertility differentials is higher at both extremes of the childbearing ages than in the intermediate ages in all ZEATs except the Middle East (where the value of the fertility rate as compared with the national value increases with age).

As stated earlier, we do not have annual age-specific population estimates available at the level of ZEATs, so we cannot examine the recent evolution, in the ZEATs, of a true fertility index such as the total fertility rate. However, because Labat and Viseur (1973, pp. 62–67) provide values of the total fertility rate for the 22 programming regions for 1968, it is possible to estimate an approximate value of the change in the total fertility rate of each ZEAT between 1968 and 1975.* In accordance with our earlier conjecture based on the evolution of the crude birth rate, the total fertility rate decreased rather uniformly across ZEATs – by about 0.70 percent between 1968 and 1975 – except in the case of the Paris Region where the drop amounted to only 0.40 percent (from 2.19 in 1968 to 1.79 in 1975). We conclude that, over the period 1968–1975, fertility differentials across ZEATs remained unchanged except for those differentials involving the Paris Region. This region, which was the least fertile ZEAT in 1968 (with a total fertility rate of 2.19 as against 2.59 for the nation), turned into a ZEAT with slightly less-than-average fertility owing to a smaller fertility decline than in the rest of France in the late sixties.

2.5 International Migration

Since the end of the Second World War, the contribution of international migration to the population growth of France has been substantial. The average annual rate of growth due to international migration amounted to 0.21 percent during the period 1946–1955, 0.50 percent during the period 1956–1965, and 0.19 percent during the period 1966–1975: that is, 25.4, 47.6, and 26.2 percent, respectively, of the annual rate of change in the corresponding periods. A large part of the influx registered in the second period, however, was due to the

*Because the values of the total fertility rate in the regions contained in each ZEAT are close to one another, it is possible to derive a rather good approximate estimate of the 1968 total fertility rate for each of the ZEATs.

above-mentioned arrival of French repatriates from the former colonies. Thus, if this particular component is set aside, the contribution of internal migration to population growth has been quite stable between 1945 and 1975, accounting for one-fourth of the population increase for an annual growth rate of roughly 0.2 percent.*

It should be noted, however, that the recent economic crisis and the concomitant rise in unemployment led the French government in 1974 to curb the immigration of foreign workers. As a result, the net inflow of population to France has been nil since 1976.

A question of obvious interest is: how have the various ZEATs benefited from the external net inflow of population observed between 1946 and 1975? No existing statistics indicate the regional breakdown of such an inflow. Nevertheless, the rough calculations, which we made earlier by subtracting the net number of migrants from the total net migration balance for each ZEAT, suggest that the Paris Region benefited relatively more, whereas the North and West ZEATs benefited relatively less than the other ZEATs.

Some precise but partial information on the subject of international migration can also be derived from relevant census results (see Table 13, which sets out the breakdown of the immigrant flow by ZEAT over the last two intercensal periods). The comparison of the 1968–1975 figures with the 1962–1968

TABLE 13 Immigrant flows for the eight ZEATs: intercensal periods 1962–1968 and 1968–1975.

	Intercensal period			
	1962–1968		1968–1975	
ZEAT	Total[a] (in thousands)	Foreign (in thousands)	Total (in thousands)	As a percent of the 1975 population
Paris Region	608.3	462.4	596.9	6.03
Paris Basin	250.5	145.5	213.9	2.21
North	79.0	61.6	62.2	1.59
East	161.6	127.7	172.5	3.51
West	102.7	50.1	78.6	1.14
Southwest	260.6	124.3	124.6	2.24
Middle East	285.6	178.1	211.8	3.46
Mediterranean	539.6	236.5	216.6	3.79
France	2288.0	1386.4	1677.1	3.18

[a]Includes French repatriates.
SOURCES: Data taken from Desplanques 1975 for the period 1962–1968; from INSEE 1977 for the period 1968–1975.

*The figures in this paragraph have been established on the basis of the annual components-of-change figures given in Croze 1976; 1979, Table 3.

figures (for foreigners only) suggests a certain stability of this breakdown. (Observe that the repatriates from the former colonies have settled in relatively greater numbers in the southernmost part of France: the Southwest and Mediterranean ZEATs.) In addition, Table 13 reveals that, in proportion to its population, the Paris Region attracts about twice as many immigrants as the ZEATs of the eastern half of the country (the East, Middle East, and Mediterranean ZEATs), three times as many as the Paris Basin and Southwest ZEATs, and four to five times as many as the North and West ZEATs.

Under normal conditions, the flow of immigrants to France essentially comprised those foreigners who were willing to accept jobs that were increasingly being refused by the French. In the mid-seventies, 80 percent of foreigners were either laborers or domestics, whereas only 40 percent of the native French population held such positions.

Additional insights can be obtained from census results that concern the spatial distribution of the foreign population. According to the last census (1975), 3442.4 thousand foreigners, or 6.5 percent of the total population, resided in France, but they were unevenly distributed over space. There were relatively more foreigners in the urban areas than in the rural areas (with the percentage increasing with the size of the commune). Moreover, as shown in the last column of Table 14, the fraction of foreigners in 1975 was substantially higher in the Paris Region (11.7 percent), Mediterranean (8.4 percent), and Middle East ZEATs (8.3 percent), which contain France's three largest agglomerations.

The above picture is the result of an evolution that, in the third quarter of this century, has not been homogeneous across ZEATs (see Table 14). Between 1954 and 1975, France's foreign population doubled: roughly a 60 percent increase of the fraction of foreigners in the total population. But the foreign population of the Paris Region and Middle East ZEATs grew more rapidly, tripling in absolute value and almost doubling in percent. By contrast, the other ZEATs experienced a less rapid growth of their foreign population relative to the nation as a whole, especially the North and Southwest ZEATs where the number of foreigners remained relatively unchanged. The Mediterranean ZEAT, with the highest proportion of foreigners in 1954, also had relatively little change because the traditional immigration of Italians and Spaniards has tended to be replaced by the immigration of Portuguese and Algerians.

2.6 *Internal Migration: Temporal Evolution*

Turning now to the analysis of internal migration, we first assess the evolution of mobility between the eight ZEATs from 1954 to 1975. The methodology used for this purpose is borrowed from a similar analysis focusing on the recent evolution of mobility between smaller geographical units (Courgeau 1978).

For each of the last three intercensal periods (1954–1962, 1962–1968, 1968–1975), Table 15 gives the proportion of migrants between ZEATs*

*That is, for each period, the number of people who resided in different ZEATs at the beginning and end of the period.

TABLE 14 Decomposition of the foreign population according to ZEAT of residence: in census years 1954 to 1975.

	Year					
	1954			1962		
ZEAT of residence	Number of foreigners (in thousands)	Percent of France's foreign population	Percent of foreigners in the ZEAT's population	Number of foreigners (in thousands)	Percent of France's foreign population	Percent of foreigners in the ZEAT's population
Paris Region	373.7	21.2	5.1	547.2	25.5	6.5
Paris Basin	230.1	13.7	2.8	237.8	11.1	2.8
North	200.1	11.4	5.9	180.8	8.4	4.9
East	225.8	12.8	5.6	289.4	13.5	6.5
West	36.2	2.1	0.6	38.7	1.8	0.6
Southwest	222.8	12.7	4.5	211.4	9.8	4.1
Middle East	197.7	11.2	4.1	268.0	12.5	5.1
Mediterranean	273.8	15.6	6.7	376.7	17.5	8.1
France	1760.2	100.0	4.1	2150.0	100.0	4.7
	1968			1975		
Paris Region	817.8	31.2	8.9	1156.1	33.6	11.7
Paris Basin	262.9	10.0	2.9	393.1	11.4	4.1
North	183.7	7.0	4.8	204.8	5.9	5.2
East	284.6	10.9	6.1	371.5	10.8	7.6
West	35.2	1.3	0.5	67.2	2.0	1.0
Southwest	227.2	8.7	4.2	257.4	7.5	4.6
Middle East	371.2	14.2	6.5	508.0	14.8	8.3
Mediterranean	438.5	16.7	8.3	484.3	14.1	8.4
France	2621.1	100.0	5.3	3442.4	100.0	6.5

SOURCE: Derived from Samman 1977, p. 58.

TABLE 15 Level of mobility between ZEATs: intercensal periods 1954–1962, 1962–1968, and 1968–1975.

Measure	Intercensal period 1954–1962		1962–1968		1968–1975
(1) Number of migrants (in thousands)	2 787		2 769		3 933
(2) At-risk population (in thousands)	44 560		47 367		50 922
(3) Proportion of migrants (per thousand)	62.5		58.5		77.2
(4) Annual migration proportion (per thousand)	7.6	(+25.0%)[a]	9.5	(+13.7%)	10.8
(5) Average annual migration rate (per thousand)	12.0	(+14.2%)	13.7	(+19.7%)	16.4

[a]Percents represent the increase from one period to the next.
SOURCES: Data taken from Schiray and Elie 1970, pp. 14, 15 for the period 1954–1962; from Desplanques 1975, p. 24 for the period 1962–1968; from INSEE 1977 for the period 1968–1975; the at-risk population data taken from Courgeau 1978.

(line 3) obtained by dividing the total number of migrants (line 1) by the population submitted to the risk of migrating (line 2). This table also shows the corresponding annual migration proportions, obtained by dividing the proportion in line 3 by the length of the intercensal period.

If we suppose that the number of migrants is a linear function of the length of the observation period, then the above annual proportions constitute approximate estimates of the population's annual migration rates. Under this assumption, we notice that there has been a large increase in mobility since 1954: +42.0 percent. The increase was larger between the first two intercensal periods (+25.0 percent) than between the last two (+13.7 percent).

The above hypothesis, however, is far from reflecting reality. In fact, an individual can move several times within a given period although he appears as a migrant only once. Moreover, if he comes back to his initial place, he will not appear as a migrant even though he may have made several moves. Thus the migration proportions previously calculated are much smaller than the actual migration rates that relate the number of total moves to the at-risk population. For example, in the United States about 50 percent of the people change their living quarters over a 5-year period, i.e., a 10 percent annual proportion, while annually the real proportion is 20 percent.

To account for this effect, we use a model developed elsewhere (Courgeau 1973) to analyze all moves observed from a retrospective survey. Such a model enables one to estimate approximately the variations in the number of migrants when the length of the observation period changes. In the absence of any further information, we suppose that this model is applicable to census data. It can be written as follows:

$$M(t) = P\,p\{(1 - k')t + (k'/k)[1 - \exp(-kt)]\}$$

where $M(t)$ is the number of migrants observed over a t-year period, P is the population present at the beginning of the period and surviving over the t-year period, p is the annual migration rate, k' is the probability that an individual having moved once will move again but not to the initial place of residence, and k is the annual probability of making a new move, calculated with respect to the at-risk population.

Clearly, for a given intercensal period, the above model can yield an average annual migration rate p from the knowledge of the number of migrants, the at-risk population, and the coefficients k and k'. According to Courgeau (1973) who worked on the case of France, the latter coefficients are, in the first approximation, independent of the territorial division retained and change little over time. Therefore, in applying the above model to the last three intercensal periods, we will suppose that the values of k and k' are constant, equaling the values estimated by Courgeau: 0.18 and 0.78, respectively.

The last line of Table 15 sets out the estimate of p for each of the three intercensal periods. It shows an increase in mobility that is smaller than the one suggested earlier by the evolution of the annual migration proportion (+36.7 percent versus 42.0 percent between the extreme periods). However, instead of a declining mobility increase observed on the basis of the migration proportion values, we obtain an acceleration of the mobility increase; the relative increase in p between the last two intercensal periods amounts to 19.7 percent versus the 14.2 percent between the first two.

By extrapolating linearly the trend observed between 1954 and 1975, we obtain a doubling of the annual rate of migration between ZEATs in 37 years. Note that Courgeau (1978), working at the level of the departments and programming regions, obtained a doubling in 37 and 39 years, respectively. Those results thus appear to agree with Courgeau's contention that the evolution of geographic mobility in France is independent of the partitioning of France. (In all likelihood, this conclusion is valid as long as the number of geographic zones remains under a certain threshold. For migration between communes, Courgeau (1978) found a doubling of the annual migration rate in 60 years only.)

Finally, recalling Tugault's (1973) result that, between 1881 and 1962, mobility between departments evolved at a pace corresponding to a doubling of the annual migration rate in 110 years, we conclude that the 20 years between the mid-fifties and mid-seventies brought an important increase of geographic mobility in France, which moreover took place at an accelerated rate.

2.7 *Migrant Flows and Streams*

Has the global increase of mobility just described been uniform across ZEATs? To answer this question, we examine how the number of net migrants into each ZEAT has evolved over the last three intercensal periods. The methodology used for that purpose is also borrowed from Courgeau (1978).

NET MIGRANTS

The analysis starts with the estimation of annual net migration indices* relating to the eight ZEATs for each of the three intercensal periods. These are obtained by dividing the number of net migrants by the sum of the beginning-of-the-period and end-of-the-period populations in the relevant ZEAT. These indices have the advantage of being between −1 and +1. The two extreme cases occur when there is no in- and out-migration, respectively.

Moreover, to calculate average annual rates, we divide these net migration indices by the length of the intercensal period. If we suppose that the population changes linearly and that the migration propensity of those who died within the period is identical to those who survived, each rate appears to be identical to the average annual rate of net migration.

Under these assumptions, Table 16 displays the average annual net migration rates for the eight ZEATs in the last three intercensal periods. The hypothesis of a uniform increase of migration into and out of each ZEAT from one period to the next is not verified. Of the three ZEATs, which in 1954–1962 had a positive net migration rate, two (Middle East and Mediterranean ZEATs) saw

TABLE 16 Annual net migration rates (per 10000) and ranking of the eight ZEATs: intercensal periods 1954–1962, 1962–1968, and 1968–1975.

	Intercensal period					
	1954–1962		1962–1968		1968–1975	
ZEAT	Annual rate	Rank	Annual rate	Rank	Annual rate	Rank
Paris Region	26.65	8	3.56	6	−12.49	3
Paris Basin	−8.56	3	0.23	5	1.42	4
North	−8.80	2	−15.88	1	−24.75	1
East	−0.90	5	−6.50	3	−12.70	2
West	−19.64	1	−10.54	2	2.78	5
Southwest	−7.39	4	−0.89	4	5.37	6
Middle East	4.87	6	10.48	7	6.88	7
Mediterranean	6.72	7	14.00	8	31.51	8

*In the remainder of this paper, mobility information, if used in absolute terms, refers to *migrant* streams or flows and if used in relation to the at-risk population, *migration* proportions or rates.

their rate increase, whereas the last one (Paris Region) had its rate decrease and even become negative in 1968–1975. Among the five ZEATs with a negative rate in 1954–1962, three had a positive rate in 1968–1975.

The variation of the annual rates between the extreme periods allows us to distinguish (see Figure 22)

(a) three ZEATs with a negative variation (the Paris Region, East, and North)
(b) three ZEATs with a positive variation less than 20 percent (the Middle East, Paris Basin, and Southwest)
(c) two ZEATs with a positive variation more than 20 percent (the West and Mediterranean)

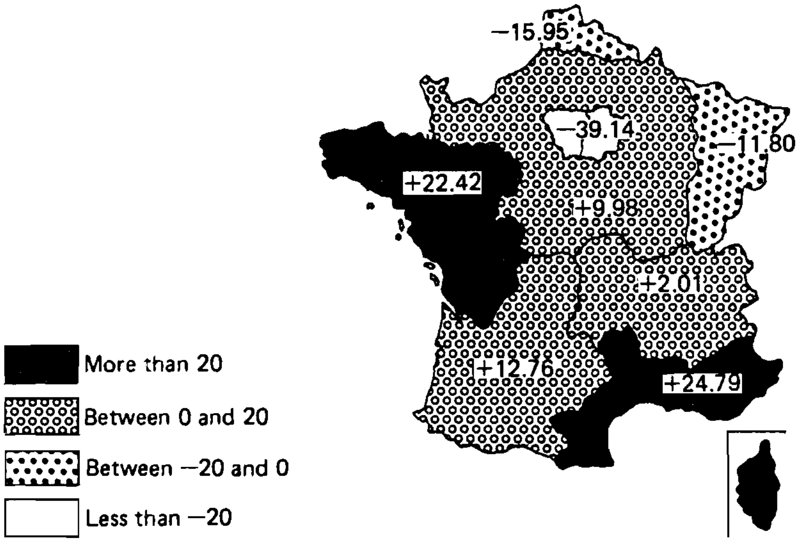

FIGURE 22 Average change in annual net migration rates between first and third intercensal periods (per 10000): ZEATs.

The conclusion here is that, over the last 25 years geographical redistribution of population in France experienced a substantial modification.

To clarify this modification, we will now examine the net migrant streams observed between each pair of ZEATs. Because it is difficult to construct migration rates that would allow for a meaningful comparison from one period to another, we will concentrate on the signs of the net migrant streams.

Of the many plausible hypotheses concerning these streams, we will test the following extremes. The first supposes that the net migrant flow of a ZEAT results from a migration exchange with a small number of neighboring ZEATs, the remaining ZEATs having virtually no impact on this flow. The alternative hypothesis imagines a coherent interaction between all of the ZEATs such that each ZEAT gains population from less attractive ZEATs and loses population to those that are more attractive.

To determine which of these two hypotheses prevails in reality, we rank the ZEATs according to their number of positive net migrant streams with other ZEATs. Table 17 indicates, for each of the last three intercensal periods, this ranking, as well as the values of the net migrant streams when they are positive for the destination ZEAT.

The figures displayed support the second hypothesis (that of a strong interaction between all ZEATs) because no element appears above the diagonal in the first and last intercensal periods and only one element (the net migrant stream between the Paris Region and the Paris Basin) in the second period.

Note that the ranking of the ZEATs according to their number of positive net migrant streams is, in each period, identical to the ranking based on increasing values of the net migration rate (see Table 16). The only exceptions are the Middle East and Mediterranean ZEATs, the order of which is reversed in both the 1954–1962 and 1962–1968 periods, and the Paris Basin and Southwest ZEATs for the 1954–1962 period only.

Focusing exclusively on the change in the ranking order of the ZEATs according to the number of net positive streams between the extreme periods 1954–1962 and 1968–1975, we can distinguish three groups of ZEATs. The first group consists of the ZEATs that have gained at least two ranks. It includes:

(a) the West ZEAT, which moved from rank 1 in the first period (zero positive net stream) to rank 5 in the last period (four positive net streams with the ZEATs of the northeastern half of France)
(b) the Southwest ZEAT, which moved from rank 3 (two positive net streams with the West and North ZEATs) to rank 6 (three additional positive net streams)
(c) the Mediterranean ZEAT, which moved from rank 6 (two negative net streams with the Middle East ZEAT and Paris Region) to rank 8 (positive net streams with all of the ZEATs)

The second group contains the ZEATs with a rank change of less than two units. It includes:

(a) the Paris Basin, which occupied rank 4 in both extreme periods (note positive net streams with the Paris Region and East ZEATs in the last period instead of positive net streams with the West and Southwest ZEATs as in the first period)
(b) the Middle East ZEAT, which remained at rank 7 (its only negative net stream was with the Paris Region in the first period and the Mediterranean ZEAT in the last period)
(c) the North ZEAT, which switched from rank 2 to rank 1 (losing in the process its only net positive stream with the West ZEAT)

TABLE 17 Net migrant streams between the eight ZEATs: intercensal periods 1954–1962, 1962–1968, and 1968–1975.

a. 1954–1962	West	North	Southwest	Paris Basin	East	Mediterranean	Middle East	Paris Region
1. West	–							
2. North	1 566	–						
3. Southwest	12 621	2 442	–					
4. Paris Basin	28 265	5 984	629	–				
5. East	6 703	5 558	4 027	8 417	–			
6. Mediterranean	11 287	7 724	8 768	13 230	7 966	–		
7. Middle East	7 000	4 240	11 377	17 424	8 186	1 310	–	
8. Paris Region	125 987	24 855	49 448	109 528	14 616	631	10 033	–

b. 1962–1968	North	West	East	Southwest	Paris Basin	Paris Region	Mediterranean	Middle East
1. North	–							
2. West	2 424	–						
3. East	3 896	1 344	–					
4. Southwest	4 536	10 468	1 932	–				
5. Paris Basin	16 992	15 028	272	15 028	–	11 708		
6. Paris Region	23 752	40 616	11 540	40 616		–		
7. Mediterranean	9 988	7 864	15 232	7 864	18 652	26 208	–	
8. Middle East	9 632	7 752	11 856	7 752	18 004	9 208	4 724	–

c. 1968–1975	North	East	Paris Region	Paris Basin	West	Southwest	Middle East	Mediterranean
1. North	–							
2. East	6 050	–						
3. Paris Region	40 735	16 515	–					
4. Paris Basin	30 970	4 270	82 600	–				
5. West	7 285	3 220	27 345	10 600	–			
6. Southwest	9 585	9 070	24 585	17 685	6 325	–		
7. Middle East	15 120	17 410	21 010	22 860	4 560	4 510	–	
8. Mediterranean	24 130	40 800	68 905	47 985	11 425	21 635	28 440	–

SOURCES: Data taken from Schiray and Elie 1970, pp. 14, 15 for the period 1954–1962; from Desplanques 1975, p. 24 for the period 1962–1968; from INSEE 1977 for the period 1968–1975.

Finally, the third group consists of the two ZEATs that have lost at least two ranks:

(a) the East ZEAT, which moved from rank 5 to rank 2 (losing its net positive streams with the Paris Basin, West, and Southwest ZEATs)
(b) the Paris Region, which switched from rank 8 (with positive net streams with all of the ZEATs) to rank 3 (keeping positive net streams with only the North and East ZEATs)

Thus the third quarter of this century has seen a profound modification of space perception in France, leading to a significant change in spatial migration patterns characterized by the rise of the southwestern half of the country (see Figure 23).

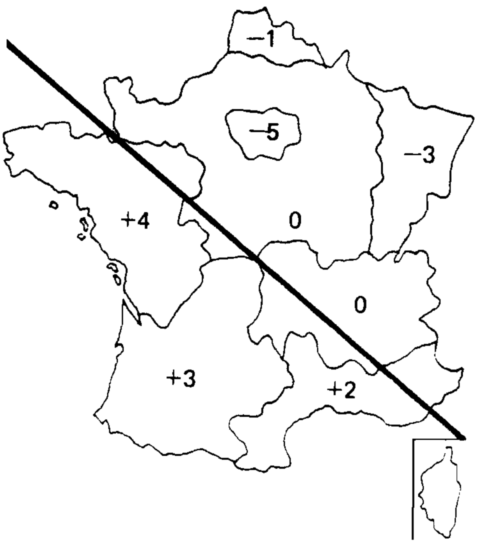

FIGURE 23 Ranking order of the ZEATs according to number of positive net migrant streams: change between the period 1954–1962 and the period 1968–1975.

GROSS MIGRANTS

We continue our study of the evolution of mobility between ZEATs by analyzing the modifications that have affected the gross migrant flows. Figure 24 shows the evolution of the in-migrant to out-migrant ratio for each ZEAT. Not too surprisingly, this figure leads to a result that is similar to the one suggested earlier by the evolution of the net number of migrants, that is, a sustained variation of this ratio in all ZEATs (except the Middle East): downward for the Paris Region, North, and East ZEATs and upward for the Paris Basin, West, Southwest, and Mediterranean ZEATs.

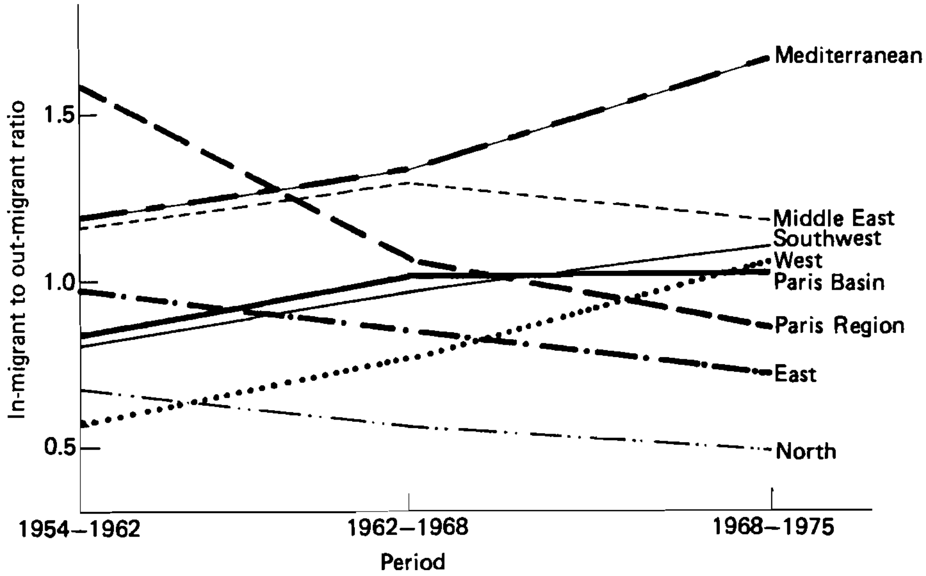

FIGURE 24 Ratio of in-migrant to out-migrant flows for the eight ZEATs: intercensal periods 1954–1962, 1962–1968, and 1968–1975. Sources: Calculations are based on data taken from Schiray and Elie 1970, pp. 14, 15 for the period 1954–1962; Desplanques 1975, p. 24 for the period 1962–1968; INSEE 1977 for the period 1968–1975.

In addition, Figure 24 shows that the magnitude of the variation in the in-migrant to out-migrant ratio observed between the first two periods, on the one hand, and the last two periods, on the other hand, is roughly similar. A substantive deceleration, however, can be seen in the case of the Paris Basin (and of course the Middle East), and a significant acceleration in the case of the Mediterranean ZEAT.

We will now examine the evolution of the gross in- and out-migrant flows. Focusing first on the out-migrant flows, for each ZEAT we estimate an annual out-migration proportion that is derived in the same way as the aggregate annual migration proportion calculated earlier (see Table 15).

According to the values of this proportion for the first and third periods (Table 18), the Paris Region and the Paris Basin had much higher out-migration proportions than the other ZEATs. The discrepancy between these two groups of ZEATs, however, was larger in the 1968–1975 period than in the 1954–1962 period. Moreover, the annual migration proportions of all ZEATs other than the Paris Region and Paris Basin appear to converge from the first to the third period. Whereas they ranged from 5.5 to 8.9 per thousand in 1954–1962, they took on values in 1968–1975 such that their extremes were separated by only 0.9 per thousand (from 8.6 to 9.5 per thousand).

All of the ZEATs saw their annual out-migration proportion increase between the two periods considered, but the increase was not uniform. The

TABLE 18 Annual out-migration proportion (per thousand) for the eight ZEATs: intercensal periods 1954–1962 and 1968–1975.

ZEAT	Intercensal period 1954–1962	Intercensal period 1968–1975	Percent increase between 1954–1962 and 1968–1975
Paris Region	9.0	16.0	77.8
Paris Basin	9.8	12.0	22.5
North	5.5	9.4	70.9
East	5.6	9.4	67.9
West	8.9	9.0	1.1
Southwest	7.5	9.5	26.9
Middle East	5.6	8.6	54.3
Mediterranean	6.9	9.2	33.1
All ZEATs	7.6	10.8	42.1

annual out-migration proportion grew faster than the national average (+42.1 percent) for the Paris Region (+77.8 percent), the North (+70.9 percent), the East (+67.9 percent), and the Middle East (+54.3 percent) and slower for the Mediterranean (+33.1 percent), the Southwest (+26.9 percent), the Paris Basin (+22.5 percent), and the West where the increase was small (+1.1 percent).

In the case of the flows into each ZEAT, we estimate an annual average. According to the values relating to the first and third intercensal periods, which are given in Table 19, the annual inflow to all of the ZEATs has increased. Again, we can distinguish two groups of ZEATs. The first group consists of those ZEATs with an increase smaller than the national average (+61.3 percent): the Paris Region (+14.6 percent), the North (+30.3 percent), and the East (+42.8

TABLE 19 Annual inflow of migrants (in thousands) for the eight ZEATs: intercensal periods 1954–1962 and 1968–1975.

ZEAT	Intercensal period 1954–1962	Intercensal period 1968–1975	Percent increase between 1954–1962 and 1968–1975
Paris Region	112.9	129.4	14.6
Paris Basin	69.2	115.1	66.3
North	13.2	17.2	30.3
East	22.9	32.8	42.8
West	30.5	64.1	110.2
Southwest	30.1	58.1	93.0
Middle East	33.2	59.3	78.6
Mediterranean	36.2	85.7	136.7
All ZEATs	348.2	561.6	61.3

percent). The other group includes the Paris Basin (+66.3 percent), the Middle East (+78.6 percent), the Southwest (+93.0 percent), the West (+110.2 percent), and the Mediterranean (+136.7 percent).

Note that the orderings of the ZEATs according to increasing values of the variations in the out-migration proportion and to decreasing values of the variations in the in-migrant flow are very similar.* This suggests the existence of an inverse relationship between the changes in the out-migration proportion and the in-migrant flow that is graphically illustrated by Figure 25 (the correlation between the two variables equals −0.788). In other words, the ZEAT that becomes comparatively more attractive to people residing elsewhere is also the one in which the dissatisfaction felt by residents grows comparatively slower.

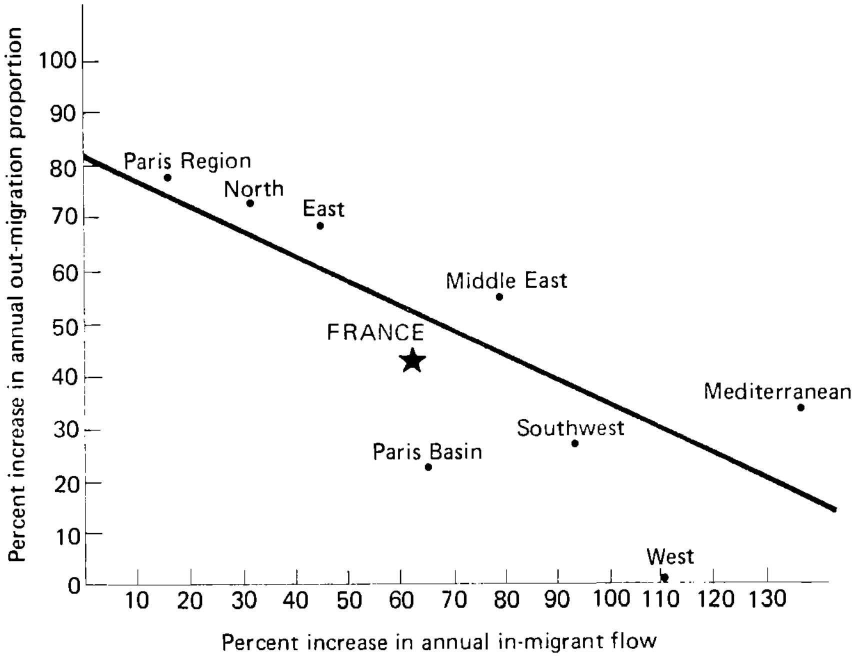

FIGURE 25 Relation between percent increases (from the period 1954–1962 to the period 1968–1975) in annual out-migration proportion and in annual in-migrant flow.

Further insights into the mobility between ZEATs can be gained by examining the variations in the gross migrant streams from one intercensal period to the next. For each migrant stream matrix shown in Table 20, a transition probability matrix (not shown here) is obtained by dividing each element by the sum

*The only peculiarities concern the Paris Basin and Mediterranean ZEATs, the very two ZEATs in which the variations of the in- to out-migrant ratio went on to experience an abrupt change of pace between the last two census periods.

TABLE 20 Gross migrant streams between the eight ZEATs: intercensal periods 1954–1962, 1962–1968, and 1968–1975.[a]

ZEAT of destination	ZEAT of origin							
	Paris Region	Paris Basin	North	East	West	Southwest	Middle East	Mediterranean
a. 1954–1962								
Paris Region	7 084 937	339 500	49 065	51 690	208 798	114 293	64 424	75 764
Paris Basin	229 972	7 864 739	52 490	55 256	106 013	38 774	45 389	26 199
North	24 210	46 506	3 487 928	7 633	9 999	6 726	5 383	5 394
East	37 074	63 673	13 191	4 063 065	17 271	16 568	19 850	15 988
West	82 811	77 748	8 433	10 568	5 983 637	38 430	9 881	16 219
Southwest	64 845	38 145	9 168	12 541	51 051	4 681 714	22 200	42 613
Middle East	54 391	62 813	9 623	28 036	16 881	33 577	4 809 080	60 255
Mediterranean	75 133	39 429	13 118	23 954	27 506	51 381	58 945	3 871 022
b. 1962–1968								
Paris Region	7 904 780	250 292	45 864	46 528	151 428	95 972	57 768	73 884
Paris Basin	262 000	8 267 976	54 996	56 204	93 912	37 660	46 200	29 792
North	22 112	38 004	3 637 172	8 524	7 252	5 928	4 308	6 940
East	34 988	55 932	12 420	4 341 096	15 428	15 220	19 584	17 884
West	110 812	78 884	9 676	14 084	6 134 152	37 652	12 280	20 692
Southwest	86 876	42 532	10 464	17 152	48 120	4 838 764	25 844	42 948
Middle East	66 976	64 204	13 940	31 440	20 032	34 024	5 135 696	68 780
Mediterranean	100 092	48 444	16 928	33 116	28 556	53 108	64 056	4 338 156
c. 1968–1975								
Paris Region	8 372 620	301 340	73 025	66 510	160 285	118 595	80 945	106 485
Paris Basin	383 940	8 627 690	77 050	77 140	110 835	46 570	68 370	42 065
North	32 290	46 080	3 730 760	11 275	8 820	6 875	7 090	7 840
East	49 995	72 870	17 325	4 504 040	19 035	18 300	27 320	24 405
West	187 630	121 435	16 105	22 255	6 362 235	51 250	21 670	28 500
Southwest	143 180	64 255	16 460	27 370	57 575	5 022 445	37 490	60 625
Middle East	101 955	91 230	22 210	44 730	26 230	42 000	5 502 165	86 805
Mediterranean	175 390	90 050	31 970	65 205	39 925	81 900	115 245	4 867 405

[a]In each matrix, the diagonal elements refer to people who were residing in the same ZEAT at the start and end of the corresponding period.

SOURCES: Data taken from Schiray and Elie 1970, pp. 14, 15 for the period 1954–1962; from Desplanques 1975, p. 24 for the period 1962–1968; from INSEE 1977 for the period 1968–1975.

of the elements in the column to which it belongs; its i,jth element gives the probability that an individual residing in ZEAT j at the beginning of the relevant period will live in ZEAT i at the end of the period. But, because the length of the three intercensal periods is unequal, a direct comparison of the corresponding elements in the transition probability matrices for the three periods is not meaningful. Therefore, instead, we will compare the allocation, among destination ZEATs, of the migrant flow out of each ZEAT (obtained by removing the diagonal elements of the matrix of streams and dividing the off-diagonal elements by their corresponding column sums).

The figures in Table 21 contrast the allocation, by ZEAT of destination, of the total migrant flow out of each ZEAT in the first and third periods. First, the relative attraction exerted by the Paris Region, North, and East ZEATs on the other ZEATs declined between the two periods. For the Paris Region, the decline of the relative attraction exerted on the Paris Basin and West ZEATs was especially substantial. Second, three ZEATs – the West, the Southwest, and especially the Mediterranean – became comparatively more attractive to migrants from all ZEATs, with minor exceptions.* Third, the relative attraction of the remaining two ZEATs decreased or increased depending upon to which ZEAT it was exerted. The general tendency, however, appears to have been a declining relative attraction of the Paris Basin and an increasing relative attraction of the Middle East.

Finally, how are the two patterns of change just described – changes in out-migration proportions and in the allocation of out-migrant flows by ZEAT of destination – responsible for the evolution of the net migrant flows noted earlier?

To answer this question, we must calculate, for each ZEAT, the number of net migrants that would have been observed in 1968–1975 if the out-migration proportions, the allocation of the outflows by ZEAT of destination, or both had remained equal to their 1954–1962 values. The results relating to these three alternative assumptions are displayed in columns (1)–(3), respectively, of Table 22. Column (4) shows the actual number of net migrants.** Thus the increase in the out-migration proportions alone would not have resulted in the reversal observed in the balance of migrants for the Paris Region, Paris Basin, and West ZEATs and would have made the one for the Southwest ZEAT barely possible. Also, the change in the outflow allocation by ZEAT of destination alone would have been insufficient to allow such reversals in all four ZEATs except the Paris Basin.

*These minor exceptions are the East ZEAT, which became comparatively more attractive to migrants from the West and Mediterranean ZEATs, and the Southwest ZEAT, which became comparatively less attractive to migrants from the Mediterranean ZEAT.

**Note that the figures in column (1) differ from the actual number of net migrants observed in 1954–1962 owing to the slightly shorter length of the 1968–1975 period and especially to the evolution between 1954 and 1968 of the at-risk populations.

TABLE 21 Allocation by destination ZEAT of the migrant flow out of the eight ZEATs (in percent): intercensal periods 1954–1962 and 1968–1975.

ZEAT of destination	ZEAT of origin: Paris Region 1954–1962	Paris Region 1968–1975	Paris Basin 1954–1962	Paris Basin 1968–1975	North 1954–1962	North 1968–1975	East 1954–1962	East 1968–1975
Paris Region	–	–	50.82	38.29	31.64	28.74	27.24	21.14
Paris Basin	40.46	35.74	–	–	33.85	30.32	29.13	24.53
North	4.25	3.01	6.96	5.84	–	–	4.01	3.59
East	6.52	4.65	9.53	9.26	8.50	6.82	–	–
West	14.57	17.47	11.64	15.43	5.43	6.33	5.56	7.08
Southwest	11.40	13.33	5.71	8.16	5.92	6.48	6.61	8.70
Middle East	9.57	9.49	9.40	11.59	6.20	8.73	14.77	14.22
Mediterranean	13.22	16.33	5.90	11.44	8.46	12.57	12.62	20.73

ZEAT of destination	West 1954–1962	West 1968–1975	Southwest 1954–1962	Southwest 1968–1975	Middle East 1954–1962	Middle East 1968–1975	Mediterranean 1954–1962	Mediterranean 1968–1975
Paris Region	47.73	37.91	38.13	32.45	28.49	22.60	31.25	29.87
Paris Basin	24.23	26.23	12.93	12.74	20.07	19.10	10.81	11.80
North	2.29	2.09	2.24	1.89	2.38	1.98	2.22	2.20
East	3.95	4.51	5.53	5.01	8.78	7.63	6.60	6.85
West	–	–	12.81	14.02	4.37	6.05	6.68	8.00
Southwest	11.67	13.63	–	–	9.82	10.47	17.58	16.92
Middle East	3.86	6.21	11.20	11.50	–	–	24.86	24.36
Mediterranean	6.28	9.43	17.13	22.41	26.08	32.19	–	–

TABLE 22 Net migrant flows for the eight ZEATs under various no-change assumptions (based on 1954–1962 flows) and actual flows: 1968–1975.

ZEAT	No-change assumptions			
	Out-migration proportions (1)	Allocation by destination (2)	Out-migration proportions and allocation by destination (3)	Actual (4)
Paris Region	93.0	46.3	269.2	−167.2
Paris Basin	−120.0	85.2	−83.6	18.8
North	−65.6	−106.8	−46.4	−133.9
East	−23.1	−55.9	−5.1	−85.2
West	−104.3	−56.9	−163.6	26.1
Southwest	4.6	−15.0	−37.2	41.1
Middle East	70.1	26.8	43.9	57.0
Mediterranean	145.4	76.3	23.2	243.3

The figures set out for each ZEAT in Table 22 readily allow an assessment of the contribution of each phenomenon to the evolution of the total net balance of migrants. The two measures shown in columns (6) and (7) of Table 23* indicate that, in six out of eight ZEATs, both phenomena act in the same direction.

TABLE 23 Impact on the number of 1968–1975 net migrants due to changes in out-migration proportions and allocation by destination based on 1954–1962 flows.

ZEAT	Due to change in			
	Out-migration proportions and allocation by destination (5) = (4) − (3)[a]	Out-migration proportions (6) = (4) − (2)	Allocation by destination (7) = (4) − (1)	Residual (8) = (5) − (6) − (7)
Paris Region	−436.4	−222.9	−176.2	−37.3
Paris Basin	102.4	168.8	−36.4	−30.0
North	−87.5	−60.4	−19.2	−7.9
East	−80.1	−50.8	−18.0	−11.3
West	189.7	106.7	59.3	23.7
Southwest	78.3	22.2	41.8	14.3
Middle East	13.1	−17.1	26.2	4.0
Mediterranean	220.1	53.1	122.2	44.8

[a]The numbers (1) through (4) refer to columns in Table 22.

*Note that the sum of these two measures does not exhaust the total net migrant change due to the conjunction of the two phenomena. There always exists a residual, given in column (8) of the same table, which results from the interaction of the two phenomena.

In such a case, the change in the out-migration proportions has a greater impact than the change in the outflow allocation for the Paris Region, North, East, and West ZEATs, whereas the situation is reversed for the Southwest and Mediterranean ZEATs. Also, observe that the evolution of the out-migration proportions (in the case of the Middle East ZEAT) and the change in the outflow allocation (in the case of the Paris Basin) have an impact that goes in the direction opposite to that observed.

2.8 *Migrant Age Profiles*

Thus far, our analysis of internal migration at the level of France's eight-ZEAT system has focused on the entire population regardless of age. In this subsection, we enlarge our investigations by focusing on the relationship between interregional migration and age.

NET MIGRANT FLOWS

Figure 26 presents eight diagrams, one for each ZEAT, which contrast the age variations of the average annual net migrant flow in the first and last of the three intercensal periods (1954–1962 and 1968–1975). Each ZEAT-specific diagram was obtained in the following way. For both observation periods, the number of net migrants in the age intervals 0–9,* 10–19, 20–24, 25–34, 35–44, 45–54, 55–64, and 65+ was divided by the length of the period and the width of the relevant age group. The resulting figures – which represent the annual net migrant flow common to all single-year groups in each age interval – were plotted on the diagram as ordinates associated with abscissas corresponding to the middle of the various age intervals. (A slightly different treatment was used for the last age group.)

In general, the net migrant age profiles have the shape of a V or an inverted V which forms a more or less sharp peak for the ages corresponding to young adulthood. The peak is especially apparent for four of the ZEATs; it is directed downward for the Paris Region, and upward for the Paris Basin, West, and Southwest ZEATs.

Moreover, the age profiles are located on both sides of the horizontal axis, thus indicating that the balance of migrants in some age groups has a sign opposite to that of the balance of migrants in other age groups. Exceptions occur in the North ZEAT for both periods and the Middle East and Mediterranean ZEATs for the 1968–1975 period. In most instances, the net migrant flows for young adults and for the elderly often have opposite signs, an observation that especially holds in both periods for those four ZEATs that have a net migrant profile with a sharp peak.

For each ZEAT, comparison of the migration age profiles in the two intercensal periods reveals no important modification (with a slight exception for

*Any individual born during the observation period is considered as a migrant if, at the end of this period, he lives in a ZEAT different from the one in which his mother resided at the beginning of the period.

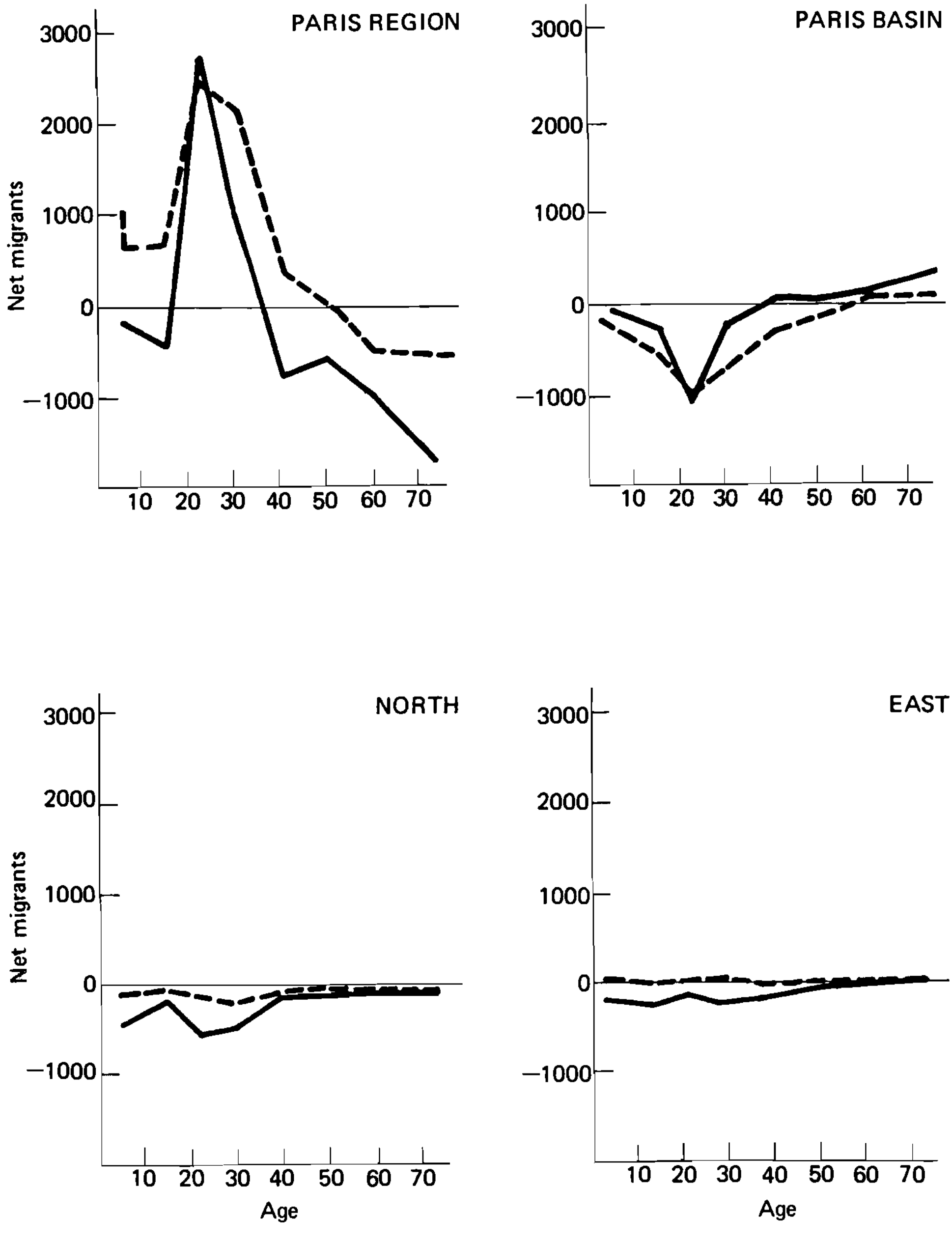

FIGURE 26 Age decomposition of the average annual net migrant flow into the ZEATs: 1954–1962 (– – –) and 1968–1975 (——). Note: The age scale refers to age at the end of the observation period. Sources: 1954–1962 data taken from unpublished 1962 census results; 1968–1975 data taken from unpublished material obtained from INSEE's Economic Observatory of Paris.

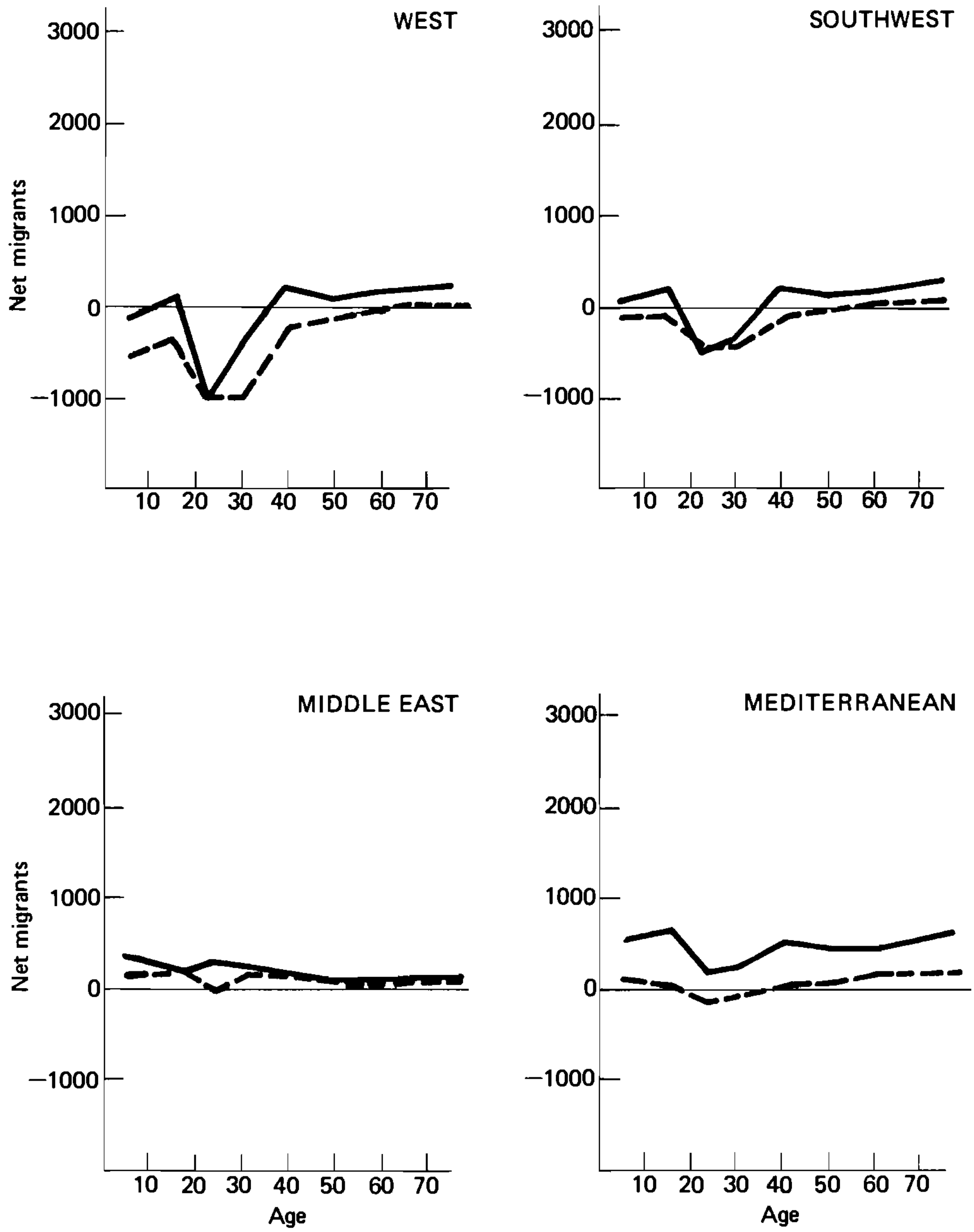

FIGURE 26 *(continued).*

the Middle East). It appears, however, that, between the 1954–1962 and 1968–1975 periods, in all of the ZEATs the annual flow of net migrants in each age group evolved in the same direction as the aggregate net flow. The magnitude of the evolution differed substantially with age except for the Mediterranean ZEAT where this magnitude was rather homogeneous over the whole spectrum. Thus the change observed is larger for younger than older age groups in the North, East, and Middle East ZEATs but virtually nil in the Paris Region, Paris Basin, West, and Southwest ZEATs.

Clearly, the most interesting migration age profiles are those of the four ZEATs just listed, which are also the ZEATs that recently showed a reversal in their net balance of migrants. The intermediate part of these profiles, unlike the rest, does not cross the horizontal axis so that the balance of net migrants in the intermediate ages still has the traditional sign.

It should be noted that the above results are based on a coarse breakdown of the age spectrum imposed by the available 1954–1962 migrant data. Fortunately, for the period 1968–1975, we have more detailed information available at the level of 5-year age groups (see Table 24). Such information allows us to determine more precisely, for each of the four sharp-peaked ZEATs, the age brackets that did not experience the net migrant reversal noted at the level of the total population. The age groups concerned are, in all cases, the 20–24, the 25–29, and the 0–4, which presumably refers to the children of the members of the two preceding groups.

Can we assess the relative importance of the phenomenon just described across the four ZEATs? For this purpose, we calculate, for each ZEAT, the sum of all the age-specific net flows having the same sign as the total net flow and the sum of all the age-specific net flows with the opposite sign. We then derive the ratio of the former to the latter, the absolute value of which is shown in column (3) of Table 25. Of course, the smaller this value, the smaller the magnitude of the age-specific net flows in the opposite direction to the general migration flow. The counterflow is less important for the Paris Region and Southwest ZEATs than for the Paris Basin and West ZEATs.

Having examined all age groups, let us turn to the fraction of the population ages 20 to 54 who contribute the most to labor supply. For the four sharp-peaked ZEATs, the net migrant flow of this segment of the population has the sign opposite to that of the total net migrant flow. We therefore conclude that *the previously observed reversal in the net migration exchange of the four ZEATs with the rest of the nation does not appear to apply to the working-age population.*

Column (6) of Table 25 gives the absolute value of a ratio similar to that in column (3), the difference being that it is calculated with regard to the 20–54-year-old population instead of the total population. The values obtained, which are greater than one (because the counterflows are predominant in this subpopulation), indicate that the sum of the age-specific counterflows is relatively less important in the Southwest ZEAT than in the Paris Region, the West, and the Paris Basin ZEATs in that order. In the case of the Paris Basin, the sum

TABLE 24 Age-specific net migrant flows for the eight ZEATs: 1968–1975.

	ZEAT							
Age group in 1975	Paris Region	Paris Basin	North	East	West	Southwest	Middle East	Mediterranean
0–4	16 085	–1 830	–19 420	–5 480	–11 440	–4 185	9 595	13 015
5–9	–30 940	5 230	–13 810	–10 010	8 805	9 590	7 480	23 655
10–14	–28 535	–2 525	–8 480	–11 330	12 465	10 255	3 570	24 580
15–19	–6 265	–7 885	–8 030	–7 930	1 950	5 730	2 485	19 945
20–24	98 135	–35 240	–20 095	–5 850	–32 735	–17 890	7 710	5 965
25–29	90 370	–12 745	–24 795	–8 555	–31 550	–23 955	9 560	1 670
30–34	–20 715	6 785	–9 490	–7 345	6 510	3 550	4 605	16 100
35–39	–32 995	5 220	–6 520	–7 915	11 785	8 090	4 005	18 330
40–44	–25 025	1 750	–4 900	–6 295	8 880	7 090	1 595	16 905
45–49	–19 595	1 780	–4 615	–5 275	6 215	5 450	1 870	14 170
50–54	–21 795	3 375	–3 580	–3 585	5 275	4 950	805	14 555
55–59	–23 450	5 415	–2 800	–1 975	6 145	4 355	575	11 735
60–64	–46 125	12 600	–2 570	–1 480	11 025	8 355	685	17 510
65–69	–56 555	18 575	–1 850	–1 070	12 640	8 860	1 060	18 340
70–74	–36 320	10 485	–1 000	90	6 995	6 465	900	12 385
75–79	–12 685	2 560	–755	–95	1 965	2 345	730	5 935
80–84	–5 945	1 300	–460	–255	880	1 215	565	2 700
85+	–3 895	1 095	–390	–125	545	875	180	1 715
All age groups[a]	–166 250	19 605	–133 560	–84 480	26 355	41 145	57 975	239 210
Ages 20–54	68 380	–29 075	–73 995	–44 820	–25 620	–12 715	30 150	87 695

[a]Note that the net migrant total for each ZEAT differs slightly from the total given in Figure 14 or Table 22. Such a discrepancy is due to the use of different sampling levels.

SOURCE: Calculated from unpublished mobility data obtained from INSEE's Economic Observatory of Paris.

TABLE 25 Comparison of the sums of negative and positive age-specific net migrant flows for selected ZEATs: 1968–1975.[a]

	Net migrant flow					
	All age groups			Ages 20–54		
ZEAT	(1)	(2)	(3) = –(2)/(1)	(4)	(5)	(6) = –(5)/(4)
Paris Region	–370 840	+204 590	0.55	–120 125	+188 505	1.56
Paris Basin	+79 830	–60 225	0.75	+18 910	–47 985	2.56
West	+102 080	–75 725	0.74	+38 665	–64 285	1.66
Southwest	+87 175	–46 030	0.53	+29 130	–41 845	1.43

[a]Columns (1) and (4) give the sum of all age-specific net flows having the same sign as the total net flow and columns (2) and (5) give the sum of all age-specific net flows having the sign opposite to that of the total net flow.

of the age-specific counterflows is about 2.5 times the sum of the age-specific flows with the same sign as the total net migrant flow.

Of course, there is no such thing as a net migrant; this is a notion that simply arises from an arithmetic concept. Thus, to obtain a better idea of the role of age in interregional migration, we now examine a more meaningful concept which involves consideration of the population at risk of migrating.

GROSS MIGRATION RATES

The main idea here is to parallel the traditional mortality and fertility analyses. We thus start by defining and estimating meaningful disaggregate migration rates based on an occurrence/exposure measure. Unfortunately, because of the type of mobility information available, such a task is not straightforward. Thus, in conjunction with the multiregional methodology discussed in the next section, we have used the migration and population data shown in Appendix A to calculate, for the period 1968–1975 only, annual migration rates (relating to 5-year age groups by sex) by ZEATs of destination. These rates, however, somewhat underestimate the true occurrence/exposure rates that we would ideally like to calculate, since they fail to capture adequately multiple and return moves.

Appendix B gives for each ZEAT the age-specific values of the various migration rates by sex. The ensuing values of the gross migraproduction rate (GMR), a synthetic measure for migration that plays the same role as does the gross reproduction rate for fertility,* are shown for males and females in Appendix B and for both sexes aggregated in Figure 27. On the basis of the latter, we can distinguish in order of increasing mobility

*Defined as the sum of the age-specific out-migration rates multiplied by the length of the typical age interval (Rogers 1975b), such a measure constitutes a true index of migration propensity – that is, devoid of any mortality effect – attached to the regions to which it applies.

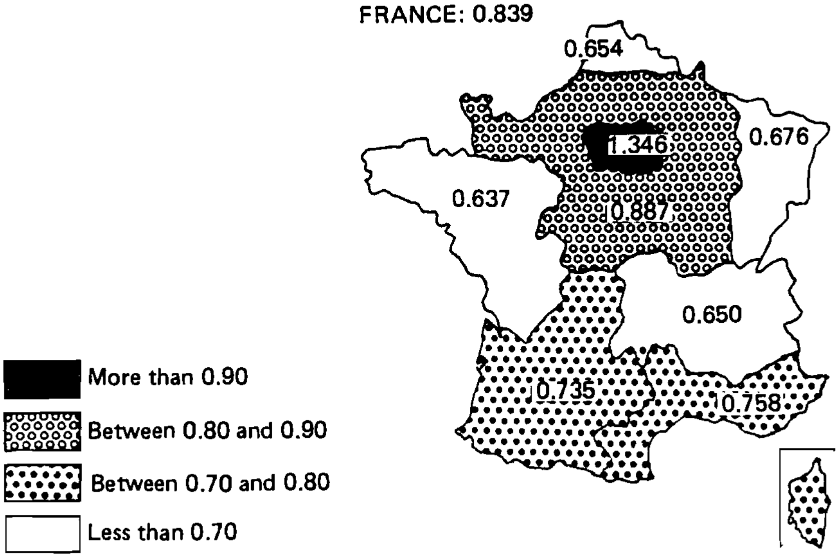

FIGURE 27 Gross migraproduction rates: ZEATs, both sexes aggregated, 1968–1975.

(a) four ZEATs – the North, East, West, and Middle East – with relatively low GMRs ranging from 0.64 to 0.68
(b) two ZEATs – the Southwest and Mediterranean – with slightly higher GMRs of 0.73 and 0.76, respectively
(c) the Paris Basin with an even higher GMR (0.89)
(d) the Paris Region with a definitely higher GMR of 1.35

Although the age-specific migration rates are generally similar for both sexes, the male GMR is slightly higher than the female GMR because of higher migration rates in the most mobile age groups. This, however, does not hold true for the three ZEATs in which the female out-migration rate peaks before its male counterpart: the Paris Basin, West, and Southwest.

Finally, bringing mortality into the picture, Figure 28 displays for all ZEATs the value of the net migraproduction rate for both sexes aggregated. Because the mortality differentials between ZEATs are relatively small, the introduction of mortality leaves the earlier picture of the gross migraproduction rates relatively unchanged.

We will now continue the analysis by examining more closely how differentials, across ZEATs, in the total migration rates vary over the age spectrum. Figure 29 illustrates the age profiles associated with migration out of the eight ZEATs for both sexes aggregated.

For all ZEATs except the Paris Region, the profile exhibits the following age variations. After an initial decline, the total out-migration rate reaches a

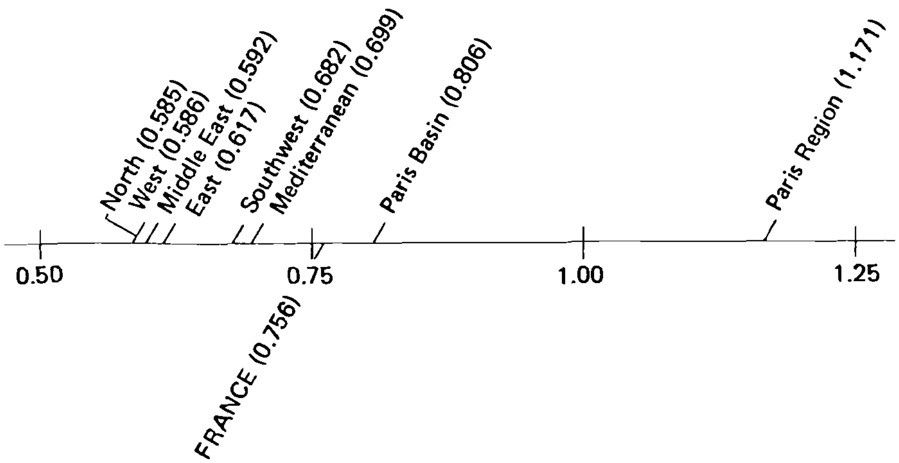

FIGURE 28 Net migraproduction rates: ZEATS, both sexes aggregated, 1968–1975.

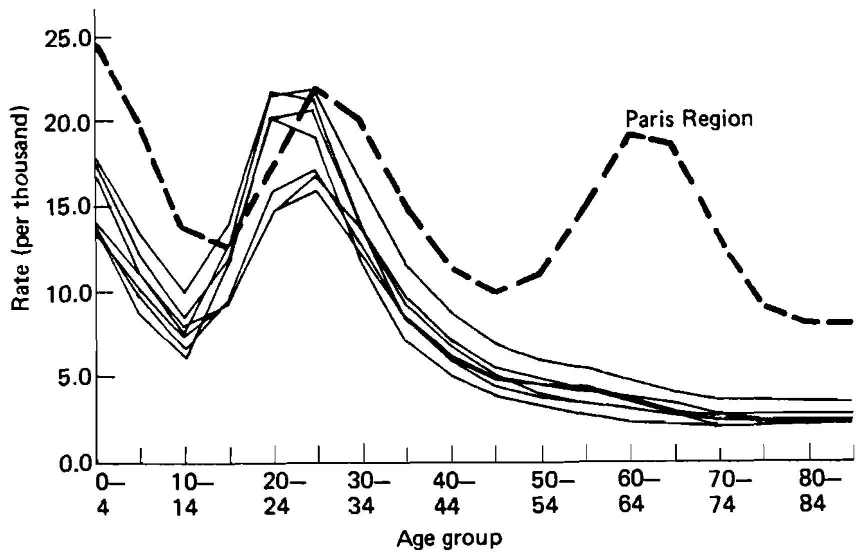

FIGURE 29 Age variations of the total out-migration rates: ZEATs, both sexes aggregated, 1968–1975. Note: No effort is made here to distinguish the age profiles relating to the ZEATs other than the Paris Region because the point of this figure is precisely to show a certain similarity between those age profiles.

local minimum in the 10–14 age group. Rising sharply within the next two age groups, it then reaches in the 25–29 age group (in some instances the 20–24 age group) a local maximum that is significantly higher than the corresponding rate in the first age group. After this, it declines substantially, leveling out after the 70–74 age group.

In the case of the Paris Region, the initial decline of the migration rate is prolonged to the 15–19 age group, and accordingly, the rise that follows occurs with an apparent 5-year delay. The local maximum, however, which is smaller than the total out-migration rate in the first age group, still occurs in the 25–29 age group. After this peak, the migration rate declines rather slowly before it increases again in the 45–49 age group. It then reaches a plateau for the two 5-year age groups between ages 60 and 70 and eventually declines. The relatively high level of the latter plateau – the total out-migration rate in the age groups 60–64 and 65–69 – is similar to the value it takes on in the most mobile age groups 25–29 and 30–34.

Earlier, we noticed a broad similarity between the age profiles of all the ZEATs except the Paris Region. But how similar are they really? To answer this question we turn to the methodology developed by Rogers et al. (1978) to calculate model migration schedule parameters.

Briefly, this methodology divides an age profile based on out-migration rates into three parts (see Figure 30):

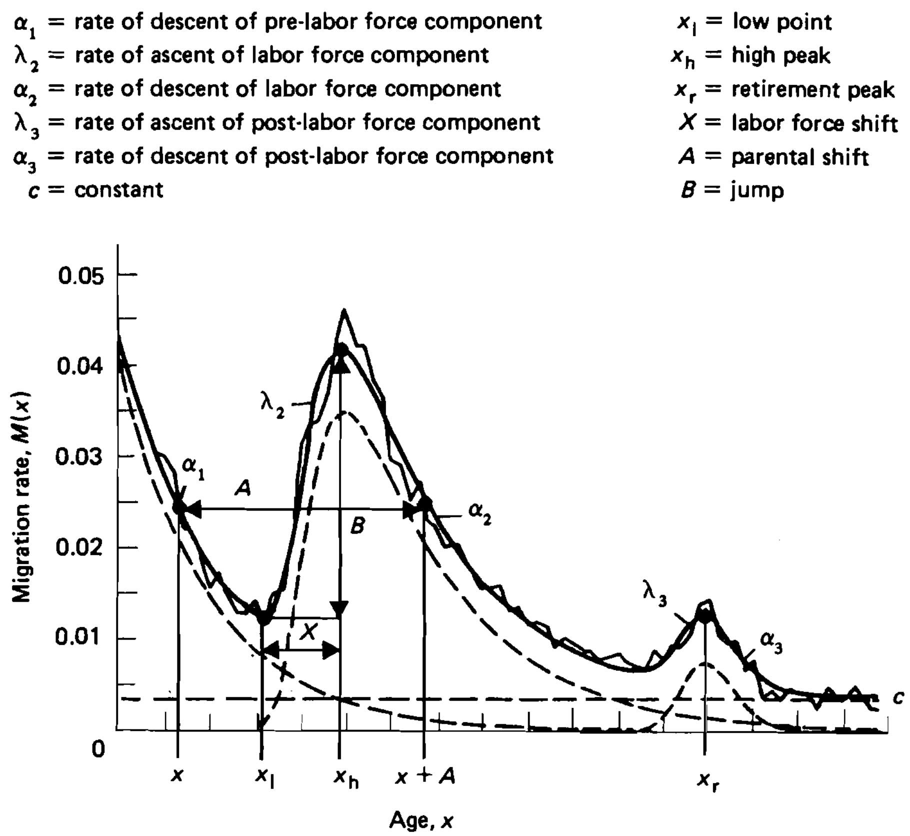

FIGURE 30 The model migration schedule. Source: Rogers and Castro 1981, p. 6.

(a) a single negative exponential curve describing the migration rate of persons in the pre-labor force age groups (with rate of descent α_1)
(b) a left-skewed unimodal curve describing the migration rate of those in the labor force age groups (with rates of ascent λ_2 and descent α_2)
(c) a bell-shaped curve describing the migration rate of the post-labor force age groups (with rates of ascent λ_3 and descent α_3), which is included only when the age profile at hand exhibits a retirement peak

In addition, there is a constant curve c (intended for improving the quality of fit), which corresponds more or less to the migration rate of the oldest age groups.

Of special interest are several points along the migration age profile: its low point x_l, its peak x_h, and its retirement peak x_r. Associated with the first two points are the labor force shift $X = x_h - x_l$ and the jump B representing the increase in the migration rate of individuals aged x_h over those aged x_l.

The values of the parameters and characteristics obtained* by applying the above methodology** to the age profiles describing total migration out of each ZEAT are recorded in Table 26.*** They naturally stress the peculiarity of the age profile relating to migration out of the Paris Region. But they also suggest the existence of some significant differences relating to the other age profiles, enabling us to classify the other ZEATs into two groups: (1) the northeastern half of the country (Paris Basin, North, East, and Middle East ZEATs), and (2) the southwestern half of the country (West, Southwest, and Mediterranean ZEATs).

A direct comparison of the parameters and characteristics of the age profiles for these two groups reveals some consistent discrepancies. First, the initial migration rate of the standardized profiles varies from 0.0261 to 0.0279 in the case of the second group as opposed to 0.0229 to 0.0255 in the case of the first group. From there, the profiles of the second group decline more steeply than those of the first group (α_1 ranges from 0.0986 to 0.1186 versus 0.0666 to 0.1001) and reach the low point more rapidly (x_l = 13.45–14.14 years versus 13.88–15.18 years). The ascent that follows is quicker (the labor force shift X = 9.83–10.08 years versus 9.81–10.45 years) and steeper (the standardized jump B ranges from 0.0185 to 0.0247 versus 0.0136 to 0.0172). From the peak – at which the value of the migration rate in the standardized profile is higher (0.0289–0.0318 versus 0.0249–0.0268) – the descent is also steeper (α_2 = 0.1159–0.1264 versus 0.0767–0.0888). Finally, the mean age of the schedule

*The c and B values provided correspond, in each case, to the "standardized" age profile, which is obtained from the original profile by setting the gross migraproduction rate, or area under the curve, equal to unity.

**Unpublished computer programs prepared by Luis Castro of IIASA's Human Settlements and Services Area were used for this application.

***In this subsection, all the migration profiles illustrated in Figures 29 and 31–34 relate to both sexes aggregated, whereas the values of the parameters and characteristics of the migration profiles displayed in Tables 26–30 concern males only.

TABLE 26 Parameters and characteristics of the total out-migration age profiles for the eight ZEATs: males, 1968–1975.

	ZEAT of origin							
Parameter[a]	Paris Region	Paris Basin	North	East	West	South-west	Middle East	Mediter-ranean
GMR	1.3567	0.8581	0.6419	0.6759	0.6194	0.7324	0.6422	0.7604
α_1	0.0936	0.0821	0.1001	0.0666	0.1186	0.1084	0.0816	0.0986
α_2	0.1333	0.0888	0.0871	0.0767	0.1264	0.1201	0.0820	0.1159
λ_2	0.1976	0.2456	0.2617	0.2441	0.2403	0.2399	0.2639	0.2256
α_3	0.3851	–	–	–	–	–	–	–
λ_3	0.0655	–	–	–	–	–	–	–
c	0.0055	0.0039	0.0037	0.0029	0.0034	0.0033	0.0039	0.0036
x_l	17.50	13.88	14.32	15.18	13.45	13.83	14.66	14.14
x_h	27.72	24.07	24.38	25.63	23.30	23.66	24.57	24.22
x_r	63.56	–	–	–	–	–	–	–
X	10.22	10.19	10.06	10.45	9.85	9.83	9.81	10.08
B	0.0076	0.0150	0.0172	0.0136	0.0247	0.0221	0.0143	0.0185
A	25.66	28.11	29.04	28.52	29.20	27.42	27.94	26.88
$\bar{n}$	39.61	31.58	31.49	30.94	29.32	29.05	31.81	29.76

[a]The parameters are defined in Figure 30 except the GMR (gross migraproduction rate) and $\bar{n}$, which denotes the mean age of the migration profile.

is much lower ($\bar{n}$ = 29.05–29.76 years versus 30.94–31.81 years). Without going into further detail, we can conclude that when comparing migration out of the northeastern ZEATs (excluding the Paris Region) with that out of the southwestern ZEATs, we find that the latter is made up of people in search of better economic opportunities who are relatively younger and more often single or perhaps married without children.

The total migration profile out of the Paris Region starts from a comparatively smaller value than the other seven ZEATs (0.0216 in the case of the standardized schedule) and declines relatively moderately (α_1 = 0.0936) until a comparatively higher age (x_l = 17.50 years). The ascent from there is quite moderate (λ_2 = 0.1976) and leads, after a comparatively longer interval (X = 10.22 years), to a relatively low high point (0.0161) that is only 0.0076 higher than the value of that rate at the low point. Also, this high point is 0.0017 less than the ordinate at age zero, whereas it is 0.035 to 0.039 higher in the case of the schedules of the first group and 0.048 to 0.073 in the case of the schedules of the second group. Finally, the importance of retirement migration for the Paris Region age profile is stressed by the rather high value of the mean age of the schedule: $\bar{n}$ = 39.61 years, that is, 8 to 10 years more than in the case of the other age profiles. We conclude that, when comparing the migration flows out of all ZEATs, the flow out of the Paris Region is less economically induced and is composed of comparatively more young adults with children and retirees.

Note that the rates of descent in both the pre-labor and labor force curves (α_1 and α_2, respectively) vary little between the eight migration age profiles; they take on values that range on the order of one to two. Moreover, as Rogers et al. (1978) found for the United States, Poland, and Sweden, values of α_1 and α_2 are similar. In the case of France, however, the value of α_2 is, in most instances, greater than α_1 (the only exception occurring for migration out of the North ZEAT). Intuitively, the larger the difference between α_2 and α_1, the rates of descent of the pre-labor and labor force curves, respectively, the longer the parental shift A. (Note that A ranges from 25.66 years in the case of the Paris Region to 29.20 years in the case of the West.) Our results confirm this contention: the correlation between the two variables is −0.849.

The general observations just made about the age profiles for the total migration flows out of each ZEAT can be repeated for the age profiles of the associated migration streams. However, since the streams originating or ending in all ZEATs except the Paris Region present roughly the same diversity in profiles, only the results relating to selected migration profiles are discussed below. Specifically, beside the various streams originating and ending in the Paris Region, only those relating to the Southwest ZEAT are examined. This ZEAT was selected essentially because its outgoing streams present an age profile with relatively sharper rates of ascent and descent for the labor force curve, whereas its incoming streams have an age profile with a small "retirement" peak. Such is not generally found for the streams ending in the other regions (the Mediterranean ZEAT being the exception).

Figure 31 displays, for both sexes aggregated, the age profiles associated with the streams originating in the Southwest ZEAT, whereas Table 27 sets out the values of the parameters and characteristics of the corresponding profiles for males only. It turns out that two of the age profiles – those associated with migration to the Paris Region and Mediterranean ZEATs – differ substantially from the remaining five, which are broadly similar. Their parameters and characteristics differ from those of the remaining five in opposite directions. On the one hand, the age profile for migration to the Paris Region is relatively younger and presents a comparatively thinner bell shape for young adults (confirmed by the relatively higher values of α_1, α_2, and B as well as the relatively small value of x_l), such that the maximal rate reached is about twice as high as the initial rate. Therefore, the migration stream from the Southwest ZEAT ending in the Paris Region consists of a greater proportion of young adults, either single or married without children, who are moving for job-related reasons. On the other hand, the age profile for the migration stream to the Mediterranean ZEAT is comparatively older. At first glance, it may even present a small retirement peak, which, however, could not be substantiated when fitting the methodology of Rogers et al. (1978).

Having just examined the migration streams originating in the Southwest ZEAT, we now turn to the analysis of the migration streams ending in that ZEAT. The associated age profiles, for both sexes aggregated, are shown in

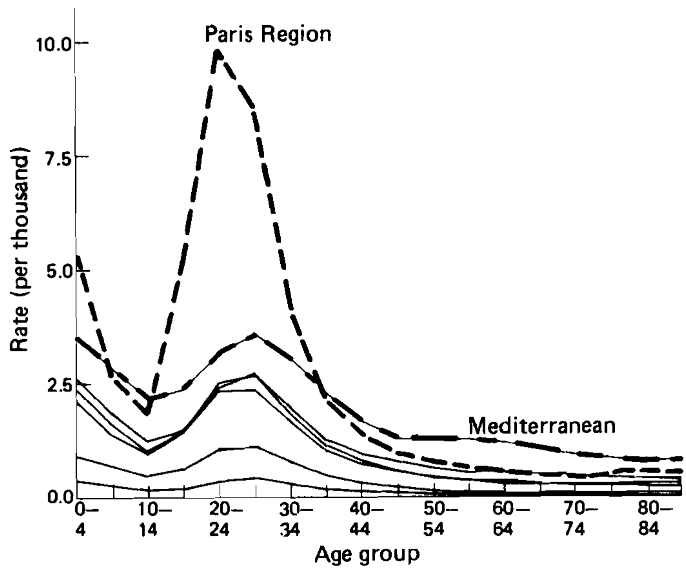

FIGURE 31 Age variations of the destination-specific migration rates: streams originating in the Southwest ZEAT, both sexes aggregated, 1968–1975. Note: Only the profiles presenting some peculiarities, i.e., those ending in the Paris Region and Mediterranean ZEATs, are singled out.

TABLE 27 Parameters and characteristics of the destination-specific age profiles for streams originating in the Southwest ZEAT: males, 1968–1975.

Parameter[a]	ZEAT of destination: Paris Region	Paris Basin	North	East	West	Middle East	Mediterranean	All ZEATs
GMR	0.2324	0.0925	0.0135	0.0364	0.1052	0.0840	0.1710	0.7324
α_1	0.1528	0.1075	0.0876	0.0784	0.1001	0.1003	0.0670	0.1084
α_2	0.1693	0.1228	0.1112	0.1293	0.1102	0.1005	0.0781	0.1201
λ_2	0.2261	0.2100	0.2324	0.1918	0.2290	0.2391	0.2433	0.2399
α_3	–	–	–	–	–	–	–	–
λ_3	–	–	–	–	–	–	–	–
c	0.0023	0.0030	0.0019	0.0020	0.0040	0.0025	0.0047	0.0033
x_l	13.06	14.26	15.15	14.30	15.04	13.86	15.37	13.83
x_h	22.86	24.63	25.11	24.94	25.05	23.91	25.36	23.66
x_r	–	–	–	–	–	–	–	–
X	9.80	10.37	9.96	10.64	10.01	10.05	9.99	9.83
B	0.0386	0.0204	0.0207	0.0201	0.0159	0.0197	0.0088	0.0221
$\bar{n}$	26.30	28.17	26.46	26.52	30.33	28.01	33.37	29.05

[a]The parameters are defined in Figure 30 except the GMR (gross migraproduction rate) and $\bar{n}$, which denotes the mean age of the migration profile.

Figure 32, whereas the values of the corresponding parameters and characteristics for males only are set out in Table 28. Once again, we can single out the Paris Region. Unlike the other incoming streams, the stream originating in the Paris Region is characterized by an age profile that presents a significant retirement peak. Thus the mean age for the male profile is 40.3 years as opposed to 32.3–34.7 in the case of the alternative incoming streams. Moreover, this profile has a comparatively higher value of α_1 and α_2 and a relatively lower value of λ.

The above examination of migration streams originating and ending in the Southwest ZEAT has shown the peculiarities of the age profiles for the streams whose end is the Paris Region. Is this finding only typical of the Southwest ZEAT or does it apply to the other ZEATs as well? To answer this question, we examine the age profiles for all streams originating and ending in the Paris Region.

First, for migration streams originating in the Paris Region, Figure 33 shows the relevant age profiles for both sexes aggregated, and Table 29 shows the values of the corresponding parameters and characteristics for males only. The age profiles for the outgoing streams are broadly similar. All exhibit a local maximum within the early labor force age groups that is never higher than the initial rate (rate at age 0) and another local maximum, often as large as the preceding maximum, which occurs between 62.5 and 65 years for males. (The small difference observed, between males and females, in the occurrence of this peak is probably due to the age difference between spouses that causes the comparatively younger female spouse to move when her husband retires.) Therefore, the features observed earlier in relation to total migration out of the Paris Region – essentially the greater-than-usual proportion of couples with young children and retirees – apply to each stream originating in this region. Thus the propensity of the labor force and retirement group to migrate out of Paris is not induced by economic opportunities in the area of destination but rather by a special link between the movers themselves and the area of destination.

In particular, the prevalent flow of Parisian residents in their fifties or sixties toward the rest of France could be composed of individuals who moved to the Paris Region in their youth, only to return to their region of origin upon or even shortly before retirement. Note that, in the case of the streams to the most industrialized ZEATs (North, East, and Middle East), the values of x_l and x_h are comparatively smaller, those of X are relatively larger, and the local maximum at the retirement peak is substantially smaller than the early labor force maximum (whereas the two maximums are of equivalent magnitude in the case of the other streams). All of these differences suggest that both labor force migration (primarily determined by employment) and retirement migration (predominantly characterized by a return to the region of origin) are substantially influenced by environmental conditions, which deter movement toward the more industrialized and thus polluted ZEATs (some of which also have a less enjoyable climate) and facilitate movement to the southern and sunny part of the country.

Finally, the age profiles for the seven migration streams ending in the Paris Region (see Figure 34 and Table 30) reveal strong similarities. All of these

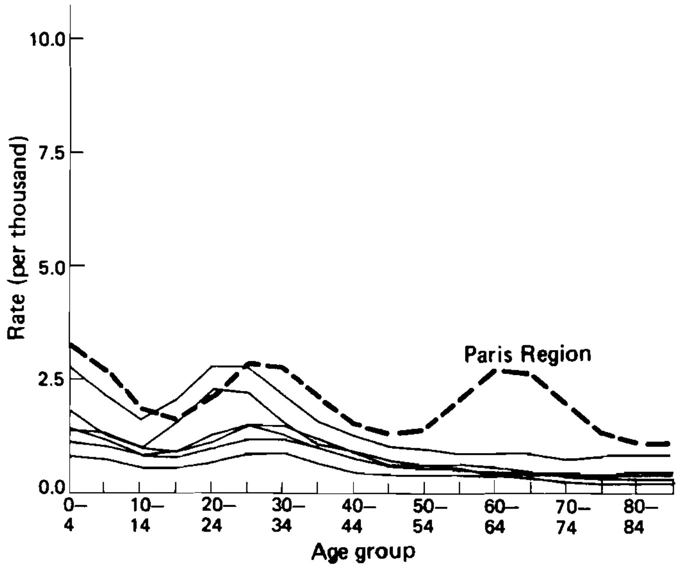

FIGURE 32 Age variations of the destination-specific migration rates: streams terminating in the Southwest ZEAT, both sexes aggregated, 1968–1975. Note: No effort is made here to separate the various age profiles except for the peculiar profile associated with the stream originating in the Paris Region.

TABLE 28 Parameters and characteristics of the destination-specific age profiles for streams terminating in the Southwest ZEAT: males, 1968–1975.

	ZEAT of origin						
Parameter[a]	Paris Region	Paris Basin	North	East	West	Middle East	Mediter-ranean
GMR	0.1824	0.0757	0.0446	0.0603	0.0910	0.0696	0.1351
α_1	0.0914	0.0389	0.0377	0.0348	0.0980	0.0635	0.0862
α_2	0.1657	0.0867	0.0437	0.0568	0.0993	0.0688	0.1212
λ_2	0.1680	0.2760	0.5016	0.2153	0.2465	0.2494	0.1893
α_3	0.3350	–	–	–	–	–	–
λ_3	0.0738	–	–	–	–	–	–
c	0.0056	0.0042	0.0029	0.0016	0.0046	0.0040	0.0059
x_l	18.15	19.20	19.55	17.05	13.31	15.66	13.78
x_h	28.75	28.61	26.74	28.48	23.34	25.92	24.24
x_r	63.90	–	–	–	–	–	–
X	10.60	9.41	7.19	11.43	10.03	10.26	10.46
B	0.0076	0.0085	0.0086	0.0073	0.0161	0.0096	0.0099
$\bar{n}$	40.28	34.26	34.66	32.74	32.28	32.95	33.88

[a]The parameters are defined in Figure 30 except the GMR (gross migraproduction rate) and $\bar{n}$, which denotes the mean age of the migration profile.

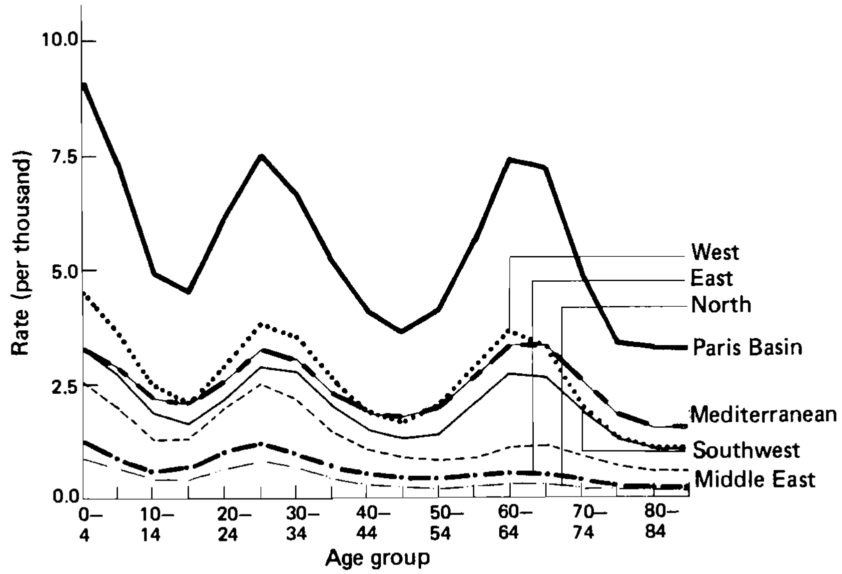

FIGURE 33 Age variations of the destination-specific migration rates: streams originating in the Paris Region, both sexes aggregated, 1968–1975. Note: The names indicated on the figure refer to the destination of the streams originating in the Paris Region.

TABLE 29 Parameters and characteristics of the destination-specific age profiles for streams originating in the Paris Region: males, 1968–1975.

	ZEAT of destination							
Parameter[a]	Paris Basin	North	East	West	South-west	Middle East	Mediter-ranean	All ZEATs
GMR	0.4921	0.0379	0.0583	0.2333	0.1824	0.1214	0.2206	1.3567
α_1	0.1062	0.0994	0.0960	0.0852	0.0914	0.0921	0.0787	0.0936
α_2	0.1341	0.1758	0.1002	0.1151	0.1657	0.1316	0.1461	0.1333
λ_2	0.2107	0.1620	0.1878	0.2145	0.1681	0.1832	0.2004	0.1976
α_3	0.4279	0.3617	0.3061	0.3757	0.3350	0.3408	0.3404	0.3851
λ_3	0.0710	0.0971	0.0563	0.0630	0.0738	0.0695	0.0611	0.0655
c	0.0062	0.0051	0.0035	0.0043	0.0056	0.0048	0.0064	0.0055
x_l	17.66	16.55	14.91	18.12	18.15	16.46	17.94	17.50
x_h	27.46	27.18	26.12	28.18	28.75	27.24	28.00	27.72
x_r	63.60	63.34	62.49	62.63	63.91	64.95	64.06	63.56
X	9.80	10.63	11.21	10.06	10.60	10.78	10.06	10.22
B	0.0066	0.0123	0.0113	0.0082	0.0076	0.0111	0.0061	0.0076
A	24.67	25.77	27.03	n.c.[b]	26.21	26.62	26.54	25.66
$\bar{n}$	40.31	34.10	34.76	38.81	40.28	35.44	42.42	39.61

[a]The parameters are defined in Figure 30 except the GMR (gross migraproduction rate) and $\bar{n}$, which denotes the mean age of the migration profile.
[b]Not calculated.

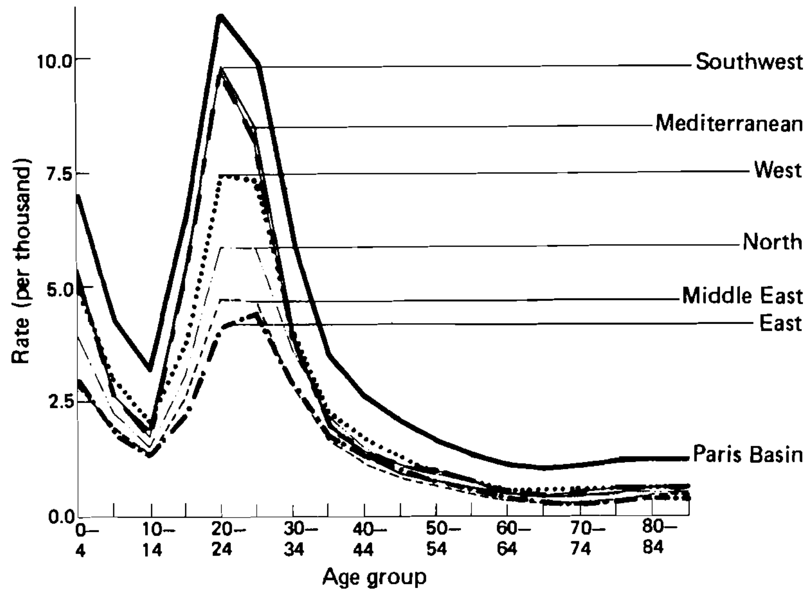

FIGURE 34 Age variations of the destination-specific migration rates: streams terminating in the Paris Region, both sexes aggregated, 1968–1975. Note: The names indicated on the figure refer to the origin of the streams ending in the Paris Region.

TABLE 30 Parameters and characteristics of the destination-specific age profiles for streams terminating in the Paris Region: males, 1968–1975.

	ZEAT of origin						
Parameter[a]	Paris Basin	North	East	West	South-west	Middle East	Mediter-ranean
GMR	0.3315	0.1819	0.1405	0.2347	0.2324	0.1421	0.2201
α_1	0.1225	0.1347	0.0963	0.1509	0.1582	0.1109	0.1175
α_2	0.1336	0.1249	0.1102	0.1586	0.1693	0.1287	0.1342
λ_2	0.2380	0.2289	0.2297	0.2537	0.2261	0.2198	0.2519
α_3	–	–	–	–	–	–	–
λ_3	–	–	–	–	–	–	–
c	0.0036	0.0031	0.0028	0.0026	0.0023	0.0026	0.0029
x_l	13.15	13.52	13.97	13.15	13.06	13.33	14.04
x_h	23.01	23.90	24.50	22.48	22.86	23.80	23.59
x_r	–	–	–	–	–	–	–
X	9.86	10.38	10.53	9.33	9.80	10.53	9.55
B	0.0261	0.0275	0.0238	0.0373	0.0386	0.0278	0.0287
A	28.45	30.11	30.31	28.30	28.46	29.76	28.26
$\bar{n}$	29.55	29.11	29.23	27.10	26.30	28.30	28.11

[a]The parameters are defined in Figure 30 except the GMR (gross migraproduction rate) and $\bar{n}$, which denotes the mean age of the migration profile.

profiles exhibit a distinct labor force peak characterized by a maximum that is three times the migration rate at the low point and about one-half higher than the initial migration rate. Therefore, of the young adults moving to the Paris Region, a substantial proportion is single persons in quest of a job, thus continuing a long-standing tradition. This is especially true for migration out of the West and Southwest ZEATs; the corresponding age profiles have higher rates of descent α_1 and α_2 and a larger jump B than the other profiles.

2.9 Population Age Composition

To conclude section 2, we will describe the age composition of the 1975 population of all ZEATs. Figure 35 shows the variations in the size of the population of each ZEAT by age and suggests a certain likeness between the ensuing age profiles.

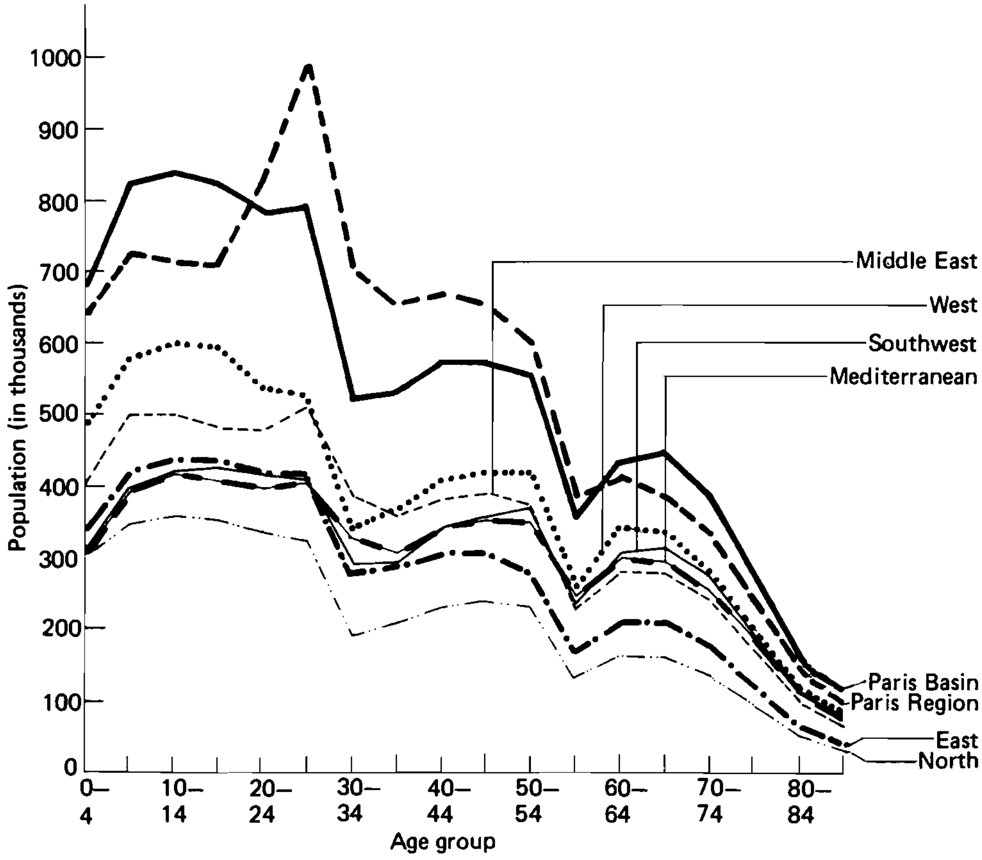

FIGURE 35 Population age decomposition: ZEATs, both sexes aggregated, 1975. Source: Derived from data in INSEE 1977.

Not surprisingly, however, the Paris Region appears to have comparatively fewer children and older people and more middle-aged people than the other ZEATs.

The decomposition of the population of each ZEAT into three large age groups (see Table 31) clearly demonstrates this singularity. First, the proportion of the population aged 20–64 is 59.7 percent in the Paris Region as opposed to 52.9–55.5 percent in the other ZEATs. (The national average is 55.0 percent.)

TABLE 31 Population age composition according to large age groups (in percent) for the eight ZEATs: both sexes aggregated, 1975.

	Age group			
ZEAT	0–19	20–64	65+	Aging index
Paris Region	28.15	59.72	12.13	0.43
Paris Basin	32.68	52.92	14.40	0.44
North	34.79	52.96	12.24	0.35
East	33.09	54.42	12.49	0.38
West	32.70	52.64	14.66	0.45
Southwest	27.91	54.35	17.75	0.64
Middle East	30.70	55.32	13.99	0.46
Mediterranean	27.57	55.45	16.98	0.62
France	30.71	55.03	14.26	0.46

SOURCE: Eurostat 1976, p. 144.

Second, the Paris Region has the smallest percent of its population in both the youngest (0–19) and oldest (65 and over) age groups, whereas, in the other ZEATs, there exists an inverse relationship between the percentages of population in those two age brackets. The correlation coefficient between the two age bracket percentages in all ZEATs except the Paris Region equals −0.918 (see Figure 36).

In addition, the figures in Table 31, especially those of the aging index in the last column, suggest a classification of the ZEATs (excluding the Paris Region) by age structure.

1. The first group consists of the Southwest and Mediterranean ZEATs where the population in the youngest and oldest age groups represents a relatively smaller and larger percentage, respectively.
2. The second group contains the Paris Basin, West, and Middle East ZEATs, the population of which in both the youngest and oldest age groups represents a percentage that is close to the corresponding national averages.

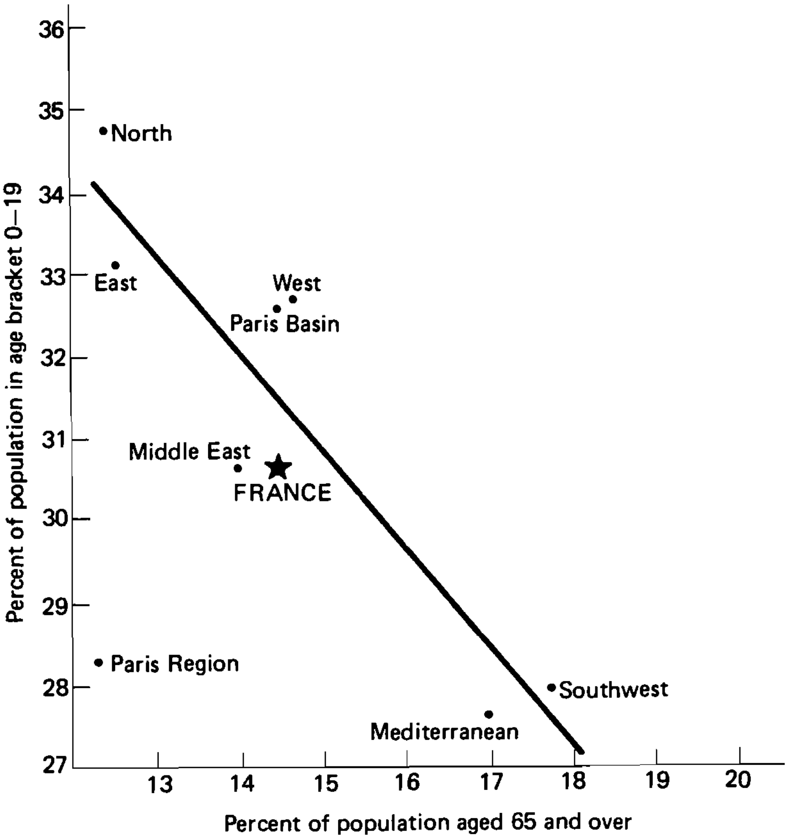

FIGURE 36 Relation between the percents of population in the age brackets 0–19 and 65+: ZEATs, both sexes aggregated, 1975. Note: The regression line appearing across this figure has been drawn on the basis of all the ZEATs except the Paris Region.

3. The third group includes the North and East ZEATs, where there are relatively larger numbers of young people and smaller numbers of old people.

Not surprisingly, such a classification reflects the patterns of natural increase and migration examined earlier in this section.

3 MULTIREGIONAL POPULATION ANALYSIS

3.1 From Single-region to Multiregional Population Analysis

In the previous section, the mortality, fertility, and migration patterns underlying recent population change in France's ZEATs were examined with the help of a methodology inherited from conventional mathematical demography. A large part of the analysis focused on the usual demographic measures such as age-specific mortality, fertility, and migration rates considering each ZEAT separately. It culminated in the examination of three synthetic indicators characteristic of the three demographic phenomena considered

(a) expectation of life at birth
(b) net reproduction rate
(c) net migraproduction rate*

which were derived from the disaggregate measures just mentioned in relation to the stationary population specific to each ZEAT.

When comparing ZEATs, however, one cannot attribute to these three synthetic measures the full interpretation, which can be attributed to them in a closed (or nearly closed) system, i.e., most nations. Because the population of an open system, such as a region within a country, is a highly volatile entity, the synthetic measures cannot easily be attached to discernable groups of people and, in the end, they are simply interpreted as indicators of the overall intensity of the particular demographic phenomenon in each ZEAT.

From this we conclude that a different population analysis, accounting for the interdependence of the ZEATs, i.e., explicitly considering the migration streams taking place between them, could yield more interesting synthetic indicators.

Such a population analysis can be performed using the methods and models of multiregional mathematical demography pioneered by Rogers (1975a, 1975b, 1979). Basically, Rogers has generalized the population models of classical mathematical demography, applicable only to a nation or an isolated region, to the case of a multiregional system. Interestingly, the generalization involves not only the explicit inclusion of interregional migration streams but also the consideration of fertility and mortality regimes specific to the regions.

The multiregional extension of the ordinary life table, referred to as the multiregional life table (Rogers 1973, 1975a), is of a particular interest to us inasmuch as it provides the basis for the derivation of synthetic indicators that are analogous to but more useful than those derived in section 2. Specifically, a multiregional life table generates a multiregional stationary population consisting of several independent stationary populations (as many as there are regions), each of which originates from an arbitrary cohort of people born at the same time in a given region. The application of the independent stationary populations to the relevant age-specific mortality, fertility, and migration rates leads to a set of demographic indicators, which are attached to identifiable groups of people rather than to such impersonal entities as regions (as was the case with the synthetic indicators derived in section 2). Expectations of life at birth, net reproduction rates, and migraproduction rates are now specific to the various regional birth cohorts.

*Recall that the last two indicators are not pure indicators of fertility and mobility since they include a provision for mortality.

Moreover, because the stationary population originating from each regional birth cohort can be broken down according to the region of residence of its members, the synthetic indicators attached to each regional birth cohort can be broken into region-specific figures. Typically, such figures attached to a given regional birth cohort indicate

(a) the fraction of the total life expectancy at birth likely to be spent in each region
(b) the fraction of the total number of births to members of the female cohort likely to occur in each region
(c) the fraction of the total number of interregional moves likely to be made by the members of the cohort out of each region

In addition to the ordinary life table, Rogers (1975a) has generalized the Lotka model to the multiregional case, thus allowing one to project simultaneously the populations of all regions. Any projection or forecasting exercise relying on such a model is superior to the corresponding exercise based on the usual practice of jointly considering several single-region Lotka models with some provision for migration. The multiregional model, through its explicit inclusion of interregional migration streams, ensures the consistency across regional populations that is clearly lacking in the alternative approach. Note that when this generalized Lotka model is used as a projection model (i.e., assuming unchanged mortality, fertility, and migration regimes in each of the regions), it eventually leads to a stable state. The analysis of this state provides, as in the single-region case, additional insights into the current patterns of the relevant demographic phenomena.

Having noted in broad terms the attributes of the multiregional population analysis, we now pursue our discussion of population change in France's ZEATs by reporting and commenting on the results (some of which are shown in Appendix C) obtained by applying the multiregional methods and models to the age-specific mortality, fertility, and migration data already examined in section 2. Before turning to this, however, we provide a short overview of these methods and models intended for the layman. The reader already familiar with multiregional mathematical demography should therefore move directly to subsection 3.3.

3.2 An Overview of the Methods and Models of Multiregional Population Analysis

In this subsection, we briefly examine the stationary and stable population models of multiregional mathematical demography, stressing the concepts and formulas that are particularly useful for the following multiregional population analysis of France.

THE MULTIREGIONAL LIFE TABLE

The starting point of multiregional mathematical demography is the multiregional life table, a generalization of the ordinary life table that *jointly* describes the life history of *independent* cohorts of people born at the same time in each of the regions of a multiregional population system. For each such cohort, or radix, it indicates the number as well as the regional distribution of the survivors at successive fixed ages, until the death of its last member.

Two basic assumptions underlie such a combined life table:

(a) the population homogeneity assumption, where all of the individuals of a given age present in a given region have identical propensities to migrate or to die, regardless of their region of birth
(b) the Markovian assumption, where such propensities are unaffected by the past mobility history of the individuals concerned

Thus when an individual migrates to a new region, he immediately adopts the mortality and mobility regimes specific to that region.

It is clear that these two assumptions define a mobility process that is governed by a Kolmogorov forward differential equation (see Schoen and Land 1979, Willekens 1980) and therefore can be described, in practical terms, by a simple Markov chain model. This gives rise to a set of transition probability matrices $\mathbf{p}_x$ ($x = 0, n, 2n, \ldots, (z-1)n$ where z is the number of age groups) whose i,jth element denotes the probability of an individual living in region j at age x, regardless of the region of birth, to survive in region i n years later. The matrix $\mathbf{p}_x$ thus appears as a straightforward generalization of the survival probability p_x of an ordinary life table, one that accounts for the regions of residence at the beginning and end of the interval $(x, x+n)$.

On the basis of this set of transition probability matrices, multiregional life table functions, which generalize the usual statistics of an ordinary life table, can be defined. As will become apparent later, such a generalization simply involves the substitution of elements in a matrix format for the scalar elements of an ordinary life table.

First, let $\mathbf{l}_x$ be a matrix whose i,jth element represents the number of the members of the jth radix who survive in region i at age x; then the series of the $\mathbf{l}_x$ matrices for $x = 0, n, 2n, \ldots, (z-1)n$ can be obtained from the repeated application of equation (1′), starting from a diagonal matrix $\mathbf{l}_0$ whose diagonal elements are the arbitrary sizes of the various radices. (All equation numbers in this discussion refer to equations appearing in the right-hand half of Table 32.)

Second, let $\mathbf{L}_x$ be a matrix whose i,jth element represents the number of person-years lived in region i between ages x and $x+n$ by the members of the jth radix. By way of analogy with the single-region case, such a matrix can be calculated, in the first approximation, from the series of matrices $\mathbf{l}_x$ using a simple linear approach: see equation (2′).

Third, the T-statistics of the ordinary life table can be generalized into a matrix $\mathbf{T}_x$ indicating the number of person-years lived in each region beyond age x by the survivors of each radix; it is simply related to the generalized L-statistics through equation (3′).

TABLE 32 The analogy between single-region and multiregional mathematical demography.

Single-region case		Multiregional case	
a. Life table			
$l_{x+n} = p_x l_x$	(1)	$\mathbf{l}_{x+n} = \mathbf{p}_x \mathbf{l}_x$	(1′)
$L_x = (n/2)(l_x + l_{x+n})$	(2)	$\mathbf{L}_x = (n/2)(\mathbf{l}_x + \mathbf{l}_{x+n})$	(2′)
$T_x = \sum_{y=x}^{(z-1)n} L_y$	(3)	$\mathbf{T}_x = \sum_{y=x}^{(z-1)n} \mathbf{L}_y$	(3′)
$e_x = T_x/l_x$	(4)	$\mathbf{e}_x = \mathbf{T}_x \mathbf{l}_x^{-1}$	(4′)
b. Synthetic indicators			
e_0	(5)	$\mathbf{e}_0$	(5′)
$NRR = \sum_x F_x L_x$	(6)	$(\mathbf{NRR}) = \sum_x \mathbf{F}_x \mathbf{L}_x$	(6′)
$NMR = \sum_x M_x L_x$	(7)	$(\mathbf{NMR}) = \sum_x (\mathbf{M}_x)_\mathrm{d} \mathbf{L}_x$	(7′)
c. Projection model			
$\mathbf{G} = \begin{bmatrix} O & O & b_\alpha \cdots b_\beta & O \cdots O \\ s_0 & & & \\ & s_n & & \\ & & \ddots & \\ & & s_{(z-2)n} & O \end{bmatrix}$	(8)	$\mathbf{G} = \begin{bmatrix} \mathbf{O} & \mathbf{O} & \mathbf{b}_\alpha \cdots \mathbf{b}_\beta & \mathbf{O} \cdots \mathbf{O} \\ \mathbf{s}_0 & & & \\ & \mathbf{s}_n & & \\ & & \ddots & \\ & & \mathbf{s}_{(z-2)n} & \mathbf{O} \end{bmatrix}$	(8′)
$s_x = L_{x+n}/L_x$	(9)	$\mathbf{s}_x = \mathbf{L}_{x+n} \mathbf{L}_x^{-1}$	(9′)
$b_x = (1/2)(L_0/l_0)(F_x + F_{x+n} s_x)$	(10)	$\mathbf{b}_x = (1/2)\mathbf{L}_0 \mathbf{l}_0^{-1}(\mathbf{F}_x + \mathbf{F}_{x+n} \mathbf{s}_x)$	(10′)

Fourth and finally, a matrix of expectation of life (by place of residence), whose i,jth element represents the number of years that an individual residing at age x in region j can expect to live in region i before dying, can be obtained from the generalized l- and T-statistics by use of equation (4′).

MULTIREGIONAL MORTALITY, FERTILITY, AND MIGRATION ANALYSIS

As indicated earlier, an interesting utilization of the multiregional stationary population generated from a multiregional life table is the determination of synthetic indicators typifying the mortality, fertility, and migration regimes that relate to various regional birth cohorts.

First, note that the construction of a multiregional life table produces a matrix $\mathbf{e}_0$ of expectations of life at birth. This expectation of life matrix, which is the multiregional counterpart of the life expectancy at birth drawn from an ordinary life table, indicates the regional allocation of the total expected lifetime specific to the members of each radix.

Second, the set of matrices $\mathbf{L}_x$, which describes the multiregional stationary population, can be used to generate multiregional counterparts of the other two synthetic measures, that is, the net reproduction and migraproduction rates.

Thus the net reproduction rate matrix **NRR** is defined in equation (6′) where $\mathbf{F}_x$ is a diagonal matrix of fertility rates relating to age group x to $x + n$. (The assumption is made that females who migrate to another region take on the fertility regime of that region.) The i,jth element of this matrix represents the number of babies born in region i to mothers who were born in region j.

Similarly, the net migraproduction rate matrix **NMR** is defined in equation (7′) where $(\mathbf{M}_x)_d$ is a diagonal matrix of total out-migration rates relating to age group x to $x + n$. The i,jth element of this matrix represents the number of moves out of region i made by an individual born in region j.

Note that the column sums of each of the three matrices just defined provide the values of three synthetic indicators -- total life expectancy at birth, total net reproduction rate, and total net migraproduction rate, respectively – specific to each regional birth cohort. From now on, these values will be referred to as the multiregional values of the synthetic indicators of mortality, fertility, and mobility. They are analogous to the single-region values obtained in section 2, using conventional population analyses. Single-region and multiregional values of those indicators are indeed directly comparable but, as already mentioned, refer to different entities: the single-region values are attributes of the regions themselves, whereas the multiregional values are attributes of the people born in each of the regions.

THE MULTIREGIONAL PROJECTION MODEL

The Lotka model of population growth can be easily extended to the multiregional case. If the existing population is arranged into a vector consisting of z subvectors containing the regional populations of each age class, the population vector n years later can be obtained from this vector by applying a growth matrix operator G. Such an operator generalizes that of the Lotka model in that adequate age-specific matrices are substituted for the age-specific fertility and survivorship coefficients of the single-region growth operator (see equation (8′)). These age-specific matrices, moreover, can be simply estimated from the multiregional life table (equations (9′) and (10′)) by a method analogous to the one used to estimate age-specific fertility and survivorship coefficients from an ordinary life table (Keyfitz 1968).

Note that the repeated application of the growth matrix operator G defines a multiregional projection model that, like its single-region counterpart, eventually leads to a stable state. Such a stable state is characterized by constant regional age compositions as well as constant regional shares of the total population (Rogers 1975a). Interestingly enough (as Rogers 1976a and Liaw 1978 note), the evolution toward stability occurs in two consecutive phases: first the stabilization of the various regional age structures occurs, followed by the stabilization of the regional shares of the total population.

In summary, multiregional population analysis is a straightforward generalization of conventional population analysis, where matrices are substituted for scalars; the left- and right-hand sides of Table 32 make this point quite clear.

3.3 The Multiregional Life Table for France (Males): Main Results

Three multiregional life tables – for males, females, and both sexes aggregated – were constructed for France's eight-ZEAT system on the basis of the age-specific mortality and migration rates previously examined in section 2.* Owing to the lack of space, however, this subsection reports only on the results of the male multiregional life table.

Before starting the discussion of these results, a short digression on the special method we used for estimating the set of transition probability matrices $\mathbf{p}_x$, from which all the other multiregional life table functions originate, is in order. We have not used the estimation method used in the other national case studies of the IIASA Comparative Migration and Settlement Study, the so-called Option 3 method in the nomenclature of Willekens and Rogers (1978). This was necessary because of the peculiar character of the disaggregated mobility information available: transition data relating to 5-year age groups observed over a 7-year period (1968–1975).

In brief, the Option 3 method is based on the availability of age-specific migration rates that have to be measured beforehand. Such a measurement is rather straightforward when the migration data come from a population register in the form of moves, but it is less obvious when the migration data come from a population census in the form of transitions (changes in residence). In the latter

*These multiregional life tables refer to a hypothetical period in which the mortality pattern is the one observed in 1975 and the mobility pattern is identical to the average pattern observed over the whole intercensal period 1968–1975.

case the age-specific migration rates, as commonly measured (Rogers 1975a), strongly depend on the length of the observation period, which has stringent consequences for the reliability of the ensuing transition probability estimates. In fact, these estimates are acceptable only if the length T of the observation period is equal to all widths n of each age group (Ledent 1980a, Ledent and Rees 1980). Since in the present case T is different from n, an alternative method was necessarily called for.

The estimation method actually used was initially devised in the case $T = n$ but later was amended to accommodate the case when T does not equal n. Full details of the method are given in Appendix D. The main feature that distinguishes this method from the Option 3 method is the additional consideration of data relating to "stayers", that is, people who are living in the same region at the beginning and end of the observation period. This permits the determination of survivorship proportion matrices from which the set of transition probability matrices can be derived in a way that parallels the method sometimes used by demographers to calculate an ordinary life table from the population information of two consecutive censuses.

In addition, consideration of stayers' flows allows a proper closure of the multiregional system at hand, thus alleviating the difficulty associated with the existence of international migration (Ledent and Rees 1980).*

We now move to the presentation and discussion of the multiregional life table statistics for males, starting with transition probabilities.

MIGRATION AND DEATH PROBABILITIES

In this report we cannot display the values of all the transition probability matrices estimated as indicated above. By way of illustration, we simply show the migration and death probabilities relating to 20-year olds (see Table 33).**

For example, there is a 0.99 probability that a 20-year-old male living in the Paris Region will reach the age of 25. There is a 0.91 probability that he will still be in the Paris Region by that time, leaving a 0.08 probability that he will move to another ZEAT. In other words, among 100000 males living in the Paris Region at 20 years of age, 690 will be dead 5 years later, whereas 8400 will be living in another ZEAT: 2900, Paris Basin; 1400, West; 1200, Mediterranean; 1050, Southwest; 960, Middle East; 540, East; and 350, North.

Observe that the probability of a 20-year-old male living in the same ZEAT 5 years later ranges from 0.89 (for a resident of the Southwest) to 0.92 (for a resident of the Middle East); the two lowest values curiously relate to the two

*The Option 3 method implies a closure by default such that international out-migrants (emigrants) are implicitly regarded as stayers.

**The numerical results of the multiregional population analysis displayed in this section have been obtained by applying the set of computer programs developed in IIASA's Human Settlements and Services Area and published in Willekens and Rogers (1978). However, the standard routine performing the estimation of the age-specific transition probabilities was replaced by several routines that performed the special estimation method devised for the purpose of this report.

TABLE 33 Five-year migration and death probabilities: 20-year-old males.

ZEAT of destination	ZEAT of origin: Paris Region	Paris Basin	North	East	West	South-west	Middle East	Mediter-ranean
Paris Region	0.9091	0.0482	0.0273	0.0195	0.0444	0.0467	0.0231	0.0377
Paris Basin	0.0290	0.8924	0.0214	0.0171	0.0219	0.0123	0.0133	0.0108
North	0.0035	0.0052	0.9176	0.0027	0.0020	0.0018	0.0016	0.0021
East	0.0054	0.0097	0.0064	0.9221	0.0053	0.0060	0.0064	0.0085
West	0.0140	0.0118	0.0039	0.0049	0.8947	0.0116	0.0039	0.0061
Southwest	0.0105	0.0056	0.0035	0.0048	0.0110	0.8861	0.0060	0.0137
Middle East	0.0096	0.0108	0.0060	0.0102	0.0050	0.0118	0.9213	0.0243
Mediterranean	0.0120	0.0071	0.0063	0.0105	0.0057	0.0151	0.0160	0.8879
Survival probability	0.9931	0.9907	0.9922	0.9919	0.9901	0.9914	0.9916	0.9909
Death probability	0.0069	0.0093	0.0078	0.0081	0.0099	0.0086	0.0084	0.0091

ZEATs that are generally considered as being the most attractive (Southwest and Mediterranean ZEATs).

More general migration and death probabilities between any two ages x_1 and x_2 can be obtained by considering the product of transition probability matrices attached to all consecutive age groups from x_1 to $x_2 - n$. Table 34 shows such migration and death probabilities between time of birth and age 20.

TABLE 34 Probabilities of survival to age 20 by ZEAT of birth: males.

ZEAT of residence at age 20	ZEAT of birth: Paris Region	Paris Basin	North	East	West	South-west	Middle East	Mediter-ranean
Paris Region	0.6739	0.0803	0.0463	0.0371	0.0611	0.0606	0.0386	0.0587
Paris Basin	0.1023	0.7360	0.0542	0.0469	0.0485	0.0305	0.0355	0.0289
North	0.0108	0.0147	0.7841	0.0077	0.0045	0.0045	0.0039	0.0054
East	0.0159	0.0236	0.0136	0.7762	0.0094	0.0129	0.0140	0.0159
West	0.0542	0.0388	0.0134	0.0156	0.7917	0.0314	0.0132	0.0219
Southwest	0.0399	0.0214	0.0133	0.0177	0.0250	0.7567	0.0204	0.0368
Middle East	0.0316	0.0289	0.0166	0.0266	0.0126	0.0266	0.7916	0.0540
Mediterranean	0.0438	0.0274	0.0222	0.0389	0.0178	0.0473	0.0551	0.7495
Survival probability	0.9724	0.9709	0.9635	0.9666	0.9706	0.9705	0.9722	0.9710
Death probability	0.0276	0.0291	0.0365	0.0334	0.0294	0.0295	0.0278	0.0290

For example, the probability that a male born in the Paris Region will be alive 20 years later is 0.97 and the probability that he will still be in the Paris Region is 0.67. Thus among 100000 males born in the Paris Region, 29850 will be living 20 years later in another ZEAT, with a large proportion of these living in the Paris Basin. A male born in a ZEAT other than the Paris Region, however, has a significantly higher probability of residing at age 20 in his ZEAT of birth, ranging from 0.74 to 0.79 (compared with 0.67 for the Paris Region).

LIFE HISTORY OF THE REGIONAL BIRTH COHORTS

The recursive application of the 5-year transition probability matrices allows us to generate the life histories of each radix, or regional birth cohort, on the basis of observed mortality and migration patterns.

In principle, it is possible to obtain a full specification of these life histories, indicating in detail the deaths and transitions between the various ZEATs within each age group. However, this requires nine sets (one for each regional cohort and one for the total birth cohort) of eight tables with 18 rows (one for each age group) and 8 columns, which we cannot reproduce here; only highlights of such sets of tables are presented below.

Table 35 shows the expected numbers of males out of each regional birth cohort of 100000 who survive in any of the ZEATs at selected ages. For example, by age 80, the number of survivors of each regional cohort ranges from 25437 (North) to 32679 (Mediterranean). The comparison of this range with the corresponding single-region one (21119 to 34956 in Table 10) suggests that the introduction of migration smooths out the spatial differences of the chances

TABLE 35 Multiregional life table (males): total expected number of survivors out of 100000 males born in each ZEAT.

	Age				
ZEAT of birth	0	20	40	60	80
Paris Region	100 000	97 236	93 996	79 356	31 266
Paris Basin	100 000	97 094	93 485	78 164	30 190
North	100 000	96 346	92 470	74 542	25 437
East	100 000	96 655	93 253	77 405	28 378
West	100 000	97 059	93 216	77 611	29 826
Southwest	100 000	97 046	93 774	80 013	32 072
Middle East	100 000	97 215	93 894	79 308	30 543
Mediterranean	100 000	97 101	93 775	79 868	32 679
France[a]	100 000	97 018	93 531	78 537	30 163

[a]The national figures were obtained on the basis of a radix allocation identical to the regional allocation of the 1975 male birth cohort.

of survival observed from a single-region population analysis.* This result is indeed a direct consequence of the Markovian assumption imbedded in the multiregional life table model, which causes each migrant to adopt the mortality regime of his new region of residence.

But where are the survivors of each birth cohort expected to reside at age 80? The last column of Table 36 indicates that slightly less than 30 percent of those born in the Paris Region and surviving to age 80 will still be living in the Paris Region, whereas the comparable percentage ranges from 43.6 to 54.8 percent in the case of the other regional birth cohorts.

TABLE 36 Percent of survivors of each regional cohort residing in the ZEAT of birth: males.

	Age				
ZEAT of birth	0	20	40	60	80
Paris Region	100.00	69.30	50.40	41.10	29.95
Paris Basin	100.00	75.80	55.00	49.49	47.47
North	100.00	81.39	61.56	53.84	43.62
East	100.00	80.30	60.71	53.62	47.08
West	100.00	81.57	61.46	57.27	54.77
Southwest	100.00	77.97	56.03	52.61	51.83
Middle East	100.00	81.42	63.41	57.84	53.03
Mediterranean	100.00	77.19	55.92	52.23	53.78
France[a]	100.00	77.19	57.19	51.12	43.93

[a]The national figures were obtained on the basis of a radix allocation identical to the regional allocation of the 1975 male birth cohort.

As we might expect, the percentage of survivors of each regional birth cohort still living in the ZEAT of birth decreases with age. Aside from the cohort born in the Paris Region, the other cohorts experience a broadly similar decline in such a percentage. But, after age 40, the cohorts born in the North ZEAT and, to a lesser degree, the East ZEAT, show a substantially faster decline and the cohorts born in the Southwest and Mediterranean ZEATs a substantially slower decline. Such a result naturally reflects the direction of the main flows of retirement-related migration characterized by a search for better climatic conditions.

Recall that in constructing a multiregional life table, the size of each radix (regional birth cohort) is arbitrary. We may therefore set each radix equal to the number of male births observed in 1975 in the corresponding ZEAT rather

*The number of survivors by age 80 is higher (smaller) in the case of the five (three) ZEATs with the highest (smallest) levels of mortality.

than to 100000. We then obtain the evolution of the size and regional distribution of the survivors issued from the total birth cohort (all ZEATs) and its various regional components in the event that mortality and migration patterns remain unchanged. (See Appendix C, selected results of which are presented in Table 37.)

TABLE 37 Evolution of France's 1975 male birth cohort: expected numbers of survivors at selected ages by ZEAT of residence.

	Age				
ZEAT of residence	0	20	40	60	80
Paris Region	75354	68362	70661	52619	15747
Paris Basin	72935	71002	66882	56600	23185
North	34115	29639	24864	18552	5323
East	36845	34015	31486	24866	8397
West	53152	52327	48067	41650	16782
Southwest	32751	33837	32737	30498	13603
Middle East	43283	43564	43589	37027	13925
Mediterranean	32063	36405	37597	36335	17805
France	380498	369151	355883	298148	114768

Owing to the influence of interregional migration, the number of survivors in each ZEAT does not necessarily decrease monotonically with age, a pattern exhibited by the North and East ZEATs only. Actually, four ZEATs (the Paris Basin, West, Southwest, and Mediterranean) present a similar evolutive pattern of the number of survivors. After an initial decline, due to infant mortality, this number increases up to age 15 (10 in the case of the Paris Basin) and decreases thereafter. The decrease is continuous in only the Paris Basin, for in the three other ZEATs there is another local increase around ages 30 to 40. For the Mediterranean ZEAT, the number of survivors increases up to age 45 (there is a local decline between ages 20 and 25 because of a large outflow of natives toward the Paris Region) and declines rather slowly thereafter; it is only after age 65 that the number of survivors living in that ZEAT falls under the initial mark.

For the Paris Region, the number of survivors decreases up to age 15 owing to a heavy out-migration of Parisian residents with children. It then increases sharply until age 30 because of the influx of young provincials in quest for a job in the Paris Region and thereafter decreases rapidly. (Contrast the local minimum of 66869 at age 15 and the maximum of 75669 at age 30 (Appendix C) with the size of the initial cohort, 75354.)

On the basis of the figures in Table 37, Table 38 presents the regional allocation of the survivors of France's 1975 male birth cohort at selected ages. Perhaps the most interesting result is provided by comparing the regional allocations

TABLE 38 Evolution of France's 1975 male birth cohort: regional allocation at selected ages (in percent).

	Age				
ZEAT of residence	0	20	40	60	80
Paris Region	19.80	18.52	19.86	17.65	13.72
Paris Basin	19.17	19.23	18.79	18.98	20.20
North	8.97	8.03	6.99	6.22	4.64
East	9.68	9.21	8.85	8.34	7.32
West	13.97	14.17	13.51	13.97	14.62
Southwest	8.61	9.17	9.21	10.23	11.85
Middle East	11.38	11.80	12.25	12.42	12.13
Mediterranean	8.43	9.86	10.56	12.19	15.51
France	100.00	100.00	100.00	100.00	100.00

at the two extremes of the age continuum (ages 0 and 80). The North ZEAT has its percentage cut by almost a half (from 8.97 to 4.64 percent), whereas the Mediterranean ZEAT sees its percentage almost doubled (from 8.43 to 15.51 percent).

Actually, there appears little change in the regional allocation over the younger age groups. The regional percentage share varies by less than one point between time of birth and age 40 in all ZEATs except the North and Mediterranean, where it decreases and increases, respectively, by two points. Beyond age 40, however, interregional migration as well as regional mortality disparities cause a substantial modification of the regional allocation. The total number of survivors in the North and Mediterranean ZEATs decreases and increases, respectively, at an accelerated rate. The Paris Region experiences an important relative loss (from 19.9 percent at age 40 to 13.7 percent at age 80), and the Southwest registers significant gains (from 9.2 percent at age 40 to 11.9 percent at age 80).

EXPECTATIONS OF LIFE BY PLACE OF RESIDENCE

We now turn to the examination of one of the most interesting products of a multiregional life table: the expectations-of-life statistics. All the values for the expectations of life by place of residence for males are shown in Appendix C.

By way of illustration, the statistics for 20-year-old males are repeated in Table 39. Depending on his current region of residence, a 20-year-old male can expect to live from 49.40 years (if living in the North) to 52.50 years (if living in the Mediterranean), a large part of which will be spent in the same ZEAT: from 65.4 percent in the case of the Paris Region to 76.6 percent in the case of the Middle East ZEAT. For example, a resident of the Paris Basin will live 51.32 additional years, 36.37 of them in the same ZEAT (that is, a 70.9 percent

TABLE 39 Expectations of remaining life by ZEAT of residence for 20-year-old males (in years).

ZEAT in which remaining time is spent	ZEAT of residence							
	Paris Region	Paris Basin	North	East	West	South-west	Middle East	Mediter-ranean
Paris Region	34.09	5.07	3.32	2.65	4.09	4.32	2.71	3.93
Paris Basin	5.85	36.37	3.54	3.13	3.31	2.23	2.40	2.12
North	0.61	0.80	36.88	0.48	0.32	0.31	0.28	0.36
East	0.99	1.41	0.90	37.93	0.70	0.84	0.99	1.11
West	3.17	2.40	1.00	1.08	38.43	2.06	0.95	1.33
Southwest	2.47	1.46	0.93	1.21	1.78	37.93	1.36	2.26
Middle East	1.95	1.87	1.19	1.87	0.97	1.78	39.58	3.29
Mediterranean	2.96	1.94	1.64	2.53	1.42	2.91	3.42	38.10
France	52.11	51.32	49.40	50.87	51.02	52.38	51.69	52.50

proportion), 5.07 in the Paris Region, 2.40 in the West, 1.94 in the Mediterranean, and so on.

Table 40 shows the total number of additional years that a resident of each ZEAT, at selected ages, can expect to live in all ZEATs. Its comparison with Table 11, established from separate single-region life tables, gives a convenient overview of the effects of migration on life expectancy, especially the smoothing out of the spatial differences in the chances of survival within France.

TABLE 40 Multiregional life table (males): total expectations of life by ZEAT of residence at selected ages (in years).

ZEAT of residence	Age 0	20	40	60	80
Paris Region	70.11	52.11	33.65	17.51	6.83
Paris Basin	69.51	51.32	32.81	17.00	6.28
North	67.47	49.40	30.29	15.17	5.78
East	68.89	50.87	32.02	16.19	6.01
West	69.26	51.02	32.52	16.85	6.13
Southwest	70.31	52.38	34.07	17.54	6.28
Middle East	69.91	51.69	33.05	16.82	6.20
Mediterranean	70.40	52.50	34.33	17.98	6.70
France[a]	69.54	51.49	32.99	17.03	6.34

[a]The national figures were obtained on the basis of a radix allocation identical to the regional allocation of the 1975 male birth cohort.

Finally, Table 41 supplements the figures shown in Table 40 by indicating, for each number of remaining years, the proportion of these to be spent in the ZEAT of residence beyond the various ages selected. As one would expect, the proportion of remaining time in the region of current residence increases with age: it rises from 65.3 percent at time of birth to 98.3 percent at age 80 after reaching 88.6 percent at age 40. Observe the significantly lower proportions at all ages of the residents of the Paris Region (especially at ages 60 and 80) and the gradual disappearance, between ages 40 and 60, of the regional disparities existing across the other ZEATs.

TABLE 41 Percent of remaining lifetime at selected ages to be spent in the ZEAT of residence: males.

	Age				
ZEAT of residence	0	20	40	60	80
Paris Region	57.20	65.42	78.63	81.61	95.73
Paris Basin	64.08	70.87	88.84	95.60	98.14
North	68.76	74.66	90.92	96.31	98.92
East	68.17	74.56	90.16	96.42	98.78
West	69.90	75.32	93.45	97.69	98.81
Southwest	65.77	72.41	92.40	97.09	98.67
Middle East	70.49	76.57	91.16	96.14	98.61
Mediterranean	65.58	72.57	91.58	97.00	98.68
France[a]	65.32	72.09	88.58	93.91	98.30

[a]The national figures were obtained on the basis of a radix allocation identical to the regional allocation of the 1975 male birth cohort.

3.4 Multiregional Mortality, Fertility, and Migration Analysis

As mentioned earlier in our introduction to multiregional population analysis, the availability of a multiregional life table makes it possible to derive three matrices – generalizing the usual synthetic indicators of mortality, fertility, and migration – from which a global assessment of the factors of regional population change, fully integrating the influence of interregional migration, can be drawn.

SPATIAL LIFE EXPECTANCIES AT BIRTH

The matrix of life expectancies e_0 appears in Table 42, which gives absolute values as well as net allocations. From this we see that a Frenchman is likely to spend a considerable proportion of his life outside his ZEAT of birth: from 29.5 percent (for a native of the Middle East ZEAT) to 35.9 percent (for a native of the Paris Basin) but 42.8 percent for a native of the Paris Region. The largest

TABLE 42 Spatial life expectancies at birth: males.

ZEATs in which lifetime is spent	ZEAT of birth								
	Paris Region	Paris Basin	North	East	West	Southwest	Middle East	Mediterranean	All ZEATs[a]
a. Absolute values (in years)									
Paris Region	40.10	7.95	5.27	4.37	6.50	6.60	4.48	6.22	12.86
Paris Basin	9.51	44.54	5.88	5.19	5.50	3.84	4.11	3.68	13.34
North	1.08	1.41	46.39	0.84	0.56	0.55	0.50	0.63	4.96
East	1.77	2.40	1.57	46.96	1.20	1.48	1.65	1.82	6.13
West	5.35	4.12	1.80	1.96	48.41	3.52	1.74	2.49	9.67
Southwest	4.10	2.54	1.69	2.13	2.93	46.24	2.40	3.84	6.64
Middle East	3.45	3.24	2.10	3.16	1.74	3.09	49.28	5.54	8.39
Mediterranean	4.75	3.31	2.77	4.28	2.42	4.98	5.75	46.17	7.55
Total	70.11	69.51	67.47	68.89	69.26	70.31	69.91	70.40	69.54
b. Regional allocations (in percent)									
Paris Region	57.20	11.44	7.82	6.34	9.38	9.39	6.40	8.84	18.49
Paris Basin	13.57	64.08	8.72	7.53	7.94	5.46	5.88	5.22	19.18
North	1.54	2.02	68.76	1.22	0.81	0.79	0.72	0.89	7.13
East	2.52	3.45	2.32	68.16	1.73	2.10	2.36	2.59	8.82
West	7.63	5.93	2.67	2.85	69.90	5.01	2.50	3.54	13.91
Southwest	5.84	3.66	2.50	3.09	4.23	65.78	3.43	5.46	9.55
Middle East	4.93	4.66	3.11	4.59	2.51	4.40	70.49	7.87	12.06
Mediterranean	6.77	4.77	4.10	6.21	3.49	7.08	8.23	65.59	10.86
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

[a]The national averages in this column were obtained on the basis of a radix allocation identical to the regional allocation of the 1975 male birth cohort.

part of this proportion would be spent in the Paris Region (for a native of the Paris Basin, West, Southwest, and Mediterranean ZEATs), the Paris Basin (for a native of the Paris Region, North, and East ZEATs), or the Mediterranean ZEAT (for a native of the Middle East ZEAT). Note that when the amount of time spent in the Paris Region does not come in first place, it comes in second place. Thus, regardless of his place of birth, a Frenchman can expect to spend a great deal of his life in the Paris Region; in all, a male born in 1975 could expect to live 12.86 years of his life in that ZEAT out of a 69.54-year total. This number is only second to the amount of time he is likely to spend in the Paris Basin (13.34 years). Actually, the regional allocations of the total life expectancy at birth for a male born anywhere in France in 1975 (see last column of part b in Table 42) differ little from the regional allocations of the male population observed in 1975 (Table 43).

TABLE 43 Regional allocations (in percent) of the 1975 population and the life expectancy at birth associated with the 1975 cohort: males.

	ZEAT							
Measure	Paris Region	Paris Basin	North	East	West	South-west	Middle East	Mediter-ranean
1975 population	18.93	18.29	7.47	9.26	13.23	10.67	11.64	10.51
Life expectancy at birth of 1975 cohort	18.49	19.18	7.13	8.82	13.91	9.55	12.06	10.86

The column sums of the expectations-of-life matrix in absolute values (see last line of part a in Table 42) indicate that the total life expectancy at birth for a male ranges from 67.5 years (for a native of the North ZEAT) to 70.4 years (for a native of the Mediterranean ZEAT), giving a maximal differential across ZEATs of 2.9 years (against 5.0 years as derived from the single-region analysis of section 2).

Table 44 contrasts these total life expectancy figures specific to the regional birth cohorts with those specific to the ZEATs themselves, which we derived in section 2 from a single-region analysis. The contrast is extended to include the case of females as well as the two sexes aggregated.* This table confirms the observation that the inclusion of migration appears to smooth mortality differentials across ZEATs. The ZEATs with comparatively higher mortality have multiregional values for their expectations of life that are higher than their single-region counterparts (Paris Basin, North, East, West, and Middle East), whereas those with comparatively lower mortality have multiregional values that are

*Note that the life expectancy at birth of a Frenchman born in 1975, obtained by aggregating the regional life expectancies at birth (multiregional values), is virtually identical to the figure traditionally calculated.

TABLE 44 Single-region and multiregional values of the regional life expectancies at birth.

ZEAT	Males		Females		Both sexes aggregated	
	Single-region	Multiregional	Single-region	Multiregional	Single-region	Multiregional
Paris Region	70.70	70.11	78.35	77.89	74.64	74.00
Paris Basin	69.28	69.51	77.48	77.58	73.26	73.48
North	66.07	67.47	74.66	75.81	70.24	71.55
East	68.25	68.89	76.44	76.99	72.25	72.87
West	68.83	69.26	77.36	77.57	73.03	73.36
Southwest	70.71	70.31	78.14	77.99	74.37	74.11
Middle East	69.74	69.91	77.66	77.78	73.63	73.79
Mediterranean	71.03	70.39	78.43	78.04	74.72	74.20
France	69.545	69.540[a]	77.510	77.521[a]	73.481	73.485[a]

[a]These national figures were obtained on the basis of a radix allocation identical to the regional allocation of the 1975 birth cohort for the relevant group.

smaller than their single-region values (Paris Region, Southwest, and Mediterranean).* Actually, a simple regression analysis of the multiregional values of total life expectancies at birth against their corresponding single-region values indicates a high correlation ($R^2 = 0.993$ for males and 0.991 for females) for a regression coefficient of 0.5840 (males) and 0.5892 (females). This suggests that the inclusion of migration leads to a general reduction of mortality differentials of roughly 40 percent (more exactly 41.6 percent for males and 41.1 percent for females).

SPATIAL FERTILITY EXPECTANCIES

The matrix of net reproduction rates **NRR** appears in Table 45, which gives absolute values as well as net allocations. Not surprisingly, given that a large proportion of an individual's life is spent outside the region of birth, a Frenchwoman has a high probability of giving birth to a daughter outside her region of birth. This probability ranges from 27.2 percent (for a native of the East) to 34.5 percent (for a native of the Southwest), but it is 39.5 percent for a native of the Paris Region.

The last column of part b in Table 45 shows the regional allocation of the female births expected to occur to a woman born anywhere in France in 1975. Comparison of this allocation with that of the female births observed in 1975 (Table 46) indicates that the 1975 female cohort and the group of their female offspring have a similar distribution of birthplace. But, whereas more mothers were born in the Paris Region (19.7 percent) than in the Paris Basin (19.2 percent), more daughters will be born in the Paris Basin (19.2 percent) than in the Paris Region (19.0 percent).

The column sums of the net reproduction rate matrix in absolute values (see last line of part a in Table 45) indicate that the total net reproduction rate of a Frenchwoman ranges, according to her ZEAT of birth, from 0.83 (for a native of the Mediterranean ZEAT) to 1.03 (for a native of the North ZEAT) for a maximum differential across ZEATs of 0.20 (as against the 0.28 figure derived from the single-region analysis of section 2).

Table 47 contrasts the single-region and multiregional values of the total net reproduction rates, suggesting that the inclusion of migration also smooths fertility differentials across ZEATs.** Multiregional values are higher in the ZEATs with comparatively lower fertility (Paris Region, Southwest, and Mediterranean), whereas single-region values are higher in those with comparatively higher fertility (Paris Basin, North, East, West, and Middle East).*** Note that a simple regression of the multiregional values against the corresponding single-region values indicates a high correlation ($R^2 = 0.997$) for a regression coefficient

*For both males and females, these two groups of ZEATs almost coincide with those that have lower and higher life expectancies at birth than the nation as a whole. The only exception is the Middle East ZEAT, which has a life expectancy at birth higher than the national average but a multiregional value of this statistic higher than its single-region value.

**Note that the total net reproduction rate of a Frenchwoman born in 1975 obtained by aggregating the regional *NRR*s (multiregional values) is virtually identical to the national figure traditionally calculated.

***These two groups almost coincide with the groups of ZEATs with fertility levels higher and lower than the national level. An exception is once again the Middle East ZEAT.

TABLE 45 Spatial fertility expectancies (net reproduction rate matrix).

ZEAT of birth of daughter	ZEAT of birth of mother								
	Paris Region	Paris Basin	North	East	West	Southwest	Middle East	Mediterranean	All ZEATs[a]
a. Net reproduction rates									
Paris Region	0.531	0.118	0.070	0.056	0.098	0.094	0.058	0.081	0.174
Paris Basin	0.119	0.633	0.075	0.063	0.069	0.043	0.049	0.040	0.176
North	0.015	0.022	0.787	0.011	0.007	0.008	0.007	0.008	0.085
East	0.020	0.030	0.018	0.671	0.013	0.015	0.020	0.021	0.083
West	0.066	0.052	0.019	0.022	0.723	0.045	0.019	0.027	0.136
Southwest	0.040	0.024	0.015	0.020	0.030	0.552	0.023	0.040	0.074
Middle East	0.040	0.039	0.024	0.039	0.019	0.036	0.652	0.069	0.107
Mediterranean	0.046	0.031	0.025	0.041	0.022	0.050	0.059	0.545	0.082
Total	0.878	0.949	1.033	0.922	0.981	0.844	0.887	0.831	0.917
b. Net reproduction allocations (in percent)									
Paris Region	60.47	12.46	6.75	6.08	9.95	11.18	6.57	9.77	19.03
Paris Basin	13.60	66.73	7.25	6.80	7.07	5.10	5.54	4.77	19.20
North	1.68	2.30	76.17	1.19	0.71	0.93	0.77	0.99	9.24
East	2.32	3.18	1.78	72.78	1.33	1.82	2.20	2.47	9.07
West	7.49	5.52	1.86	2.39	73.70	5.32	2.16	3.27	14.83
Southwest	4.61	2.48	1.44	2.13	3.08	65.45	2.59	4.85	8.07
Middle East	4.55	4.09	2.34	4.19	1.95	4.23	73.50	8.30	11.65
Mediterranean	5.28	3.24	2.41	4.43	2.20	5.97	6.67	65.59	8.89
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

[a]The national figures in this column were obtained on the basis of a radix allocation identical to the regional allocation of the 1975 female birth cohort.

TABLE 46 Regional allocations (in percent) of the 1975 female birth cohort and its female offspring.

Measure	ZEAT Paris Region	Paris Basin	North	East	West	South-west	Middle East	Mediter-ranean
1975 cohort	19.74	19.22	8.97	9.64	13.92	8.70	11.33	8.47
Daughters of members of 1975 cohort	19.03	19.20	9.24	9.07	14.83	8.07	11.65	8.89

TABLE 47 Single-region and multiregional values of the regional net reproduction rates.

Measure	ZEAT Paris Region	Paris Basin	North	East	West	South-west	Middle East	Mediter-ranean	France
Single-region	0.852	0.969	1.084	0.934	1.019	0.818	0.892	0.802	0.917
Multiregional	0.878	0.949	1.033	0.922	0.981	0.844	0.887	0.831	0.917[a]

[a]This national figure was obtained on the basis of a radix allocation identical to the regional allocation of the 1975 female birth cohort.

of 0.6969. This suggests that the inclusion of migration leads to a general reduction of fertility differentials across ZEATs of 30.3 percent.

SPATIAL MIGRATION EXPECTANCIES

The matrix of net migraproduction rates **NMR** relating to males only is set out in Table 48, which gives absolute values as well as net allocations.

Based on the same migration information as the total net migraproduction rates estimated in section 2 from a single-region methodology, the values of the elements contained in the **NMR** matrix greatly underestimate the number of moves made annually out of each ZEAT. (A multiplication of all elements by 1.6 is required to obtain a rough estimate of the true **NMR** matrix.) Since the underestimation is roughly identical for each element, however, the net allocation matrix can be regarded, in the first approximation, as being accurate.

As we could reasonably expect in light of earlier results, a large proportion of the "transfers"* that a Frenchman makes between ZEATs relates to transfers

*"Transfer" is substituted here for "move" to reflect the incorrect migration base used for the calculation of the **NMR** matrix.

TABLE 48 Spatial migration expectancies (net migraproduction rate matrix): males.

ZEAT of out-migration	ZEAT of birth Paris Region	Paris Basin	North	East	West	Southwest	Middle East	Mediterranean	All ZEATs[a]
a. Net migraproduction rates									
Paris Region	0.678	0.122	0.080	0.066	0.100	0.101	0.068	0.095	0.210
Paris Basin	0.089	0.535	0.054	0.048	0.051	0.034	0.037	0.032	0.147
North	0.008	0.010	0.425	0.006	0.004	0.004	0.003	0.004	0.044
East	0.013	0.018	0.012	0.448	0.009	0.011	0.012	0.014	0.055
West	0.035	0.026	0.010	0.012	0.426	0.022	0.010	0.015	0.078
Southwest	0.030	0.018	0.012	0.015	0.021	0.483	0.017	0.029	0.061
Middle East	0.024	0.022	0.014	0.022	0.012	0.022	0.434	0.040	0.069
Mediterranean	0.036	0.024	0.020	0.032	0.017	0.039	0.044	0.497	0.069
Total	0.913	0.775	0.628	0.648	0.640	0.716	0.627	0.727	0.732
b. Net migraproduction allocations (in percent)									
Paris Region	74.26	15.71	12.79	10.22	15.60	14.15	10.85	13.09	28.63
Paris Basin	9.78	68.94	8.67	7.34	7.93	4.77	5.93	4.46	20.03
North	0.86	1.33	67.75	0.93	0.62	0.55	0.55	0.61	5.98
East	1.45	2.38	1.90	69.10	1.40	1.56	1.98	1.91	7.54
West	3.79	3.36	1.66	1.80	66.62	3.12	1.63	2.11	10.62
Southwest	3.33	2.31	1.83	2.30	3.36	67.45	2.73	3.98	8.31
Middle East	2.62	2.89	2.25	3.35	1.81	3.01	69.27	5.46	9.39
Mediterranean	3.91	3.08	3.15	4.96	2.67	5.39	7.06	68.38	9.45
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

[a]The national figures in this column were obtained on the basis of a radix allocation identical to the regional allocation of the 1975 male birth cohort.

made out of a ZEAT other than his ZEAT of birth: from 30.7 percent (for a native of the Middle East) to 33.4 percent (for a native of the West) but only 25.7 percent for a native of the Paris Region. These percentages match the corresponding proportions of time spent by a Frenchman outside his region of birth in all cases except for a native of the Paris Region who, at the time of his birth, can expect to spend 42.8 percent outside this region. The large discrepancy in this case can be attributed to the earlier observation that older natives of the Paris Region have a comparatively higher propensity to move out and never return.

The last column of part b in Table 48 shows the regional allocation of the total net migraproduction rate for a male born anywhere in France in 1975. As suggested by the figures in Table 49, this allocation is little different from the 1975 allocation of the inter-ZEAT transfers by place of origin.

TABLE 49 Regional allocations (in percent) of the 1975 transfers and the total net migraproduction rate associated with the 1975 cohort: males.

	ZEAT							
Measure	Paris Region	Paris Basin	North	East	West	South-west	Middle East	Mediter-ranean
1975 transfers	27.92	19.69	6.11	8.15	10.23	9.19	9.30	9.42
Total net migra-production rate of 1975 cohort	28.63	20.03	5.98	7.54	10.62	8.31	9.39	9.45

The total net migraproduction rates, that is, the column sums of the matrix (see last line of part a in Table 48), take on values ranging from 0.63 (for a native of the North and Middle East ZEATs) to 0.91 (for a native of the Paris Region) for a maximal differential of 0.32 as against the 0.57 figure derived from the single-region analysis of section 2.

Table 50 contrasts these total net migraproduction rate figures with their single-region analogs, a comparison that is also extended to the case of females and both sexes aggregated.* As in the cases of mortality and fertility, the adoption of a multiregional framework also smooths differentials across ZEATs. The Paris Region, the ZEAT with the highest mobility level, has the multiregional value of its total *NMR* more than two-tenths of a point under its single-region value. The Paris Basin, the ZEAT with the second highest mobility level, has single-region and multiregional values that are roughly equal. The remaining

*Observe that the total net reproduction rate of a male or a female born in 1975 obtained by aggregating the regional net reproduction rate (multiregional values) is virtually identical to the corresponding figure calculated on the basis of a single-region methodology.

TABLE 50 Single-region and multiregional values of the regional net migraproduction rates.

	Males		Females		Both sexes aggregated	
ZEAT	Single-region	Multi-regional	Single-region	Multi-regional	Single-region	Multi-regional
Paris Region	1.137	0.912	1.204	0.963	1.171	0.938
Paris Basin	0.767	0.775	0.848	0.846	0.806	0.810
North	0.567	0.628	0.604	0.671	0.585	0.649
East	0.606	0.648	0.627	0.680	0.617	0.664
West	0.562	0.640	0.611	0.697	0.586	0.668
Southwest	0.671	0.716	0.693	0.749	0.682	0.732
Middle East	0.575	0.627	0.610	0.665	0.592	0.646
Mediterranean	0.697	0.727	0.701	0.746	0.699	0.737
France	0.732	0.732[a]	0.780	0.780[a]	0.756	0.756[a]

[a]These national figures were obtained on the basis of a radix allocation identical to the regional allocation of the 1975 birth cohort for the relevant group.

ZEATs, which have weaker mobility propensities, are characterized by higher multiregional than single-region values.

A rough indicator of the reduction in regional mobility differentials implied by the switch from a single-region to a multiregional framework is provided by a simple regression of the multiregional values of the total *NMR*s against their single-region analogs. There appears to be a high correlation ($R^2 = 0.978$ for males and 0.976 for females) for a regression coefficient of 0.5017 (males) and 0.4942 (females). In other words, the explicit consideration of place-to-place migration streams leads to an overall reduction of the estimated mobility differentials across ZEATs of roughly 50 percent.

3.5 Projection and the Long-run Stable Equilibrium

In this subsection we report on the consequences of keeping regional fertility, mortality, and mobility patterns observed in 1975 indefinitely unchanged.* Specifically, we present selected results following from the use of the multiregional population growth model described in subsection 3.2 as a projection model (for the female population only).

Table 51 shows the female population of the eight ZEATs during the period 1975–2050 at 5-year intervals. It suggests that the (female) population of France, if fertility, mortality, and migration levels are kept constant at their observed levels, will eventually vanish – a result that was expected since France's

*This exercise implicitly considers the country as a closed country; it ignores the influence of international migration.

TABLE 51 Multiregional population projection: 1975–2050 evolution and stable equivalent of the female population (in thousands) of France and its eight ZEATs.

Year	France	ZEAT Paris Region	Paris Basin	North	East	West	South-west	Middle East	Mediter-ranean
1975	26 751	5 063	4 894	1 997	2 477	3 540	2 855	3 114	2 810
1980	27 264	5 140	5 007	2 013	2 506	3 626	2 871	3 189	2 912
1985	27 692	5 191	5 107	2 027	2 531	3 705	2 878	3 256	2 997
1990	28 072	5 229	5 200	2 038	2 551	3 780	2 882	3 319	3 072
1995	28 341	5 245	5 270	2 042	2 558	3 841	2 878	3 373	3 133
2000	28 504	5 245	5 318	2 039	2 555	3 887	2 866	3 412	3 181
2005	28 601	5 239	5 355	2 033	2 544	3 924	2 848	3 441	3 216
2010	28 840	5 255	5 417	2 035	2 542	3 981	2 853	3 484	3 272
2015	28 830	5 229	5 431	2 024	2 522	4 007	2 827	3 496	3 293
2020	28 783	5 193	5 437	2 012	2 498	4 028	2 803	3 502	3 310
2025	28 648	5 142	5 423	1 996	2 467	4 037	2 773	3 496	3 314
2030	28 444	5 086	5 392	1 975	2 428	4 033	2 739	3 480	3 311
2035	28 220	5 036	5 361	1 953	2 387	4 026	2 703	3 455	3 299
2040	27 723	4 944	5 270	1 918	2 327	3 977	2 636	3 402	3 247
2045	27 255	4 862	5 186	1 883	2 269	3 932	2 573	3 353	3 197
2050	26 809	4 787	5 105	1 850	2 214	3 886	2 515	3 304	3 149
Stable equivalent	33 595	6 033	6 452	2 219	2 436	5 311	2 992	4 193	3 959

net reproduction rate was observed to be below replacement level in 1975. Note that the population decline will not start in 1975; the projected population increases until 2010 at which time it reaches its peak of 28.84 million. In spite of fertility being at subreplacement level, this initial increase in population simply reflects the strong momentum of the female population originating from an age structure that was still relatively young in 1975. The same evolutive pattern can be observed in the case of the individual ZEATs, but the maximal female population is reached at different times (as early as 1990 in the case of the Southwest ZEAT and as late as 2025 in the case of the West ZEAT).

Table 52, which shows the evolution of the national and regional growth rates of the female population over the period 1980–2050, points to an overall downward trend. This tendency, however, is not monotonic; rather curiously, a temporary break appears to occur during the period 2005–2010 in all ZEATs. Eventually, the female population of each ZEAT will decline at the same long-term rate of 3.05 per thousand, a value which some regional growth rates should approach around the middle of the next century. At that time the growth rates of the Southwest and East ZEATs, and to a lesser degree those of the North and West ZEATs, will still differ substantially from their long-term values.

TABLE 52 Multiregional population projection: growth rates (per thousand) of the female population of France and its eight ZEATs at 5-year intervals (1980–2050) and at stability.

		ZEAT							
Year	France	Paris Region	Paris Basin	North	East	West	South-west	Middle East	Mediter-ranean
1980	3.802	3.017	4.580	1.640	2.314	4.790	1.111	4.729	7.098
1985	3.117	1.966	3.950	1.349	2.005	4.334	0.496	4.185	5.733
1990	2.721	1.457	3.623	1.089	1.528	4.002	0.330	3.820	4.946
1995	1.913	0.606	2.680	0.392	0.609	3.209	−0.289	3.205	3.956
2000	1.147	−0.006	1.803	−0.321	−0.273	2.391	−0.841	2.337	3.068
2005	0.678	−0.216	1.371	−0.605	−0.823	1.875	−1.257	1.701	2.170
2010	1.663	0.593	2.307	0.220	−0.186	2.923	0.362	2.423	3.475
2015	−0.065	−0.970	0.535	−1.077	−1.597	1.254	−1.841	0.710	1.298
2020	−0.330	−1.404	0.198	−1.210	−1.904	1.071	−1.707	0.335	0.997
2025	−0.941	−1.956	−0.524	−1.612	−2.482	0.441	−2.164	−0.345	0.235
2030	−1.427	−2.194	−1.117	−2.132	−3.193	−0.202	−2.439	−0.919	−0.202
2035	−1.586	−1.968	−1.175	−2.171	−3.436	−0.364	−2.689	−1.411	−0.739
2040	−3.554	−3.682	−3.410	−3.691	−5.035	−2.422	−5.015	−3.081	−3.132
2045	−3.402	−3.352	−3.233	−3.627	−5.079	−2.299	−4.837	−2.942	−3.096
2050	−3.296	−3.127	−3.144	−3.529	−4.934	−2.368	−4.587	−2.907	−3.025
Stability	−3.046	−3.046	−3.046	−3.046	−3.046	−3.046	−3.046	−3.046	−3.046

Table 53, which presents the evolution of the regional shares of the female population over the projection period, indicates a general monotonic evolution: upward in the case of the Paris Basin, West, Middle East, and Mediterranean ZEATs, and downward in the case of the North, East, and Southwest ZEATs, and to some extent the Paris Region. The Paris Region share decreases until 2040 and then slowly increases toward its long-term value. Although this multiregional projection exercise is based on migration data relating to the period 1968–1975, the above evolutive tendencies are not always an extension of the trend observed during that period. For example, the Paris Region share, which was increasing before 1975 as a consequence of a large net entry of international migrants, will decrease without such an influx. Moreover, the Paris Basin share, which was stable immediately before 1975, and the West share, which was declining previously, will both increase as a result of the comparatively higher fertility levels observed in these ZEATs in 1975 (see Table 47).

Observe the rather small change in the regional distribution of the population implied by our multiregional projection exercise. The differential existing between the 1975 and long-term shares, in absolute values, ranges from slightly less than 1 percent (in the case of the North ZEAT) to slightly over 2.5 percent (in the case of the West ZEAT). In most ZEATs, the long-term share is approached

TABLE 53 Multiregional population projection: percentage shares of the female population by ZEAT for selected years and at stability.

Year	ZEAT Paris Region	Paris Basin	North	East	West	South-west	Middle East	Mediter-ranean
1975	18.93	18.29	7.47	9.26	13.23	10.67	11.64	10.51
1980	18.85	18.37	7.39	9.19	13.30	10.53	11.70	10.68
1985	18.75	18.44	7.32	9.14	13.37	10.39	11.75	10.82
1990	18.63	18.53	7.26	9.09	13.47	10.27	11.82	10.94
1995	18.51	18.60	7.21	9.03	13.55	10.16	11.97	11.16
2000	18.40	18.66	7.15	8.96	13.64	10.06	11.97	11.16
2005	18.32	18.72	7.11	8.90	13.72	9.96	12.03	11.24
2010	18.22	18.78	7.06	8.81	13.81	9.89	12.08	11.35
2015	18.14	18.84	7.02	8.75	13.90	9.81	12.13	11.42
2020	18.04	18.89	7.00	8.68	14.00	9.74	12.17	11.50
2025	17.95	18.93	6.97	8.61	14.09	9.68	12.20	11.57
2030	17.88	18.96	6.94	8.54	14.18	9.63	12.23	11.64
2035	17.85	19.00	6.92	8.46	14.27	9.58	12.24	11.69
2040	17.84	19.01	6.92	8.40	14.35	9.51	12.27	11.71
2045	17.84	19.03	6.91	8.33	14.43	9.44	12.30	11.73
2050	17.86	19.04	6.90	8.26	14.49	9.38	12.33	11.75
2075	17.86	19.10	6.87	7.99	14.80	9.17	12.40	11.80
2175	17.91	19.18	6.75	7.47	15.45	8.92	12.50	11.82
2275	17.94	19.20	6.68	7.32	15.68	8.90	12.50	11.80
2375	17.95	19.20	6.64	7.27	15.76	8.90	12.49	11.79
2475	17.95	19.20	6.62	7.26	15.71	8.90	12.48	11.79
2575	17.96	19.20	6.61	7.25	15.81	8.90	12.48	11.79
Stability	17.96	19.20	6.60	7.25	15.81	8.91	12.48	11.79

rapidly. By the year 2050, the population share of each ZEAT generally falls within half a point of its long-term value, the only exceptions being the East and West ZEATs, which have population shares that are still 1.0 and 1.3 percent away from their ultimate values.

For each of the eight ZEATs, Figure 37 contrasts the age structure of the female population in the years 1975 and 2000 as well as at stability. Generally, the relationship of the age structure in the year 2000 to that of 1975 is clearly illustrated since the middle part of the former exhibits a similar shape to the early part of the latter. The only exception is the Paris Region, for which the high peak observed in 1975 for the age group 20–24 does not give way to a high peak for the age group 45–49, 25 years later. The age structures at stability initially resemble, with the exception of the Paris Region, a straight line, which slopes upward except for the North ZEAT. All the lines have a final portion that falls downward regularly and rather rapidly.

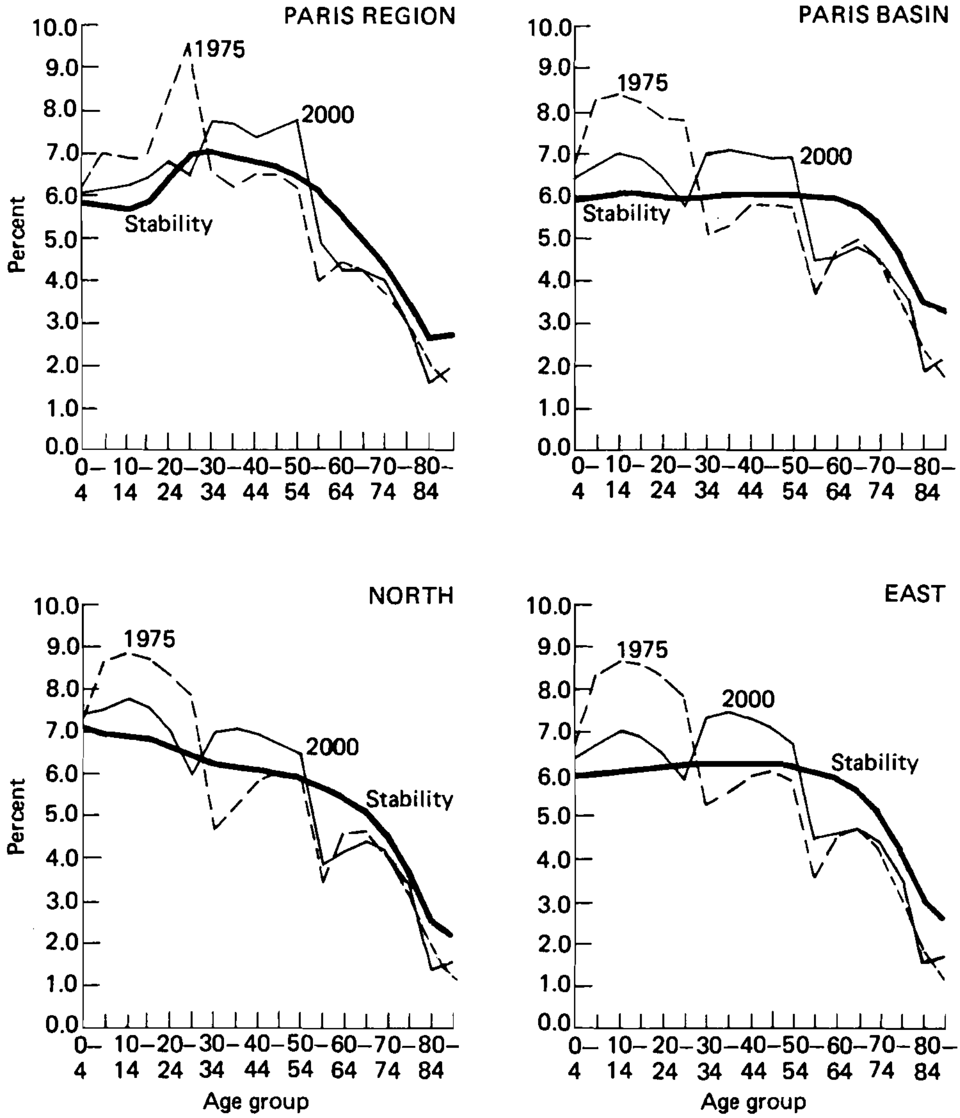

FIGURE 37 Age structure of the female population (in percent): ZEATs, 1975, 2000, and at stability.

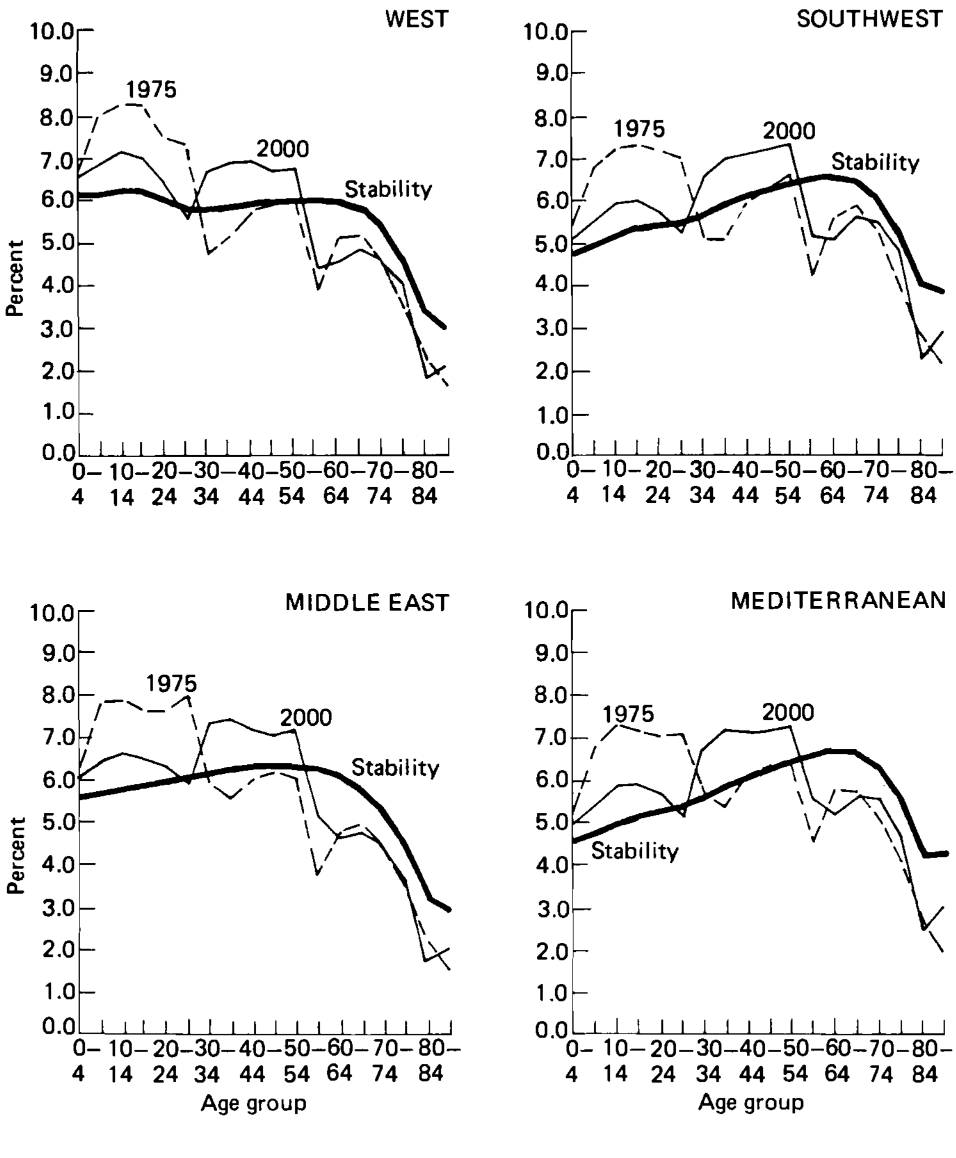

FIGURE 37 *(continued).*

Figure 38, which plots the stable age structure of each ZEAT on the same graph, allows some interesting comparisons. For example, the ZEATs with the two smallest fertility levels – the Southwest and Mediterranean – have a comparatively smaller number of youngsters and a comparatively higher number of elderly. The North ZEAT, however, is the most fertile, and has relatively more youngsters and less elderly than the other ZEATs. Figure 38 also illustrates that all of the ZEATs have similar proportions of females in mid-life, with only the Paris Region having a significantly higher proportion.

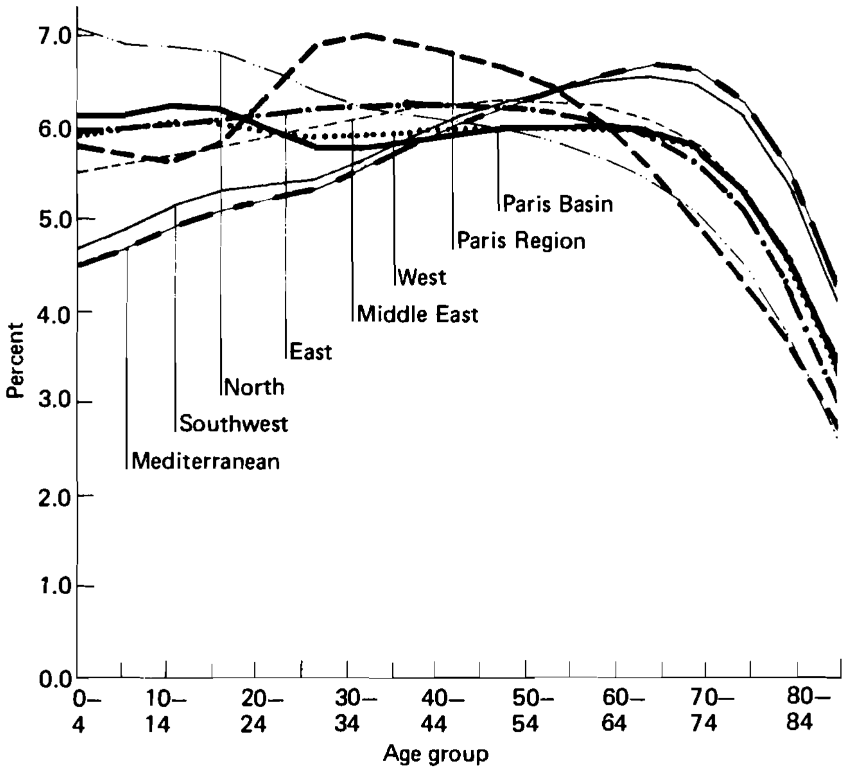

FIGURE 38 Stable age structure of the female population (in percent).

Finally, Table 54 shows the evolution of the mean age of the female population of France and its ZEATs over the projection period. It substantiates the expected aging of these populations. The national value of the mean age increases from 37.44 years in 1975 to 42.62 years in 2035 and, after passing through this maximum, decreases to 42.39 years in 2050, slowly fluctuating around its ultimate value of 42.36 years thereafter.

TABLE 54 Multiregional population projection: mean age of the female population (in years) for France and its eight ZEATs for selected years and at stability.

Year	France	ZEAT Paris Region	Paris Basin	North	East	West	South-west	Middle East	Mediter-ranean
1975	37.44	37.04	36.74	35.27	35.69	37.30	40.16	37.25	40.06
1980	37.99	37.42	37.31	35.67	36.43	37.77	40.82	37.79	40.85
1985	38.26	37.58	37.58	35.79	36.85	37.94	41.17	38.08	41.25
1990	38.49	37.77	37.85	35.87	37.18	38.07	41.44	38.30	41.54
1995	38.81	38.06	38.21	36.12	37.63	38.32	41.75	38.65	41.87
2000	39.30	38.49	38.74	36.54	38.27	38.75	42.20	39.18	42.37
2005	39.83	38.97	39.32	36.97	38.94	39.20	42.70	39.78	42.89
2010	40.60	39.62	40.14	37.55	39.75	39.92	43.57	40.60	43.76
2015	40.97	39.90	40.56	37.80	40.19	40.24	43.91	41.01	44.18
2020	41.37	40.17	41.02	38.12	40.65	40.65	44.34	41.43	44.65
2025	41.79	40.45	41.49	38.50	41.13	41.09	44.80	41.87	45.13
2030	42.22	40.74	41.93	38.84	41.56	41.52	45.30	42.30	45.67
2035	42.62	41.05	42.39	39.18	41.95	41.95	45.77	42.66	46.15
2040	42.54	40.90	42.29	39.10	41.90	41.87	45.68	42.60	46.10
2045	42.45	40.81	42.21	39.00	41.78	41.80	45.56	42.54	46.03
2050	42.39	40.79	42.15	38.94	41.67	41.73	45.45	42.49	45.97
2075	42.41	40.81	42.19	38.97	41.62	41.80	45.38	42.54	46.02
2375	42.36	40.77	42.17	38.93	41.35	41.87	45.18	42.56	45.99
Stability	42.36	40.77	42.17	38.92	41.34	41.87	45.18	42.55	45.99

The age structure shows a similar evolution in all ZEATs, although the aging of the population is not uniform: the mean age of the female population increases between 1975 and stability from 3.7 years (North ZEAT) to 5.7 years (East ZEAT), causing the maximal differential of 4.9 years observed in 1975 to increase to 7.1 years at stability.

Table 54 also indicates that the stable age distribution is generally reached rapidly; by the year 2050, the mean age of the female population approaches its ultimate value in all ZEATs except the East, West, and Southwest. In any case, as suggested by comparing Tables 53 and 54, the stability of the regional age structures is reached more rapidly than the stability of the regional population shares.

3.6 Some Limitations

We could reasonably ask ourselves: How accurate are the results obtained above? This question is not so much addressed to the multiregional mobility analysis (the accuracy of which is impaired by the incorrect estimation of the migration rates used) as to the whole multiregional population analysis, for this analysis relies on assumptions that may not reflect the real world. Recall that these assumptions are such that an individual adopts the mortality, fertility, and mobility regimes of the region to which he has just moved, regardless of his mobility history (Markovian assumption) and his region of birth (population homogeneity assumption). The issue then becomes one of testing the validity of this "forgetting" hypothesis.

Because the necessary data are commonly lacking, such a test cannot be performed and indications about the hypothesis validity can only be obtained indirectly. Actually, there exists some evidence suggesting that the hypothesis may be acceptable, in the first approximation, with respect to mortality and fertility. Rees (1979, p. 100) cites two studies in the United Kingdom, which conclude that fertility rates of recent immigrants "fall between those of the country of origin and the host country and show fairly rapid convergence over time." The hypothesis is not correct, however, in the case of mobility. Past studies tend to indicate that neither the Markovian assumption nor the population homogeneity assumption hold in the real world. There are some individuals (chronic movers) who are more prone to migrate than others (Goldstein 1954, Morrison 1971). Furthermore, migration propensities heavily depend on the place of birth; in particular, the propensity to migrate to a given region is several times higher for a native than for a non-native of this region (Long and Hansen 1975, Ledent 1981).

Note that Ledent (1981) has constructed a multiregional life table for the four-region system of the US (females only) observed between 1965 and 1970 using native-dependent migration data. Comparison of the results with those obtained from the more usual construction based on native-independent migration data indicates a reduction of at least 50 percent in the proportion of the total expectations of life at birth to be spent outside the region of birth. Thus the reader should not attach too much importance to the actual values of the multiregional statistics derived but rather should consider the above multiregional population analysis as an illustration of multiregional population techniques, making use of French data.

4 POPULATION DISTRIBUTION POLICIES

Since there is no legislation restricting the internal migration of citizens in France, population distribution can only be controlled through incentive measures. It is, in fact, an integral part of *aménagement du territoire* (territorial planning).

Territorial planning, a process that seeks a better geographical distribution of economic activity in relation to that of natural resources, was introduced as early as 1950 to achieve a harmonious distribution of economic development in France. However, because it did not involve a global strategy capable of influencing the policies and programs pursued by individual government ministries, such an approach remained mostly inefficient until 1963. That year, a new impetus was given with the creation of the Délégation à l'Aménagement du Territoire et à l'Action Régionale (DATAR) – an interministerial organization in charge of coordinating the various governmental decisions influencing the development of the regions. DATAR was to become the main element responsible for the recent elaboration of territorial planning.

In this section, we present a review of the different aspects of territorial planning in France, inasmuch as they affect the geographical redistribution of the population. Subsection 4.1 describes the nature of the regional problem in France. Subsection 4.2 stresses how territorial planning can solve this problem and indicates how the solution has evolved. Two periods are distinguished: before and after the creation of DATAR. The means and ways of territorial planning used in the latter period are discussed in detail in subsections 4.3 to 4.6. Subsection 4.3 examines its political aspects, whereas the next three deal with its main economic orientations (location of activities, urban and rural development policy, and transportation policy). Finally, subsection 4.7 provides a rapid appraisal of the influence of territorial planning on population redistribution in France.

4.1 The Nature of the Problem

In the late forties, France's population was unequally distributed as a result of concentration and depopulation, characteristic since the middle of the last century. This twofold demographic disequilibrium was indeed the reflection of an economic process whereby the most populated zones accumulated the fruits of economic development, while the others, very often losing their population, remained underdeveloped.

On the one hand, the industrial revolution caused the exertion of pull effects by a few industrial cities in the North and the East and some metropolitan areas such as Marseille and especially Paris. The rapid growth experienced by Paris since the middle of the nineteenth century – which had no equivalent in the neighboring countries – was stressed by Gravier (1947) in a provocative essay entitled *Paris and the French Desert.* In it he outlines the sequence that led from an administrative centralization (which progressively dominated the decision-making process in France) to an economic centralization, thus resulting in the formation of a Parisian monopoly.*

On the other hand, the agricultural sector, a factor of political stability generally considered as a means of counterbalancing periodic industrial crises, was slowed down by the adoption of protectionist measures. Because of this, the rural milieu did not benefit from the overall economic transformation of the country. The western and southwestern regions, where most of the farmers were concentrated, particularly suffered; the half of France located west of a line from Le Havre to Marseille lost two million inhabitants between 1866 and 1946.

*According to Gravier, approximately one-half of the national population increase registered between 1861 and 1936 took place in Paris, while industrial employment, between 1896 and 1931, rose by 63 percent in Paris as opposed to 18 percent in the rest of the country.

In addition to this twofold disequilibrium inherited from the industrial revolution, another aspect of the regional problem in France followed in the late forties. Structural changes were starting to affect traditional industries, a problem that soon was to be exacerbated with the creation of the Common Market and the emergence in the world of new industrial powers. The main areas affected were the regions engaged in such activities as coal mining, iron and steelmaking, and textiles: the northern area (where, in 1950, about three-fourths of the labor force was employed in the declining mining and textile sectors), the eastern area (Lorraine and Alsace), and the St. Etienne area.

Thus since the late forties and early fifties, France has had three regional problems: the dominance of Paris over the rest of the country, the decline of the agricultural western and southwestern areas, and more recently, the effects of industrial change.

4.2 The Development of Territorial Planning

In spite of the vivid nature of the regional problem in the years following the Second World War, the first two national economic plans adopted failed to affect the spatial distribution of socioeconomic opportunities, especially the Plan Monnet (Plan of Modernization and Equipment, 1948–1952).

THE EARLY STAGE OF TERRITORIAL PLANNING (1950–1962)

Territorial planning, as a means of remedying the regional problem in France, was first suggested in 1950 by the Minister for Reconstruction and Housing, who hoped to promote decentralized industrialization as well as agricultural renaissance.

Unfortunately, the means to establish such a proposed approach were modest. Only a small loan fund, the Fonds National d'Aménagement du Territoire, was created to finance the development of well-located and well-equipped industrial parks as well as housing for workers. Indeed, the results were limited: by 1954, only nine industrial parks had been established and few (about 50) industrial projects of importance had taken place in the provinces. By contrast, in the same period, 270 industrial expansion projects had been undertaken in the Paris Region.

Nevertheless, territorial planning was becoming accepted as an integral part of the national policy for economic expansion. In the years 1954–1955, several decisions establishing a systematic and coherent policy and employing much greater technical and financial resources were taken. Three directions were established reflecting the three aspects of the regional problem identified above.

The leading idea was to check the flow of economic activity and population into the Paris Region. Thus a control of industrial and commercial construction was imposed in Paris with the creation of the Commissariat à la Construction et à l'Urbanisme pour la Région Parisienne. Establishments employing more than 50 persons or occupying more than 500 square meters could not expand by more than 10 percent without the approval of the Commissariat. In addition, a loan fund, the Fonds de Développement Economique et Social (FDES), was created to finance industrial decentralization outside the Paris Region through loans (at an interest rate 2 to 3 percent below the market rate) and tax rebates (on the transfer tax concerning buildings required for industrial purposes).

Rural renewal legislation was passed to permit the creation of Sociétés d'Equipement d'Economie Mixte (that is, joint public/private sector ventures) to undertake major infrastructural programs in rural regions. Centered around the transformation of the economy in meridional regions, these companies were intended to renovate all aspects of agricultural activities, particularly irrigation and drainage.

Moreover, industrial reconversion grants amounting to 20 percent of the required capital investment for location in the critical zones were offered by the government. (In practice, however, the loans amounted to 8 or 12 percent.) These zones were defined as regions suffering from underemployment and insufficient economic development. In addition, regional credit organizations (Sociétés de Développement Régional) were created, which were intended to counter the centralization of the country's credit resources in Paris and to facilitate the location of new or decentralizing firms in those critical regions. These companies were authorized to acquire equity in firms, make loans, or underwrite long-term borrowing of the firms in which they had interests.

Note that manpower programs were also designed to help the relocation of the victims of industrial transformation. Assistance was offered by the FDES to those who were unemployed and living in areas where no employment opportunities were available to them and were willing to accept a job in an area indicated by the fund distributing assistance. (In general, assistance was accorded to key workers in industries moving out of Paris.) The benefits promised consisted of a reimbursement of the cost of moving and an installation bonus varying with the area of destination. This policy came the closest to being a direct policy of population distribution in France, but few workers seem to have benefited from it. Klaasen and Drewe (1973) indicate that, in 1966, 1288 workers received assistance under this scheme. They conclude that "from the point of view of the regional goal of quantitative and qualitative balance on migration, the scheme's effectiveness is very limited." (p. 74) They argue that "even if the schemes were more widely known, however, it is questionable whether, given their basic limitations, they would be much more effective." (p. 75)

Examining in detail this battery of programs, Sundquist (1975, p. 98) concludes that "France has put in place what was, for its time, the most systematic and comprehensive approach to the problem of population distribution of any free country in the world."

Were these measures successful? Yes, at least in one crucial aspect: the limitation of the construction of factories in the Paris region, a limitation that was further strengthened by two later decrees (in 1958 and 1960). One decree subjected the conversion of nonindustrial premises to industrial use to the same requirements as new construction. Thus the capital region's share of new factory construction fell from 33 to 10 percent between 1955 and 1963. (Between 1960 and 1963, the region realized a net loss of factories, as abandonments qualifying for grants exceeded new construction.)

The programs were not so successful in other repects, however. Restraining the growth of industry in the Paris Region merely resulted in diverting the growth to the neighboring regions of the Paris Basin. Bauchet (1965) indicates that by December 1961 more than half (109 000) of the 200 000 jobs concerning the 1 031 industrial operations of relocation out of Paris, were created in the five programming regions abutting on the Paris Region (the Paris Basin). Also, between 1954 and 1962, the population growth of the Paris Region was almost twice that of the rest of the country. Hence the main objective of national policy – the balancing of national growth and the channeling of migration into critical zones – which was strongly supported in the Third Economic Plan (1958– 1961), could not be met in the late fifties.

Two main reasons seem to have accounted for such a failure. First, although the measures taken were part of a coherent policy concerning territorial planning, they did not reflect an underlying global strategy and their efficiency was necessarily low. Second, the traditional, largely centralized structures of France were not adapted to the implementation of territorial planning. "The resistance of the administrative, professional, and psychological structures that acted as so many powerful brakes upon the centrifugal movement, had without doubt been underestimated." (Lajugie 1956, p. 31)

A COMPREHENSIVE APPROACH TO TERRITORIAL PLANNING (1963 TO DATE)

Owing to its poor record, territorial planning came under heavy criticism and would have been abandoned, had the "ardent obligation" of the economic planning process not created the necessity of correcting the disequilibria existing between activities and thus between territorial zones.

In fact, territorial planning became more and more perceived as a supplement to economic planning, which to a certain extent allows for a correction of its negative effects at the level of the various activities and territorial zones. Finally, with the Fourth Economic Plan (1962–1968), territorial planning was fully integrated with economic planning, thus acquiring the underlying global strategy, which had been clearly missing in the fifties.

The fusion of territorial and economic planning then led, in 1963, to a partial regionalization of the budget. Each year, the budget is to be altered to meet the objectives of the plan. For this purpose, the French government created DATAR, the interministerial organization that authorized and coordinated the elaboration and implementation of the budget at the regional level.

With the creation of DATAR, the haphazard operations of the fifties were progressively replaced by a comprehensive policy conceived with the cooperation of the various political bodies concerned. In this way territorial planning tended toward a complete organization of the economic space, centered around three main themes:

(a) decentralizing and locating industrial and service activities
(b) developing the country's urban and rural areas
(c) establishing means of transportation and communication

Since 1963, government policies for territorial planning have evolved around these three orientations, with DATAR increasingly achieving the coordinating mission assigned to it by the legislation of 1963.

Such a mission, however, would have had limited results had not a certain amount of administrative decentralization also taken place. In the past, the largely centralized French government had applied the same solutions to all of its departments. Yet the necessity of fusing economic and territorial planning accentuated the regional dimension of economic problems. This initiated a move to devise policies adapted to the specific needs of each territorial zone by associating their representative bodies. An administrative reform was therefore developed in several steps from 1959 to 1972. Twenty-two programming regions were created (Figure 1), which eventually were given an assembly and a budget. Over the years, they have been increasingly associated with the process of territorial planning, even though this association has been achieved rather slowly and remains rather modest.

From 1963 to 1973 the increased coordination between ministries achieved by DATAR and the slow progress of administrative decentralization allowed territorial planning to proceed essentially along the lines of the three themes noted above, thereby reducing inequalities across regions. Such a reduction, however, was accompanied by "counterstreams" to the overall movement of economic development, which was necessarily slowed down.

This approach to territorial planning was maintained as long as the positive effects on the equilibrium of the regions outweighed the negative effects on the overall growth. With the sharp decline in the rate of economic development that followed the 1973 oil crisis, it had to be abandoned. In the development of the Seventh Plan (1975–1981), the former accent on economic objectives was replaced by an accent on quality of life. In spite of this change of direction, the necessity of territorial planning was recognized as an integral part of government action. The reduction of territorial inequalities was to be performed by submitting governmental policies to a global strategy of territorial transformation based on an improvement of living conditions in urban as well as rural areas (Commissariat Général du Plan 1976).

The evolution of territorial planning since 1963 described above is explored in detail in the next subsections. The political aspects of territorial planning are examined first; its economic aspects based on the three orientations described above are then discussed.

4.3 The Political Aspects of Territorial Planning

As just seen, territorial planning in France was not conceived as another decision-making process, merely supplementing those already in existence. It was thought of as "a state of mind rather than a technique" (Monod and de Castelbajac 1978, p. 30), that is, a way of approaching problems and implementing their solutions by affecting a convergence of the interests specific to the various levels of governmental bodies involved. No wonder the implementation of territorial planning required a change of orientation with regard to traditional habits. Among the political decisions that related to this change, the most decisive ones were to create DATAR and to pursue administrative decentralization.

DATAR*

Composed of about 30 individuals, DATAR seeks to apprehend the process of economic development in France so that the necessary elements of regional policy could be brought together for governmental decisions and that the decisions could then be executed by the appropriate ministries. DATAR was initially established in the Office of the Prime Minister in 1963, but was later attached to the Ministry of Equipment and finally to the Ministry of Home Affairs.

DATAR's influence is exerted at various levels. First, it maintains contacts with the relevant governmental bodies (national, regional, and local) taking part in the decision-making process. Second, it assumes certain responsibilities in some specialized organizations such as the FDES, the Groupe Interministériel Foncier (GIF), and the Commission Nationale de l'Aménagement du Territoire (CNAT). Third, it prepares the decisions of the government relating to territorial planning.

As already mentioned, DATAR's role is brought to bear through the regionalization of the budget of the central government, a yearly operation that allocates to the programming regions capital expenditures corresponding to projects that can be explicitly located. But, DATAR can also act more directly. Besides influencing the award of regional development grants from the FDES, it can attribute credits through a fund of its own, the Fonds d'Intervention à l'Aménagement du Territoire (FIAT).

The credits of the FIAT, from which transportation networks and especially roads are the largest beneficiaries, are not used to finance projects in their entirety but rather to help their inception or acceleration. Thus in spite of its small size (it represents about one-hundredth of the government's capital expenditures) the FIAT is capable of mobilizing an important part of these expenditures.

In the early seventies, DATAR inherited from another fund, the Fonds d'Aide à la Décentralisation (FAD). This fund was intended to award credits even smaller than those of the FIAT that would facilitate the location of activities in the regions.

Over the years, the role of DATAR as instigator and executant of governmental territorial planning policies – a role desired by the legislation in 1963 – has proved to be practicable. The action of DATAR, however, has always been largely hampered by the opposition of certain governmental bodies with direct administrative responsibilities.

*For a more detailed description of the role of DATAR, see Comité Interministériel pour l'Information (1973).

In fact, as argued by Monod and de Castelbajac (1978, pp. 33, 34), DATAR's orientation toward specific goals unmistakably led to clashes with the various ministries whose decisions had an impact on the regional problem in France. It is not surprising that by the mid-seventies the amount of the budget allocated to individual regions was still no more than one-fourth of the overall budget. Indeed, the difficulties encountered in the last 15 years have been the price paid for the stringent approach chosen by the French government, but in the long run, the advantages have outweighed the inconveniences. DATAR has certainly achieved the objective of an increased cooperation between ministries – and this with relatively small financial means.

REGIONAL REFORM

Although the department has traditionally been the territorial unit for governmental action, interdepartmental levels have developed. The rarity of specialists in some disciplines and the impossibility of using efficient technological resources accelerated this evolution (Monod and de Castelbajac 1978, p. 39) and led in 1955 to the creation of the *Régions de Programme* to serve as a common geographical framework.

From there, steps were initiated to strengthen the regional level in France's administrative structure in view of the implementation of the Fourth Economic Plan. First, the prefect of the main department of each programming region was designated as the regional coordinating prefect. Second, all of the departmental prefects and two regional officials of various agencies formed the Conférence Interdépartementale, which was in charge of completing or updating their regional programs and preparing regional investment programs to be incorporated in the Fourth Economic Plan. Then, in 1960, the programming regions were replaced by 21 groupings of departments called *Circonscriptions d'Action Régionale* within which the various administrative divisions were to be harmonized.

The results of such a reform appear to have been limited, however, due to the continued unwillingness of the central ministries to relinquish any decision-making responsibility. Thus in 1964 the powers of the *Circonscriptions d'Action Régionale* were increased.* The coordinating prefect, now called the "regional prefect", was given clear responsibility for the regional-level stages of the planning process. For this purpose, he was joined by the Mission Régionale, a small group of civil servants placed directly under his authority and acting in liaison with DATAR. He was also joined by two consulting commissions, a newly created regional development commission (CODER) and the Conférence Interdépartementale renamed Conférence Administrative Régionale.

In fact, these 1964 modifications contributed to the deconcentration rather than the decentralization of power. Still the region was not an administrative unit like the department or the commune but simply a link between the central

*In 1970, Corsica was detached from Provence to become the 22nd *Circonscription d'Action Régionale.*

government and the departments. In 1969, a projected administrative reform, which was centered around an increased participation of the citizens in public affairs, was proposed in order to make the region an administrative unit (Boucher 1973). However, the reform was rejected by referendum. A regional reform was nevertheless adopted in 1972, one that was much less ambitious with regard to the regions than the aborted administrative reform of 1969.

With the 1972 regional reform (Abrial 1974), each *Circonscription d'Action Régionale*, renamed *Région*, simply became a specialized public establishment with given legal and financial responsibilities, which did not affect the rights and prerogatives of the departments and communes. The regional prefect remained the executive body of the *Région* but the CODER was replaced by two assemblies having consulting as well as decision-making attributions: an elected body, the Concile Régional, and the Comité Economique et Social composed of officials representing the various interests of the *Région*.

The role of the *Région* as a contributor to economic and social development was reaffirmed with the 1972 reform. The prefect could now interact with the government to obtain credits regarding regional and departmental projects. In addition, the Concile Régional received a budget of its own for specific projects whose location and nature did not have to be decided in Paris.

To summarize, the reform of 1972 has given the *Régions* two instruments without which no real decentralization of power could take place: an assembly and a budget. In addition, it has opened the way for an increased association of the *Régions* with territorial planning projects.

4.4 The First Orientation of Territorial Planning: Decentralization of Industrial and Service Activities

We now turn to the technical aspects of territorial planning, looking first at the allocation of economic activities in such a way as to create new jobs where the needs are the most acute.

INDUSTRIAL ACTIVITIES

Governmental policies for industrial activities continued in the sixties and seventies along the lines introduced in the fifties:

(a) control of the construction of industrial buildings in the Paris Region
(b) introduction of regional policy measures that encourage industrialization and industrial conversion of the regions

With regard to the first, all construction of industrial buildings in the Paris Region was penalized by additions to the Comité de Décentralisation. In addition, a premium for destruction of industrial buildings was temporarily granted in the late sixties and early seventies. Finally, the decentralization of industrial firms was encouraged with the adoption in 1964 of a special indemnity provided to firms moving out of Paris (up to 60 percent and, more recently, 30 percent of the cost of disassembling, transporting, and reassembling industrial equipment). In 1972, however, industries became ineligible to receive the decentralization indemnity if they relocated near the Paris Region. This was because many industries were relocating in the five programming regions abutting on the Paris Region (even though investment grants were generally not available there) rather than in the less developed regions.

The industrial development of the regions, the second direction of government policies, was pursued by the continuation of regional investment grants and tax reliefs with however many modifications needed to increase their efficiency.

Let us first examine the case of the investment grants which were accorded to "critical" zones in the mid-fifties. Soon, it became obvious that the centering of action around such zones was ill conceived, mainly because these were regions having temporary, not necessarily permanent, demographic and economic problems. Thus in 1960, incentives to industry were made available in the West where the problem of population surplus had been endemic for quite some time. Several major western cities were designated as special conversion zones to receive even larger benefits than the earlier critical zones.

In 1964, the incentives given to these conversion zones were extended, according to a system of graduated benefits, to broad areas of the country, defined by specific demographic trends, levels of economic development, and both actual and potential disequilibria in the labor market. For this purpose, the country was divided into several zones; the West was given the most incentives and the Paris Region was denied any.

Since 1964, the areas eligible for investment grants have not changed substantially, although there have been certain shifts in priority. In 1976, regional development grants were available in about half of France, comprising the western and southwestern parts of the country as well as some areas along the northern and northeastern borders. They were made available mostly to manufacturing industries as well as food processing industries (although the latter were temporarily ineligible from 1972 to 1976).

The conditions applicable to receiving grants have changed substantially over the years, and through successive adjustments have become quite complex. They require both minimum levels of investment and minimum job creation/maintenance, but they greatly depend on whether the project is new or an extension of an existing project. Moreover, they are less demanding in the upland areas, rural areas, and in Corsica than in the other designated areas. They are also less stringent the smaller the locality in which the project is situated. Additional requirements concern the viability of the projects to be aided, their execution (they must fulfill investment and job creation targets agreed upon by the administration and the applicant firms), and the nature of the jobs to be created or maintained.

The value of the regional development grant is related to the number of jobs created or maintained and the amount of qualifying investment associated with the project. In 1977, the actual average rate awarded amounted to 12.3 percent of eligible investments (Hull 1980, p. 68).

Aside from the regional development grant, tax reliefs have been available to firms carrying out territorial reorganization (Bourgeois-Pichat 1975). They include a reduction of duty on transfer of property (from 13.2 percent to 1.4 percent in the case of the buying of plants built during the last 5 years), a special amortization (30 percent instead of 5 percent of the cost in the first year of utilization), a reduced tax on unearned increments (5 percent instead of 10 percent), and a local business tax concession.

The latter tax relief is, like the regional development grant, project related. It involves a concession for a period of up to 5 years on a firm's license fee, which each department charges. The eligibility conditions are broadly similar to those of the regional development grant, although much less restrictive; they are not based on the amount of associated investment but require that the original labor force be preserved. The concession can be offered in all of those areas qualifying for the regional development grant as well as in a number of other areas. In addition, projects corresponding to a relocation out of the Paris and Lyons areas are eligible in some additional areas.

Finally, in addition to the regional development grants and the tax reliefs just described, four new grants have been introduced since 1975, which provide incentives for small firms (DATAR 1976). One of these is a decentralization grant for artisan subcontractors in the Paris Region who follow the relocated firms for which they normally work. Another incentive is intended to encourage the setting up of artisan firms in rural areas and some selected urban locations. A third complements the latter scheme and is made available to extension projects at sites within the Massif Central with less than 50000 inhabitants. The last incentive, introduced in 1976, is a grant available to rural areas with sparse population. Awards vary according to the number of jobs created and project type.

SERVICE ACTIVITIES

Initially, it was thought that the service sector would follow the industrial sector and that it would be sufficient to move factories away from Paris to achieve a complete decentralization of the economic system. In practice, things turned out differently.

Thus, in the early seventies, a series of measures, inspired by those taken earlier in the case of industries, were imposed to limit the construction of offices in the Paris Region (ceilings on the size of speculative building, graded building permit fees, etc.). By 1976, the number of building permits for office use in the Paris Region had decreased to one-fifth its 1971 level.

In addition, a grant equivalent to the regional development grant for industrial activities was accorded firms in the service sector having management, administration, consultancy, and data-processing activities. This service activities grant is project related and awarded to projects involving 30 new jobs (creations, extensions, or transfers from Paris). Available throughout the country except in the Paris Region and Basin, it awards 20000 francs per job in areas where the regional development grant is available and half this amount in the other eligible regions.

Moreover, the service sector is entitled to certain tax reliefs. In particular, it benefits from the local business tax concession described earlier for the industrial sector, but the conditions of eligibility are significantly different. First, takeovers and internal reorganizations do not qualify for this grant; only new projects, extensions, and transfers from the Paris Region are eligible. Second, the job requirements are the same as those that apply to the service activities grant.

Note that, in the case of research and development activities, the conditions of eligibility for the service activities grant and the local business tax concession are somewhat different. Ten new jobs (either creation, extension, or transfer from Paris) of pure and applied research activities are mandatory, with some additional requirements in the case of an extension. (The new jobs must represent at least 30 percent of the original labor force.) The award of the research activities grant depends on the value of associated investment and the location.

Finally, the government took specific measures for three activities that are part of the public sector and thus are not influenced by financial incentives: universities, banks, and central administrations. Some of the most prestigious educational institutions have been moved out of Paris. The principal banks have been induced to increase their activities in the larger metropolitan areas. Finally, in 1973, the government prohibited any extension of central administrations in the Paris Region (except in the new towns) and set up a plan aiming at transferring away from the Paris Region 15–20 thousand jobs in that sector (which represented about 20 percent of the current total number of jobs).

4.5 The Second Orientation of Territorial Planning: Urban and Rural Development

The hierarchical organization of the largest cities of a nation represents a question of fundamental importance for the implementation of territorial planning. Clearly, if the capital does not relinquish some of its functions to other cities, thus providing its hinterlands with the most basic economic functions, the main goal of territorial planning – the reduction of disequilibria between regions – cannot be achieved.

For this reason, one of the first objectives of territorial planning was to promote regional capitals. The main objective set forth in the preparation of the Fifth Plan (1966–1971) was the harmonious development of eight *métropoles d'équilibre* (Lille–Roubaix–Tourcoing; Metz–Nancy; Strasbourg; Lyons–St. Etienne–Grenoble; Marseille; Toulouse; Bordeaux; Nantes–St. Nazaire). The underlying idea was that these metropoles would act as counterweights to the growth of Paris. In addition, in accordance with the growth-pole theory (Perroux 1950), it was hoped that the ensuing growth of these metropoles would be diffused to the middle-sized cities located in their attraction zone and that the growth of these cities would, in turn, affect the growth of the rural service and trading centers located in their own zone of attraction.

To be effective, such a growth-pole strategy was indeed aimed at developing the role (economic functions) rather than the mass (population size) of the metropoles. It was primarily conceived as a policy for the service sector: the metropoles were thought to be the appropriate places for the decentralization of administrations, universities, research laboratories, and other service activities.

To implement this growth strategy, top priority in public investment was given to the metropoles for their renovation and expansion. Special teams known as OREAMs (Organisations d'Etudes d'Aménagement d'Aires Métropolitaines) and supervised by regional authorities were constituted to develop comprehensive plans for these metropoles. In addition, it was decided to create new towns adjacent to Lyons, Lille, Rouen, and Marseille in order to relieve the development pressures in the center of these cities as well as to reorganize the suburbs. (But, counter to these measures, five new towns (Marne-la-Vallée, Cergy-Pontoise, St. Quentin-en-Yvelines, Evry, Melun-Senart) were also created in the Paris Region to absorb two-thirds of its population growth.)

This policy of concentrating public expenditures in the metropoles rapidly drew criticism from politicians as well as from the large cities that had not been designated metropoles. Even planners started doubting that the growth-pole idea would work and that it would contribute to the balancing of national growth. A "backlash" was feared (Hull 1980, p. 55); for example, with reference to Gravier's theme of two decades earlier (Gravier 1947), Lajugie (1969, p. 33) writes:

> The problem is to direct the distribution of population, over the national territory, in the direction of an urban–rural balance . . . that will not substitute for Paris and the French desert a collection of Bordeaux and the Aquitaine desert, Toulouse and the Garonnais desert, etc. . . .

Thus in 1972 the emphasis of the French urban development policy shifted from the metropoles to the *villes moyennes* (medium-sized cities), that is, those cities in the 50–100 thousand population bracket that fill the role of a service center for the surrounding area. "The favoritism accorded the metropoles in urban development and in the expenditure of national funds for infrastructure was also extended to [these cities]." (Sundquist 1975, p. 126)

The implementation of this new objective, however, proved difficult because of the rules governing financial transfers between the national and local levels of government. It was then decided that the comprehensive development plans to be prepared for the medium-sized cities were to be developed on the basis of a formal contract between the local government and DATAR (Leruste 1975). Starting in 1974, several dozens of such contracts, governing the direction and tempo of these cities' development were signed. The central government generally agreed to underwrite 25–40 percent of the total expenses requested.

This policy gave special treatment to the main cities of the Paris Basin (Caen, Rouen, Amiens, Troyes, Orléans, Tours, Le Mans), which together with the eight metropoles and those cities similar to the metropoles (Rennes, Clermont-Ferrand, and Dijon), were seen as constituting the top level of the urban hierarchy. The principal role assigned to these cities was the welcoming of new activities that could not be developed without the proximity of Paris.

The retreat from the growth-pole concept was affirmed when the government started paying greater attention to rural zones and their depopulation. Already in 1967, zones of rural renovation (in Brittany and the Massif Central) and mountain zones (Alps) were created, and various kinds of subsidies were granted to them. This action, however, did not stop the flight from rural areas because rural–urban migration was less the consequence of low income than the result of poor living conditions. Thus in 1975 the government undertook a policy of rural renovation aimed at not only the agricultural sector but also all factors affecting the rural areas. For this purpose, an action similar to that taken for the middle-sized cities was adopted, that is, the signing of *contrats de pays* (contracts for natural local regions), between DATAR and the authorities of the rural areas concerned (DATAR 1977). In those contracts, priority was given to the development of local activities, the improvement of public services (education, telephone, leisure, etc.), and the construction of adequate housing to retain the young population. By 1977, 50 such contracts had been approved by the French government (DATAR 1977).

From then on, a contractual policy *tous azimuts* (in all directions) was pursued with the development of cultural contracts and land action programs. Can such a contractual policy be successful? It is still early to draw significant conclusions, but we can assert that such a policy seemingly interferes with the functioning of the regional institutions created in 1972 and is not a good substitute for the local financial reform that the French government seems to delay over and over. In any case, because of their modest importance, these contracts are expected to have a relatively small impact on the spatial distribution of economic development.

4.6 The Third Orientation of Territorial Planning: Transportation Networks

Perhaps the single most important reason accounting for the disequilibria observed between regions has been, and still is, the isolation of certain regions, especially those of the West. It follows that a meaningful strategy of territorial planning is one that includes a coherent approach to the organization of transportation networks in order to better connect the lagging regions with the rest of the country.

Initially, the governmental approach followed the theory that reduced transportation rates were the best way to help the development of a region. For example, in the early sixties the government accorded to some regions (West and Massif Central) a temporary decrease in transportation rates for goods sent by rail (up to 15 percent).

In the long run, however, the improvement of transportation conditions is much more effective than reduced rates. In the mid-sixties, the government switched to an approach that would direct goods to the most suitable means of transportation to ensure the best possible service quality and cost. In practice, the role of the government developed into one of progressively modernizing the infrastructure and equipment.

The railway system was upgraded in successive stages; in the early seventies, the links between Paris on the one hand, and the metropoles and various Paris Basin cities on the other hand, were improved. More recently, this has been extended to links between metropoles (for example, Lyons toward Nantes, Bordeaux, or Strasbourg).

The French road system had a relatively dense secondary network but not a good interregional connection until the construction of superhighways in the early sixties. Because their existence was vital for the development of the country as a whole, superhighways were first constructed in the regions where traffic flows were the most important: the richest half of the country (along the Lille–Paris–Lyons–Marseille axis). In the seventies, however, with the problems of road transportation becoming less acute from a national viewpoint, the government made two important decisions concerning the realization of high-speed freeways in Brittany and the Massif Central as well as the extension of the superhighway network toward the West and the Southwest.

Finally, air transportation has been greatly improved over the last two decades, largely because of the special attention it received from DATAR. Air transportation does not require any costly infrastructure, which makes it very flexible. It can be easily and rapidly adapted to new traffic flows as well as to new government policies because modifications of the network do not involve high transformation costs. In the sixties, the objective followed – one which was finally reached in 1972 – was to connect Paris with all of France's main cities by means of routes identical in quality and cost. In 1972, the government started encouraging local political bodies and chambers of commerce to finance air links between Paris and the medium-sized cities as well as between those cities themselves. To date about one hundred air connections have been created at a modest cost, half of which were financed by DATAR.

Clearly, the transportation network policy has been aimed at improving the distribution of economic activities across the territory.

4.7 A Rapid Appraisal of Territorial Planning in France

To conclude this section, let us ask whether the government policies devised in the last two decades have contributed to solve the regional disequilibrium in France. Without a doubt, there is no clear-cut answer to this question. There are people who view territorial planning as an inefficient means of reducing disparities. Either they contend that the regions evolve much in the same way as the nation (thus leaving regional disparities unchanged), or they argue that numerous policy measures have been taken that are contradictory in their objectives or contrary to the objectives of balancing the growth of the territory. For example, the creation of five new towns around Paris, considered by Lamour (1978) as "the metastases preparing for the extension of the cancer" is one counteracting force to decentralization. Another is the encouragement of foreign investors to select Paris as the site of their European headquarters or research centers in order to enhance the international image of France.

There are other people, however, who find it difficult not to attribute certain results to government policies (Sundquist 1975). They note that some significant past trends, such as the concentration of population and activities in Paris and the depopulation of the western part of the country, have been reversed in the very period in which incentives and controls have been imposed by DATAR.

Even though several studies (Louis 1976, Grelet and Thélot 1977) have attempted to assess the efficiency of some governmental policies concerning territorial planning, to date no study has provided significant evidence that supports either side. Grelet and Thélot, who examined the inducement the regional development grant played in the four departments of the Pays de la Loire, found that the number of jobs created between 1962 and 1972 with the help of such a grant comprised between 40 and 60 percent of the total increase in jobs. Because they had expected a higher percentage, they interpreted this result as being the consequence of a lack of information available to many industries, of the continuous creation and demise of jobs, and also of the role of small firms in the development process. On the basis of a comparison of the development in the four departments with that in the noneligible, neighboring Sarthe department, Grelet and Thélot concluded that sometimes the regional development grant seems to be a real incentive, but more often it appears as simply an accompanying or sustaining development. In short, the regional development grant should be considered as a complementary measure, which offers monetary relief, and only in this context can it be viewed as being efficient.

Finally, leaving unanswered the question of how influential these territorial planning policies have been, we should add here that, owing to the current uncertainty *vis-à-vis* economic development, the future of territorial planning appears today rather bleak even though some progress can be expected as a result of the switch from economic to social objectives. Moreover, the reaching out of the French economy to the European community creates a high risk that the international role of Paris will be put before the search for a national equilibrium, even though economic activities have been somewhat freed from locational constraints through technological progress and transformations (Goze 1976).

5 CONCLUSION

This study has examined the population dynamics of France's ZEATs by means of a twofold analysis. Initially, a traditional analysis based on conventional single-region methods confirmed and clarified the observations made by previous researchers of the changing patterns of spatial population distribution. Then a multiregional population analysis based on the work of Rogers (1968, 1975a, 1979) completed those observations by bringing new insights into the mortality, fertility, and mobility patterns of the recent past.

The foremost findings of the traditional analysis illustrated recent modifications to the traditional picture of population growth across the territory: (a) the end of the population decline of the western half of the country continuously observed since the late 1800s and (b) the slowing down, since the mid-sixties, of population growth in the Paris Region, which had gone unabated since the beginning of the last century.

Although there are some sizable differences in fertility and mortality across ZEATs, natural increase was found to be of little importance to the above modifications. For example the West ZEAT, a region of comparatively high natural increase, and the Southwest ZEAT, a region of comparatively low natural increase, experienced the same population reversal almost simultaneously. The key factor was internal migration. It improved the net migration balance of the West and Southwest ZEATs and eroded that of the Paris Region for virtually all age groups. In light of the general rise of geographical mobility observed in the third quarter of this century, this result simply reflects the below-average rise in migration out of the western part of the country toward the Paris Region and the above-average rise in migration out of the Paris Region toward the western half. As just seen in section 4, the reversal of solidly established trends that these results imply has been attributed by some people to the policies of incentives and controls pursued by the French government with regard to territorial planning.

The multiregional analysis has demonstrated the applicability of the methods and models of multiregional mathematical demography to France's system of ZEATs. A first multiregional life table was produced together with estimates of matrices generalizing the synthetic indicators of mortality, fertility, and mobility of the traditional population analysis. A projection of multiregional age-disaggregated populations (based on unchanged fertility, mortality, migration patterns) was then carried out. (Forecasts of such populations (based on predetermined evolutions of the fertility, mortality, and migration patterns) could have been produced as well.)

Although its results must be considered with caution, this multiregional population analysis has proved to be quite helpful in providing useful insights into fertility and migration as well as mortality and migration interferences and, more generally, into the demographic interdependencies existing between the ZEATs.

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APPENDIXES

Appendix A

OBSERVED POPULATION AND NUMBERS OF BIRTHS, DEATHS, AND MIGRANTS DISAGGREGATED BY AGE AND REGION FOR MALE AND FEMALE POPULATIONS

This appendix displays the input data set necessary to carry out the multiregional population analysis in section 3. For males and then females, it includes eight tables, one for each of France's eight ZEATs.* Each table sets out, broken down into 5-year age groups,

(a) the population observed at the time of the 1975 census (source: INSEE 1977)**
(b) the number of births of the relevant sex *by age of mother* in 1975 (source: unpublished data from INSEE's Bureau of Population Movements)
(c) the number of deaths in 1975 (source: unpublished data from INSEE's Bureau of Population Movements)
(d) the number of survivors at the time of the 1975 census – by ZEAT of residence – among those present in the ZEAT of reference at the time of the previous census (1968). The age group breakdown relates to the end of the period (1975), and the figures shown for age group 0–5 correspond to children surviving in the various ZEATs who were born to women residing in the ZEAT of reference at the time of the previous census (1968). (Source: microfiche obtained from INSEE's Economic Observatory of Paris.)

*All data were obtained in relation to France's system of 22 *Régions* and were appropriately aggregated to yield the data shown below.

**Citations appearing in the appendixes can be found in the preceeding references.

Observed population characteristics.

Males.

region par.reg

age	population	births	deaths	migration from par.reg to: par.reg	par.bas	north	east	west	s.west	m.east	medit
0	323200.	0.	1245.	229255.	18630.	1780.	2860.	9235.	6265.	5105.	6640.
5	370785.	0.	136.	307315.	19960.	1825.	2600.	10170.	7685.	5685.	7360.
10	364800.	5.	134.	320720.	13870.	1330.	1620.	7250.	5120.	3805.	6025.
15	359750.	4054.	336.	317010.	10120.	955.	1270.	5015.	3925.	2510.	4800.
20	405150.	23882.	560.	299340.	10055.	1180.	1955.	4535.	3685.	3435.	4375.
25	507105.	29860.	628.	340790.	19155.	2385.	3630.	9660.	6855.	6445.	7700.
30	373070.	11944.	566.	284015.	17360.	2165.	2995.	9285.	7035.	6250.	7925.
35	341670.	4355.	736.	290520.	14135.	1450.	2100.	7450.	5695.	4170.	5890.
40	341560.	1173.	1294.	305160.	11185.	895.	1555.	5565.	4005.	3015.	4725.
45	325585.	77.	2029.	299985.	8585.	735.	1165.	3865.	3240.	2110.	3895.
50	291340.	4.	2697.	273060.	7265.	515.	930.	2985.	2295.	1825.	3285.
55	182055.	0.	2322.	172800.	5835.	300.	560.	2875.	1810.	1065.	2615.
60	187795.	0.	3894.	181350.	9540.	475.	770.	5210.	3815.	1455.	4415.
65	161200.	0.	5300.	156610.	12410.	455.	830.	5995.	4265.	1915.	5330.
70	129970.	0.	6369.	126610.	8370.	360.	635.	3395.	3010.	1160.	3810.
75	82620.	0.	6289.	80165.	2565.	80.	180.	1040.	1075.	520.	1735.
80	41030.	0.	4467.	39585.	1050.	60.	105.	410.	440.	190.	635.
85	24520.	0.	4817.	23515.	655.	25.	60.	240.	245.	115.	345.
total	4813205.	75354.	43819.	4047805.	190745.	16970.	25820.	94180.	70465.	50775.	81505.

region par.bas

age	population	births	deaths	migration from par.reg	par.bas	par.bas to north	east	west	s.west	m.east	medit
0	345005.	0.	1363.	19035.	282885.	2855.	4675.	6695.	3030.	5770.	3540.
5	420405.	0.	151.	13775.	364120.	2800.	4320.	7095.	3900.	4840.	4940.
10	426620.	7.	181.	8535.	387330.	2015.	2890.	6145.	3290.	3925.	4070.
15	418975.	6504.	491.	8795.	388480.	1575.	2690.	4395.	2485.	3115.	3490.
20	400090.	27653.	752.	21330.	355040.	2385.	4510.	5330.	2690.	4905.	3760.
25	407625.	25059.	602.	30530.	330480.	3240.	5995.	7560.	3530.	6945.	4050.
30	271390.	8336.	461.	13050.	216475.	2020.	3380.	4720.	2745.	4085.	3370.
35	272135.	3902.	766.	7660.	233040.	1505.	2470.	4410.	2350.	2970.	2920.
40	290210.	1352.	1398.	5610.	261545.	1360.	1945.	3735.	2245.	2500.	2700.
45	290145.	120.	2057.	4715.	269030.	1035.	1365.	2645.	1320.	1850.	2225.
50	277595.	2.	2844.	3750.	262055.	745.	885.	1960.	1210.	1375.	1740.
55	170035.	0.	2509.	1745.	160010.	365.	540.	1235.	720.	785.	1295.
60	204565.	0.	4607.	1565.	191035.	320.	550.	1425.	845.	810.	1495.
65	205090.	0.	7024.	1190.	189275.	235.	430.	1390.	890.	580.	1335.
70	169465.	0.	8839.	940.	158870.	285.	310.	820.	530.	430.	865.
75	106605.	0.	8643.	835.	102775.	120.	175.	430.	280.	255.	560.
80	49260.	0.	6171.	420.	47620.	70.	130.	195.	145.	160.	225.
85	28625.	0.	6047.	380.	27525.	45.	55.	160.	90.	105.	130.
total	4753840.	72935.	54906.	143860.	4227590.	22975.	37315.	60345.	32295.	45405.	42710.

region north

age	population	births	deaths	migration from north to							
				par.reg	par.bas	north	east	west	s.west	m.east	medit
0	151440.	0.	857.	5555.	5725.	139205.	1415.	940.	960.	1395.	1625.
5	176970.	0.	81.	3470.	4630.	166370.	1145.	1025.	970.	1325.	1695.
10	185325.	2.	59.	1905.	3040.	177970.	630.	620.	785.	930.	1340.
15	181440.	3100.	178.	1835.	2375.	175945.	380.	630.	705.	640.	1320.
20	171050.	13245.	268.	5200.	4090.	161520.	1325.	895.	820.	1175.	1310.
25	167960.	11505.	246.	7845.	6105.	150295.	1740.	1015.	895.	1740.	1700.
30	100175.	3543.	190.	3470.	3340.	88305.	795.	635.	560.	935.	1080.
35	106695.	1971.	414.	2180.	2310.	98960.	660.	560.	585.	775.	890.
40	117380.	673.	720.	1645.	1645.	111920.	320.	440.	440.	575.	915.
45	121045.	74.	1178.	1165.	1485.	117340.	220.	340.	370.	495.	730.
50	114950.	2.	1619.	775.	1015.	112365.	170.	265.	340.	265.	640.
55	63850.	0.	1257.	455.	575.	62630.	95.	190.	190.	210.	500.
60	74380.	0.	2156.	340.	675.	73095.	70.	190.	225.	160.	610.
65	70000.	0.	3224.	260.	480.	69000.	95.	165.	175.	145.	555.
70	55375.	0.	3817.	155.	300.	54530.	35.	120.	150.	90.	340.
75	35355.	0.	3470.	110.	180.	35050.	15.	30.	30.	50.	140.
80	15125.	0.	2095.	60.	60.	14960.	10.	20.	15.	45.	60.
85	7590.	0.	1793.	50.	65.	7500.	0.	0.	15.	0.	20.
total	1916105.	34115.	23622.	36475.	38095.	1816960.	9120.	8080.	8230.	10950.	15470.

region east

age	population	births	deaths	migration from par.reg	par.bas	east to north	east	west	s.west	m.east	medit
0	170355.	0.	772.	3740.	4740.	695.	143810.	1060.	1385.	2740.	3080.
5	212235.	0.	103.	3315.	4745.	785.	190795.	1385.	1605.	2460.	3605.
10	223040.	6.	100.	2180.	3270.	585.	208595.	1100.	1395.	1700.	3405.
15	221675.	2973.	309.	1900.	2745.	330.	209665.	855.	1040.	1405.	2680.
20	214315.	13597.	349.	4000.	3345.	510.	189540.	1225.	1150.	2125.	2380.
25	221490.	12772.	323.	7045.	6215.	1020.	178450.	1585.	1555.	3655.	3495.
30	150080.	4693.	254.	3895.	4095.	665.	122915.	950.	1140.	2500.	2630.
35	151095.	2067.	361.	2290.	3125.	515.	133450.	820.	1150.	1615.	2470.
40	158845.	677.	730.	1605.	2225.	395.	146300.	825.	950.	1310.	2170.
45	156905.	58.	1132.	1335.	1525.	260.	149155.	580.	695.	850.	1620.
50	132920.	2.	1484.	885.	1080.	160.	128110.	370.	520.	635.	1265.
55	78785.	0.	1315.	475.	685.	55.	76210.	150.	310.	355.	755.
60	96480.	0.	2363.	300.	675.	80.	94135.	205.	375.	340.	935.
65	92295.	0.	3597.	220.	505.	45.	90260.	220.	235.	335.	855.
70	72670.	0.	4326.	140.	265.	20.	71125.	100.	165.	150.	545.
75	44565.	0.	4027.	70.	160.	5.	43945.	50.	50.	95.	230.
80	20170.	0.	2654.	55.	95.	0.	19770.	25.	30.	45.	80.
85	10780.	0.	2427.	50.	75.	5.	10545.	0.	25.	25.	55.
total	2428700.	36845.	26626.	33500.	39570.	6130.	2206775.	11505.	13775.	22340.	32255.

region west

age	population	births	deaths	migration from par.reg	migration from par.bas	west to north	east	west	s.west	m.east	medit
0	244740.	0.	972.	11870.	8510.	645.	1415.	216325.	3470.	1855.	1905.
5	295405.	0.	114.	6280.	6035.	525.	920.	265770.	2950.	1400.	2030.
10	307475.	4.	107.	3455.	3775.	280.	685.	284140.	2025.	945.	1715.
15	303080.	3566.	388.	4005.	3445.	295.	595.	285370.	2005.	785.	1520.
20	275060.	20316.	550.	14120.	6405.	605.	1700.	251995.	3690.	1455.	1795.
25	268865.	19063.	445.	19920.	10485.	940.	2405.	234945.	4780.	2530.	2700.
30	172920.	6272.	332.	6265.	4915.	420.	925.	147685.	2175.	1255.	1590.
35	183665.	2976.	548.	2870.	3065.	265.	515.	163630.	1435.	805.	1170.
40	204615.	877.	994.	2215.	2350.	235.	455.	188390.	1360.	570.	1015.
45	209940.	76.	1602.	1670.	1695.	180.	245.	198395.	1295.	480.	890.
50	205730.	2.	2299.	1480.	1375.	105.	210.	197310.	820.	305.	635.
55	125740.	0.	1872.	820.	635.	50.	90.	119805.	560.	175.	480.
60	158710.	0.	3656.	465.	710.	45.	80.	150155.	435.	90.	510.
65	151815.	0.	5197.	350.	710.	45.	40.	142830.	460.	130.	470.
70	118055.	0.	6210.	290.	445.	40.	50.	112720.	360.	80.	355.
75	72495.	0.	6063.	265.	255.	20.	15.	70490.	170.	70.	200.
80	32095.	0.	4154.	165.	100.	0.	5.	31270.	140.	40.	110.
85	19490.	0.	4239.	100.	150.	0.	10.	18930.	80.	25.	40.
total	3349895.	53152.	39742.	76605.	55060.	4695.	10360.	3080155.	28210.	12995.	19130.

APPENDIX A *Continued.*

region s.west

age	population	births	deaths	migration from s.west to par.reg	par.bas	north	east	west	s.west	m.east	medit
0	157385.	0.	607.	7450.	3100.	420.	1040.	3165.	130340.	2625.	4075.
5	202305.	0.	75.	4010.	2460.	360.	1085.	2655.	172305.	2035.	3905.
10	214365.	1.	101.	2470.	1630.	260.	760.	1875.	191745.	1435.	3395.
15	217885.	2208.	293.	2610.	1345.	180.	555.	1545.	199445.	1285.	2970.
20	211745.	11660.	367.	10870.	2665.	330.	1455.	2525.	186970.	2895.	3820.
25	208790.	12115.	306.	16135.	4680.	750.	2100.	4215.	175860.	4030.	4905.
30	147030.	4372.	208.	5955.	2445.	405.	1030.	2515.	121835.	2150.	3355.
35	146045.	1791.	297.	2705.	1415.	235.	615.	1540.	127005.	1325.	2365.
40	170645.	543.	533.	1910.	1085.	145.	530.	1270.	154945.	920.	2305.
45	177040.	59.	977.	1385.	865.	115.	345.	1005.	165095.	840.	1785.
50	181880.	2.	1484.	1035.	655.	115.	175.	825.	172685.	535.	1510.
55	114905.	0.	1448.	505.	325.	40.	110.	485.	109215.	425.	1025.
60	146530.	0.	2851.	455.	320.	50.	65.	550.	138795.	265.	1200.
65	146575.	0.	4608.	375.	370.	20.	75.	575.	138515.	260.	1170.
70	120965.	0.	5896.	295.	185.	20.	75.	370.	115390.	165.	825.
75	75690.	0.	5904.	190.	125.	10.	35.	260.	73405.	120.	475.
80	36495.	0.	4559.	185.	80.	5.	30.	125.	35320.	55.	220.
85	22750.	0.	4824.	80.	50.	5.	20.	105.	22045.	45.	190.
total	2699025.	32751.	35338.	58620.	23800.	3465.	10100.	25605.	2430915.	21410.	39495.

region m.east

age	population	births	deaths	migration from m.east to							
				par.reg	par.bas	north	east	west	s.west	m.east	medit
0	206145.	0.	747.	4695.	4195.	430.	1660.	1165.	1785.	165980.	5295.
5	254120.	0.	97.	3450.	3880.	360.	1420.	1330.	2230.	220480.	5845.
10	256010.	5.	97.	2210.	2655.	305.	910.	980.	1565.	232210.	4990.
15	244945.	2538.	314.	2260.	2005.	160.	780.	685.	1350.	226300.	4225.
20	241220.	14333.	406.	5665.	3045.	330.	1460.	985.	1660.	207330.	4395.
25	264225.	16315.	372.	9215.	5510.	730.	2675.	1585.	2230.	209760.	5725.
30	202020.	6448.	299.	4930.	3680.	415.	1665.	1185.	1930.	163955.	5105.
35	186310.	2728.	432.	2555.	2585.	305.	1015.	870.	1240.	161395.	3825.
40	195130.	834.	768.	1940.	1755.	225.	755.	690.	1245.	176550.	3350.
45	198350.	79.	1232.	1335.	1365.	115.	535.	470.	870.	185375.	2675.
50	185660.	3.	1836.	1030.	1005.	140.	405.	395.	760.	176860.	2355.
55	112660.	0.	1539.	420.	640.	45.	215.	240.	380.	107740.	1450.
60	131655.	0.	3058.	330.	635.	65.	200.	125.	460.	127060.	1685.
65	124580.	0.	4360.	260.	550.	55.	180.	175.	410.	120010.	1830.
70	101800.	0.	5458.	145.	455.	15.	145.	145.	290.	98845.	1245.
75	63420.	0.	5261.	90.	160.	5.	70.	30.	185.	61815.	610.
80	29410.	0.	3712.	85.	115.	10.	10.	10.	65.	28615.	300.
85	16970.	0.	3688.	75.	60.	0.	20.	15.	45.	16465.	180.
total	3014630.	43283.	33676.	40690.	34295.	3710.	14120.	11080.	18700.	2686745.	55085.

APPENDIX A *Continued.*

region medit

age	population	births	deaths	migration from par.reg	par.bas	medit to north	east	west	s.west	m.east	medit
0	149670.	0.	598.	5745.	2290.	510.	1385.	1365.	2710.	5045.	113775.
5	200885.	0.	81.	4160.	2290.	425.	1130.	1650.	2945.	4245.	162395.
10	212890.	5.	69.	3005.	1535.	265.	850.	1565.	2350.	2925.	180360.
15	208015.	1978.	238.	2435.	1275.	225.	670.	1120.	1980.	2585.	179530.
20	200960.	10646.	366.	7460.	1960.	335.	1685.	1305.	3045.	4945.	165015.
25	206200.	11883.	297.	12050.	3780.	750.	2735.	1925.	4010.	7600.	158715.
30	168800.	4951.	258.	5795.	2450.	475.	1415.	1345.	2490.	4190.	129740.
35	157275.	1952.	325.	2770.	1405.	320.	880.	1100.	1615.	2600.	126905.
40	170455.	595.	530.	2175.	1205.	280.	685.	1030.	1610.	2190.	145040.
45	175740.	49.	936.	1895.	895.	150.	480.	665.	1295.	1730.	155870.
50	170205.	4.	1475.	1185.	630.	115.	285.	445.	1265.	1220.	154645.
55	117770.	0.	1527.	800.	335.	60.	160.	185.	660.	830.	107135.
60	140720.	0.	2826.	535.	295.	50.	150.	335.	705.	785.	127275.
65	135385.	0.	4025.	365.	285.	30.	115.	190.	855.	660.	121760.
70	109945.	0.	5004.	370.	240.	30.	85.	205.	585.	525.	100460.
75	72305.	0.	5138.	270.	195.	30.	55.	90.	260.	280.	67585.
80	35235.	0.	4109.	135.	55.	10.	50.	15.	215.	150.	33275.
85	21815.	0.	4215.	115.	50.	5.	35.	10.	150.	105.	20615.
total	2654270.	32063.	32017.	51265.	21170.	4065.	12850.	14545.	28745.	42610.	2250095.

Females.

region par.reg

age	population	births	deaths	migration from par.reg to par.reg	par.bas	north	east	west	s.west	m.east	medit
0	310025.	0.	894.	221130.	17120.	1755.	2575.	8220.	5930.	5045.	5975.
5	354760.	0.	89.	293285.	18825.	1825.	2345.	9270.	6815.	5335.	6885.
10	348735.	6.	88.	306095.	13230.	1060.	1615.	6430.	5140.	3485.	5770.
15	347820.	3795.	152.	302520.	9710.	710.	1305.	4545.	3490.	2530.	4375.
20	419125.	22611.	265.	287670.	10720.	910.	1805.	4580.	3655.	3545.	5160.
25	484905.	28167.	308.	335330.	21045.	2140.	3290.	10150.	7405.	6615.	8690.
30	332205.	11377.	259.	266050.	15455.	1525.	2325.	8360.	6855.	5505.	7720.
35	312555.	4296.	355.	273385.	11980.	1015.	1510.	6480.	4970.	3610.	5595.
40	328840.	1117.	615.	299510.	9545.	715.	1215.	4415.	3730.	2600.	4635.
45	328145.	88.	1003.	305535.	8090.	595.	1025.	3700.	2975.	2195.	4040.
50	311550.	5.	1306.	295100.	7925.	480.	880.	4135.	3115.	1925.	4435.
55	200740.	0.	1184.	191555.	7190.	325.	745.	3875.	2515.	1220.	3520.
60	224925.	0.	1995.	216365.	11200.	585.	1050.	5480.	4450.	1700.	5540.
65	222935.	0.	3143.	215200.	13370.	620.	900.	6345.	4665.	2055.	5865.
70	200625.	0.	4834.	194025.	8200.	425.	790.	3835.	3535.	1700.	4425.
75	155180.	0.	6825.	149535.	4225.	275.	445.	1825.	1680.	1070.	2340.
80	104470.	0.	7667.	100780.	2845.	245.	175.	1025.	1085.	610.	1335.
85	75920.	0.	11842.	72745.	2520.	115.	180.	780.	705.	435.	1080.
total	5063460.	71462.	42824.	4325815.	193195.	15320.	24175.	93450.	72715.	51180.	87385.

region par.bas

age	population	births	deaths	migration from par.bas to							
				par.reg	par.bas	north	east	west	s.west	m.east	medit
0	328280.	0.	1018.	18555.	270215.	2895.	4510.	6455.	2855.	4965.	3455.
5	401740.	0.	88.	12955.	348100.	2730.	4290.	6760.	3525.	4815.	4275.
10	410205.	5.	94.	8535.	373060.	2025.	2630.	5650.	3230.	3660.	4080.
15	401560.	6276.	201.	9780.	372685.	1575.	2220.	4185.	2380.	2970.	3385.
20	381880.	26495.	275.	31015.	336240.	2620.	4690.	6230.	2580.	6120.	4020.
25	380630.	23863.	232.	32465.	311900.	3165.	5400.	7470.	3430.	7200.	4775.
30	247280.	7908.	210.	11495.	204940.	1715.	2990.	4855.	2900.	3840.	3555.
35	258080.	3679.	291.	6905.	227570.	1485.	2025.	4030.	2255.	2835.	2970.
40	282070.	1263.	593.	5350.	258895.	1190.	1545.	3525.	1935.	2120.	2645.
45	282740.	115.	880.	4575.	265035.	800.	1095.	2475.	1420.	1705.	2340.
50	279790.	1.	1194.	3500.	264160.	665.	1095.	2005.	990.	1425.	2085.
55	179465.	0.	1096.	2005.	168085.	325.	545.	1405.	890.	765.	1500.
60	229430.	0.	2174.	2010.	213535.	415.	670.	1625.	980.	890.	1715.
65	242850.	0.	3544.	2235.	224990.	445.	600.	1465.	800.	695.	1535.
70	220035.	0.	5694.	1970.	208825.	380.	415.	1150.	610.	670.	1140.
75	168470.	0.	7987.	1780.	161760.	355.	320.	660.	505.	470.	750.
80	114060.	0.	9684.	1295.	109295.	170.	275.	600.	360.	345.	450.
85	85135.	0.	14466.	1055.	80990.	150.	240.	545.	315.	335.	405.
total	4893700.	69605.	49721.	157480.	4400280.	23105.	35555.	61090.	31960.	45825.	45080.

region north

age	population	births	deaths	migration from north to par.reg	par.bas	north	east	west	s.west	m.east	medit
0	144040.	0.	626.	4950.	5470.	132635.	1320.	920.	795.	1280.	1485.
5	171975.	0.	54.	3255.	4660.	161830.	1085.	855.	990.	1170.	1485.
10	176375.	2.	36.	2115.	2750.	169425.	520.	615.	815.	970.	1280.
15	173950.	2848.	85.	1800.	2260.	168515.	440.	480.	525.	750.	1185.
20	165960.	12595.	101.	6325.	4715.	157305.	1180.	835.	660.	1425.	1405.
25	156070.	11024.	113.	8255.	6550.	144080.	1510.	1095.	905.	1835.	1935.
30	92825.	3458.	97.	2745.	3175.	85355.	710.	650.	780.	990.	1195.
35	104135.	1866.	190.	1735.	2065.	98935.	345.	510.	565.	715.	955.
40	115870.	646.	345.	1300.	1645.	111950.	270.	385.	440.	480.	835.
45	121020.	39.	520.	1050.	1290.	118235.	190.	335.	295.	395.	880.
50	119250.	2.	739.	875.	1005.	116945.	155.	295.	300.	320.	785.
55	68675.	0.	566.	420.	730.	67545.	80.	225.	220.	215.	530.
60	91335.	0.	1077.	465.	730.	89860.	125.	205.	305.	230.	615.
65	92580.	0.	1815.	285.	625.	91065.	105.	190.	245.	165.	555.
70	80835.	0.	2631.	330.	400.	79725.	75.	170.	125.	140.	365.
75	61620.	0.	3474.	270.	395.	60715.	25.	105.	140.	80.	240.
80	37850.	0.	3714.	175.	295.	37285.	45.	80.	75.	65.	140.
85	22780.	0.	4281.	200.	195.	22395.	25.	75.	50.	35.	90.
total	1997145.	32480.	20464.	36550.	38955.	1913800.	8205.	8025.	8230.	11260.	15960.

region east

age	population	births	deaths	migration from east to par.reg	par.bas	north	east	west	s.west	m.east	medit
0	163335.	0.	588.	3695.	4415.	545.	138420.	1165.	1165.	2610.	2440.
5	205870.	0.	62.	2915.	4535.	725.	185285.	1350.	1330.	2610.	3305.
10	213965.	7.	50.	2330.	3315.	615.	200130.	1100.	1480.	1815.	3130.
15	212930.	2772.	104.	1875.	2545.	390.	201420.	730.	1070.	1385.	2415.
20	205960.	12908.	91.	5180.	4020.	480.	183545.	1040.	1270.	2790.	2970.
25	193115.	12029.	118.	6455.	5710.	605.	165350.	1325.	1510.	3720.	3520.
30	129845.	4439.	118.	3105.	3225.	440.	113480.	875.	1135.	2030.	2585.
35	137235.	2046.	148.	1920.	2570.	415.	126090.	780.	1010.	1480.	2330.
40	147110.	662.	268.	1400.	1800.	320.	139135.	625.	970.	1020.	1860.
45	150515.	52.	423.	1355.	1405.	195.	145230.	515.	660.	680.	1490.
50	145075.	3.	687.	775.	1190.	165.	140570.	340.	525.	600.	1345.
55	87485.	0.	621.	435.	540.	55.	84915.	225.	345.	405.	865.
60	112295.	0.	1103.	370.	655.	50.	109255.	205.	345.	410.	935.
65	116565.	0.	1903.	375.	605.	55.	113905.	185.	285.	280.	850.
70	104860.	0.	3078.	270.	325.	35.	102590.	135.	240.	190.	525.
75	77085.	0.	4219.	205.	270.	25.	75655.	65.	100.	135.	320.
80	45210.	0.	4460.	175.	250.	20.	44350.	55.	90.	145.	265.
85	28655.	0.	5264.	175.	195.	10.	27940.	35.	65.	85.	140.
total	2477110.	34918.	23305.	33010.	37570.	5145.	2297265.	10750.	13595.	22390.	31290.

region west

age	population	births	deaths	migration from west to: par.reg	par.bas	north	east	west	s.west	m.east	medit
0	233175.	0.	696.	10960.	7780.	595.	1145.	206710.	3445.	1710.	1975.
5	282975.	0.	75.	6270.	6130.	435.	1085.	255075.	2660.	1425.	2045.
10	293290.	1.	66.	3250.	3590.	260.	605.	271655.	2005.	850.	1580.
15	292660.	3437.	163.	4635.	2965.	255.	570.	276690.	1940.	760.	1415.
20	266035.	19158.	158.	19315.	7925.	515.	1190.	245265.	4375.	1685.	1930.
25	258985.	18214.	148.	20335.	10390.	720.	1690.	227955.	4580.	2475.	2450.
30	168010.	5899.	146.	5575.	4305.	365.	755.	145350.	2115.	1180.	1625.
35	182820.	2784.	223.	2800.	2800.	215.	500.	165235.	1490.	790.	1345.
40	204200.	850.	372.	2285.	2225.	150.	370.	190480.	1300.	595.	1065.
45	210320.	70.	620.	1900.	1440.	135.	225.	199690.	1180.	415.	785.
50	213980.	1.	933.	1595.	1570.	120.	160.	204640.	880.	365.	715.
55	135425.	0.	805.	985.	765.	50.	40.	128265.	565.	165.	440.
60	182045.	0.	1719.	780.	850.	85.	55.	173030.	655.	195.	620.
65	184605.	0.	2818.	740.	860.	65.	65.	174980.	605.	195.	640.
70	163895.	0.	4255.	700.	650.	70.	100.	157485.	550.	190.	415.
75	126620.	0.	6096.	710.	575.	45.	60.	123080.	460.	120.	335.
80	82755.	0.	7387.	475.	505.	25.	40.	80430.	260.	60.	205.
85	58015.	0.	10352.	370.	450.	20.	20.	56175.	300.	60.	135.
total	3539810.	50414.	37032.	83680.	55775.	4125.	8675.	3282190.	29365.	13235.	19720.

region s.west

age	population	births	deaths	migration from s.west to							
				par.reg	par.bas	north	east	west	s.west	m.east	medit
0	150955.	0.	436.	7305.	2770.	435.	950.	3020.	124805.	2555.	3560.
5	192585.	0.	62.	4200.	2290.	390.	840.	2620.	165755.	2000.	3805.
10	205890.	1.	53.	2205.	1425.	245.	660.	1865.	183735.	1305.	3105.
15	208410.	2116.	119.	2640.	1195.	220.	505.	1425.	191105.	1265.	2650.
20	204630.	11133.	123.	13555.	2970.	415.	960.	2695.	180790.	2805.	4135.
25	200105.	11599.	131.	15380.	4415.	615.	1530.	4340.	169410.	3675.	5240.
30	145215.	4276.	108.	4455.	1965.	305.	760.	2210.	121790.	1785.	3380.
35	145715.	1792.	169.	2130.	1240.	185.	500.	1400.	128700.	1075.	2455.
40	170325.	553.	257.	1835.	1000.	140.	380.	1065.	156285.	900.	2215.
45	180210.	37.	445.	1275.	760.	130.	285.	1070.	169150.	710.	1705.
50	188740.	4.	725.	1050.	600.	100.	200.	895.	179240.	600.	1585.
55	118655.	0.	660.	700.	325.	30.	115.	445.	111915.	385.	1115.
60	160115.	0.	1301.	700.	440.	55.	135.	600.	150940.	300.	1535.
65	167985.	0.	2323.	710.	385.	35.	100.	665.	159070.	380.	1420.
70	153030.	0.	3705.	595.	310.	30.	100.	475.	146110.	340.	1100.
75	118605.	0.	5470.	530.	295.	45.	90.	385.	114345.	215.	770.
80	81240.	0.	6799.	385.	205.	30.	50.	255.	78345.	215.	610.
85	62220.	0.	10682.	325.	180.	5.	40.	215.	60040.	80.	415.
total	2854630.	31511.	33568.	59975.	22770.	3410.	8200.	25645.	2591530.	20590.	40800.

region m.east

age	population	births	deaths	migration from m.east to par.reg	par.bas	north	east	west	s.west	m.east	medit
0	194980.	0.	601.	4435.	4220.	395.	1685.	1160.	1770.	156695.	5175.
5	243505.	0.	49.	3290.	3730.	445.	1255.	1300.	2025.	210745.	5590.
10	244595.	1.	57.	2305.	2605.	290.	915.	1010.	1535.	222015.	4555.
15	237075.	2282.	108.	1990.	1920.	215.	805.	645.	1150.	218730.	3760.
20	236930.	13669.	131.	6560.	3270.	310.	1450.	805.	1655.	201575.	5230.
25	247380.	15505.	138.	8775.	5580.	600.	2345.	1410.	2595.	202215.	6750.
30	184345.	6161.	157.	4240.	3230.	345.	1245.	1110.	1800.	156210.	5020.
35	172100.	2550.	181.	2170.	2100.	210.	800.	775.	1255.	153270.	3460.
40	186900.	799.	289.	1590.	1570.	185.	670.	610.	1060.	173325.	3360.
45	192195.	64.	458.	1295.	1245.	80.	410.	500.	855.	181645.	2535.
50	188280.	3.	741.	920.	1000.	95.	440.	295.	680.	180035.	2410.
55	116055.	0.	672.	550.	565.	70.	215.	180.	415.	111090.	1775.
60	149100.	0.	1295.	485.	785.	40.	275.	195.	545.	143515.	2045.
65	154150.	0.	2397.	360.	845.	35.	265.	175.	455.	148645.	2065.
70	138780.	0.	3716.	415.	535.	40.	230.	155.	415.	134255.	1425.
75	109950.	0.	5383.	395.	335.	10.	90.	140.	255.	106915.	1000.
80	69805.	0.	6120.	240.	280.	15.	65.	70.	175.	67725.	605.
85	48350.	0.	8589.	240.	260.	0.	40.	55.	150.	46825.	485.
total	3114475.	41034.	31082.	40255.	34075.	3380.	13200.	10590.	18790.	2815430.	57245.

APPENDIX A *Continued.*

region medit

age	population	births	deaths	migration from medit to par.reg	par.bas	north	east	west	s.west	m.east	medit
0	142495.	0.	459.	5230.	2155.	460.	1360.	1275.	2720.	4960.	109385.
5	188655.	0.	47.	4300.	2080.	320.	1140.	1530.	2615.	4285.	152865.
10	204115.	3.	45.	2715.	1465.	300.	800.	1280.	2155.	2650.	172780.
15	199765.	1992.	98.	2435.	1250.	210.	650.	885.	2075.	2450.	173440.
20	196785.	10125.	108.	7135.	1760.	340.	1270.	985.	3270.	5225.	161330.
25	197980.	11107.	142.	11130.	3390.	670.	1815.	1515.	3775.	6820.	154935.
30	159785.	4904.	112.	5070.	1865.	310.	935.	1280.	2605.	3810.	127590.
35	149730.	1896.	172.	2365.	1215.	210.	640.	1125.	1660.	2405.	124840.
40	170150.	567.	297.	1915.	920.	200.	485.	890.	1500.	1805.	148415.
45	177165.	58.	435.	1670.	700.	100.	305.	585.	1255.	1700.	159475.
50	181135.	2.	698.	1345.	490.	105.	280.	400.	1130.	1340.	164220.
55	127285.	0.	750.	685.	390.	65.	170.	250.	805.	735.	115270.
60	162160.	0.	1289.	760.	405.	60.	205.	250.	885.	925.	146435.
65	160675.	0.	2185.	740.	400.	55.	180.	280.	1055.	925.	145285.
70	146135.	0.	3391.	715.	320.	45.	150.	215.	785.	725.	135200.
75	115545.	0.	4813.	650.	320.	30.	110.	155.	700.	625.	108545.
80	75615.	0.	5987.	415.	205.	25.	85.	125.	570.	485.	71260.
85	55190.	0.	8965.	390.	200.	45.	70.	70.	395.	355.	51880.
total	2810365.	30654.	29993.	49665.	19530.	3550.	10650.	13095.	29955.	42225.	2423150.

Appendix B

OBSERVED AGE-SPECIFIC RATES

B.1 Fertility Rates (1975) by Age of Mother
B.2 Age-specific Mortality Rates (1975) and Out-migration Rates (Average for the Period 1968–1975): Males
B.3 Age-specific Mortality Rates (1975) and Out-migration Rates (Average for the Period 1968–1975): Females

APPENDIX B.1 Fertility rates (1975) by age of mother.

age	par.reg	par.bas	north	east	west	s.west	m.east	medit
0	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
5	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
10	0.000032	0.000029	0.000023	0.000061	0.000017	0.000010	0.000025	0.000039
15	0.022566	0.031826	0.034194	0.026981	0.023929	0.020748	0.020331	0.019873
20	0.110929	0.141793	0.155700	0.128690	0.148379	0.111386	0.118187	0.105552
25	0.119667	0.128529	0.144352	0.128426	0.143935	0.118508	0.128628	0.116123
30	0.070201	0.065691	0.075421	0.070330	0.072442	0.059553	0.068399	0.061677
35	0.027678	0.029375	0.036846	0.029970	0.031506	0.024589	0.030668	0.025700
40	0.006964	0.009271	0.011383	0.009102	0.008457	0.006435	0.008737	0.006829
45	0.000503	0.000831	0.000934	0.000731	0.000694	0.000533	0.000744	0.000604
50	0.000029	0.000011	0.000034	0.000034	0.000014	0.000032	0.000032	0.000033
55	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
60	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
65	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
70	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
75	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
80	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
85	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
gross	1.792839	2.036777	2.294436	1.971627	2.146869	1.708965	1.878754	1.682148
crude	0.028995	0.029127	0.033345	0.028970	0.029258	0.022511	0.027073	0.022316
m.age	27.3947	26.8875	27.0970	27.2190	27.1202	27.1696	27.5021	27.3622

APPENDIX B.2 Age-specific mortality rates (1975) and out-migration rates (average for the period 1968–1975): males.

Mortality rates.

age	par.reg	par.bas	north	east	west	s.west	m.east	medit
0	0.003852	0.003951	0.005659	0.004532	0.003972	0.003857	0.003624	0.003995
5	0.000367	0.000359	0.000458	0.000485	0.000386	0.000371	0.000382	0.000403
10	0.000367	0.000424	0.000318	0.000448	0.000348	0.000471	0.000379	0.000324
15	0.000934	0.001172	0.000981	0.001394	0.001280	0.001345	0.001282	0.001144
20	0.001382	0.001880	0.001567	0.001628	0.002000	0.001733	0.001683	0.001821
25	0.001238	0.001477	0.001465	0.001458	0.001655	0.001466	0.001408	0.001440
30	0.001517	0.001699	0.001897	0.001692	0.001920	0.001415	0.001480	0.001528
35	0.002154	0.002815	0.003880	0.002389	0.002984	0.002034	0.002319	0.002066
40	0.003788	0.004817	0.006134	0.004596	0.004858	0.003123	0.003936	0.003109
45	0.006232	0.007090	0.009732	0.007215	0.007631	0.005519	0.006211	0.005326
50	0.009257	0.010245	0.014084	0.011165	0.011175	0.008159	0.009889	0.008666
55	0.012754	0.014756	0.019687	0.016691	0.014888	0.012602	0.013661	0.012966
60	0.020735	0.022521	0.028986	0.024492	0.023036	0.019457	0.023227	0.020082
65	0.032878	0.034248	0.046057	0.038973	0.034232	0.031438	0.034998	0.029730
70	0.049004	0.052158	0.068930	0.059529	0.052603	0.048741	0.053615	0.045514
75	0.076120	0.081075	0.098147	0.090362	0.083633	0.078002	0.082955	0.071060
80	0.108872	0.125274	0.138512	0.131582	0.129428	0.124921	0.126216	0.116617
85	0.196452	0.211249	0.236232	0.225139	0.217496	0.212044	0.217325	0.193216
gross	2.639523	2.886046	3.413633	3.118855	2.967620	2.783485	2.922939	2.595048
crude	0.009104	0.011550	0.012328	0.010963	0.011864	0.013093	0.011171	0.012062
m.age	77.7483	77.6380	76.9528	77.5697	77.6219	78.2618	77.9635	77.8918

APPENDIX B.2 *Continued.*

Out-migration rates.

	migration from par.reg to								
age	total	par.reg	par.bas	north	east	west	s.west	m.east	medit
0	0.025453	0.000000	0.009362	0.000862	0.001308	0.004658	0.003335	0.002574	0.003355
5	0.020308	0.000000	0.007340	0.000674	0.000902	0.003740	0.002759	0.002034	0.002860
10	0.013891	0.000000	0.004958	0.000467	0.000588	0.002514	0.001856	0.001288	0.002221
15	0.012484	0.000000	0.004380	0.000459	0.000688	0.002061	0.001643	0.001273	0.001980
20	0.016860	0.000000	0.005820	0.000698	0.001089	0.002813	0.002100	0.001930	0.002411
25	0.021830	0.000000	0.007364	0.000906	0.001308	0.003797	0.002794	0.002530	0.003131
30	0.020520	0.000000	0.006937	0.000785	0.001101	0.003648	0.002780	0.002260	0.003009
35	0.015621	0.000000	0.005544	0.000507	0.000788	0.002823	0.002106	0.001553	0.002300
40	0.011848	0.000000	0.004318	0.000352	0.000588	0.002043	0.001572	0.001107	0.001870
45	0.009839	0.000000	0.003671	0.000286	0.000482	0.001574	0.001268	0.000906	0.001653
50	0.010278	0.000000	0.003963	0.000236	0.000434	0.001803	0.001233	0.000837	0.001772
55	0.014380	0.000000	0.005443	0.000273	0.000470	0.002848	0.001979	0.000890	0.002476
60	0.020132	0.000000	0.007808	0.000326	0.000562	0.003954	0.002846	0.001195	0.003441
65	0.020618	0.000000	0.008281	0.000325	0.000585	0.003683	0.002895	0.001209	0.003640
70	0.014294	0.000000	0.005538	0.000214	0.000406	0.002235	0.002095	0.000882	0.002925
75	0.008807	0.000000	0.003176	0.000136	0.000264	0.001261	0.001325	0.000608	0.002036
80	0.007092	0.000000	0.002674	0.000126	0.000254	0.001007	0.001054	0.000473	0.001504
85	0.007092	0.000000	0.002674	0.000126	0.000254	0.001007	0.001054	0.000473	0.001504
gross	1.356746	0.000000	0.496260	0.038784	0.060352	0.237339	0.183468	0.120101	0.220441
crude	0.016460	0.000000	0.005917	0.000533	0.000803	0.002907	0.002185	0.001589	0.002527
m.age	39.6252	0.0000	40.4234	32.5658	34.8471	38.8886	40.5232	34.8739	43.0128

migration from par.bas to

age	total	par.reg	par.bas	north	east	west	s.west	m.east	medit
0	0.018330	0.007069	0.000000	0.001183	0.001887	0.002851	0.001406	0.002216	0.001719
5	0.013658	0.004284	0.000000	0.000907	0.001364	0.002463	0.001333	0.001635	0.001672
10	0.009957	0.003023	0.000000	0.000623	0.000969	0.001825	0.000996	0.001218	0.001303
15	0.012797	0.005417	0.000000	0.000711	0.001287	0.001744	0.000918	0.001428	0.001291
20	0.019751	0.009674	0.000000	0.001039	0.001941	0.002379	0.001130	0.002172	0.001417
25	0.021343	0.009681	0.000000	0.001195	0.002112	0.002765	0.001427	0.002471	0.001691
30	0.016616	0.006077	0.000000	0.001015	0.001688	0.002599	0.001442	0.002017	0.001778
35	0.011951	0.003620	0.000000	0.000770	0.001192	0.002183	0.001222	0.001467	0.001496
40	0.008907	0.002625	0.000000	0.000606	0.000838	0.001609	0.000896	0.001096	0.001237
45	0.006795	0.002159	0.000000	0.000451	0.000570	0.001163	0.000637	0.000815	0.000999
50	0.005804	0.001711	0.000000	0.000345	0.000454	0.001018	0.000610	0.000681	0.000985
55	0.005235	0.001295	0.000000	0.000264	0.000417	0.001006	0.000590	0.000608	0.001055
60	0.004509	0.000973	0.000000	0.000191	0.000338	0.000966	0.000594	0.000477	0.000970
65	0.003722	0.000794	0.000000	0.000194	0.000269	0.000795	0.000509	0.000367	0.000793
70	0.003171	0.000857	0.000000	0.000180	0.000222	0.000568	0.000368	0.000315	0.000660
75	0.003014	0.000950	0.000000	0.000147	0.000247	0.000460	0.000320	0.000325	0.000565
80	0.003028	0.001087	0.000000	0.000149	0.000226	0.000473	0.000300	0.000343	0.000450
85	0.003028	0.001087	0.000000	0.000149	0.000226	0.000473	0.000300	0.000343	0.000450
gross	0.858067	0.311925	0.000000	0.050595	0.081223	0.136711	0.074989	0.099966	0.102657
crude	0.011754	0.004423	0.000000	0.000699	0.001138	0.001832	0.000983	0.001373	0.001306
m.age	31.0836	29.0618	0.0000	29.9744	29.1944	32.2266	33.8481	30.6237	36.1752

APPENDIX B.2 *Continued.*

	migration from		north to						
age	total	par.reg	par.bas	north	east	west	s.west	m.east	medit
0	0.014310	0.004139	0.004668	0.000000	0.001147	0.000843	0.000843	0.001201	0.001469
5	0.009906	0.002308	0.003245	0.000000	0.000752	0.000677	0.000723	0.000939	0.001261
10	0.006635	0.001453	0.002107	0.000000	0.000390	0.000478	0.000574	0.000605	0.001028
15	0.009164	0.002831	0.002635	0.000000	0.000691	0.000613	0.000612	0.000725	0.001057
20	0.014987	0.005479	0.004298	0.000000	0.001278	0.000772	0.000703	0.001200	0.001256
25	0.016813	0.005940	0.005057	0.000000	0.001316	0.000855	0.000762	0.001398	0.001485
30	0.013263	0.004064	0.004023	0.000000	0.001022	0.000810	0.000782	0.001189	0.001372
35	0.008951	0.002480	0.002554	0.000000	0.000636	0.000627	0.000650	0.000862	0.001141
40	0.006380	0.001677	0.001854	0.000000	0.000319	0.000455	0.000475	0.000630	0.000971
45	0.004857	0.001144	0.001470	0.000000	0.000228	0.000352	0.000415	0.000443	0.000804
50	0.004440	0.000957	0.001222	0.000000	0.000203	0.000358	0.000404	0.000381	0.000915
55	0.004387	0.000800	0.001215	0.000000	0.000163	0.000367	0.000400	0.000365	0.001076
60	0.003764	0.000557	0.001045	0.000000	0.000150	0.000319	0.000360	0.000276	0.001058
65	0.003033	0.000418	0.000769	0.000000	0.000125	0.000282	0.000325	0.000231	0.000883
70	0.002191	0.000350	0.000620	0.000000	0.000062	0.000177	0.000209	0.000178	0.000595
75	0.001800	0.000382	0.000487	0.000000	0.000058	0.000116	0.000098	0.000235	0.000425
80	0.001748	0.000493	0.000583	0.000000	0.000031	0.000061	0.000137	0.000138	0.000306
85	0.001748	0.000493	0.000583	0.000000	0.000031	0.000061	0.000137	0.000138	0.000306
gross	0.641892	0.179830	0.192179	0.000000	0.043005	0.041126	0.043040	0.055674	0.087038
crude	0.009043	0.002628	0.002724	0.000000	0.000647	0.000569	0.000582	0.000781	0.001113
m.age	30.7094	28.6583	29.9825	0.0000	26.0321	31.8203	33.2909	30.8029	37.0021

	migration from			east to					
age	total	par.reg	par.bas	north	east	west	s.west	m.east	medit
0	0.014592	0.002959	0.003934	0.000606	0.000000	0.000974	0.001215	0.002156	0.002748
5	0.011323	0.002001	0.002901	0.000491	0.000000	0.000875	0.001063	0.001497	0.002496
10	0.007993	0.001327	0.001962	0.000297	0.000000	0.000629	0.000788	0.001007	0.001983
15	0.008767	0.002001	0.002091	0.000287	0.000000	0.000713	0.000746	0.001204	0.001726
20	0.014011	0.003921	0.003428	0.000544	0.000000	0.000987	0.000959	0.002057	0.002115
25	0.017078	0.004588	0.004380	0.000710	0.000000	0.001035	0.001134	0.002611	0.002620
30	0.014243	0.003205	0.003706	0.000601	0.000000	0.000876	0.001150	0.002108	0.002597
35	0.010298	0.001882	0.002583	0.000436	0.000000	0.000772	0.001000	0.001400	0.002225
40	0.007470	0.001346	0.001719	0.000299	0.000000	0.000637	0.000748	0.000986	0.001735
45	0.005714	0.001079	0.001264	0.000202	0.000000	0.000456	0.000588	0.000721	0.001405
50	0.005041	0.000891	0.001173	0.000132	0.000000	0.000323	0.000545	0.000646	0.001331
55	0.004489	0.000636	0.001075	0.000104	0.000000	0.000272	0.000533	0.000550	0.001319
60	0.003775	0.000376	0.000834	0.000088	0.000000	0.000299	0.000428	0.000479	0.001269
65	0.002922	0.000284	0.000588	0.000049	0.000000	0.000241	0.000309	0.000368	0.001083
70	0.002067	0.000215	0.000441	0.000024	0.000000	0.000152	0.000206	0.000256	0.000773
75	0.001730	0.000239	0.000462	0.000006	0.000000	0.000131	0.000144	0.000242	0.000507
80	0.001838	0.000355	0.000563	0.000022	0.000000	0.000059	0.000183	0.000219	0.000437
85	0.001838	0.000355	0.000563	0.000022	0.000000	0.000059	0.000183	0.000219	0.000437
gross	0.675945	0.138302	0.168336	0.024608	0.000000	0.047445	0.059609	0.093622	0.144023
crude	0.009519	0.002035	0.002370	0.000366	0.000000	0.000678	0.000814	0.001333	0.001924
m.age	30.6969	28.6382	30.2781	26.7446	0.0000	30.0184	32.3254	29.9239	33.8906

APPENDIX B.2 *Continued.*

age	migration from west to								
	total	par.reg	par.bas	north	east	west	s.west	m.east	medit
0	0.014361	0.005364	0.004178	0.000326	0.000660	0.000000	0.001832	0.000909	0.001092
5	0.008797	0.002644	0.002617	0.000212	0.000420	0.000000	0.001318	0.000612	0.000974
10	0.006171	0.001809	0.001750	0.000138	0.000308	0.000000	0.000974	0.000414	0.000778
15	0.010750	0.004606	0.002506	0.000225	0.000577	0.000000	0.001455	0.000552	0.000829
20	0.019157	0.008928	0.004406	0.000392	0.001055	0.000000	0.002218	0.001006	0.001152
25	0.019228	0.008122	0.004915	0.000418	0.001023	0.000000	0.002212	0.001174	0.001364
30	0.011923	0.004014	0.003441	0.000287	0.000611	0.000000	0.001546	0.000863	0.001160
35	0.007161	0.002007	0.002127	0.000192	0.000375	0.000000	0.001083	0.000533	0.000844
40	0.005204	0.001389	0.001441	0.000146	0.000248	0.000000	0.000940	0.000369	0.000671
45	0.003937	0.001095	0.001062	0.000098	0.000157	0.000000	0.000731	0.000269	0.000524
50	0.003299	0.000985	0.000834	0.000064	0.000123	0.000000	0.000600	0.000203	0.000489
55	0.002642	0.000685	0.000676	0.000048	0.000086	0.000000	0.000511	0.000138	0.000498
60	0.002062	0.000378	0.000643	0.000041	0.000054	0.000000	0.000405	0.000099	0.000442
65	0.001924	0.000330	0.000575	0.000043	0.000046	0.000000	0.000413	0.000104	0.000414
70	0.001747	0.000389	0.000465	0.000039	0.000040	0.000000	0.000344	0.000104	0.000366
75	0.001785	0.000506	0.000380	0.000016	0.000020	0.000000	0.000384	0.000126	0.000354
80	0.001869	0.000505	0.000528	-0.000000	0.000032	0.000000	0.000414	0.000123	0.000266
85	0.001869	0.000505	0.000528	-0.000000	0.000032	0.000000	0.000414	0.000123	0.000266
gross	0.619422	0.221307	0.165366	0.013425	0.029341	0.000000	0.088954	0.038606	0.062423
crude	0.008668	0.003215	0.002294	0.000193	0.000429	0.000000	0.001194	0.000534	0.000809
m.age	28.7177	26.3823	28.6626	26.5904	25.6355	0.0000	31.8914	28.8991	34.4145

migration from s.west to

age	total	par.reg	par.bas	north	east	west	s.west	m.east	medit
0	0.017428	0.005369	0.002460	0.000344	0.000943	0.002613	0.000000	0.002096	0.003603
5	0.011241	0.002619	0.001612	0.000242	0.000731	0.001789	0.000000	0.001371	0.002876
10	0.007782	0.001775	0.001033	0.000152	0.000458	0.001191	0.000000	0.000945	0.002227
15	0.012069	0.004637	0.001379	0.000173	0.000686	0.001411	0.000000	0.001433	0.002351
20	0.021143	0.009381	0.002476	0.000363	0.001211	0.002323	0.000000	0.002363	0.003026
25	0.022019	0.008823	0.002817	0.000457	0.001250	0.002745	0.000000	0.002490	0.003437
30	0.014706	0.004617	0.001984	0.000328	0.000855	0.002111	0.000000	0.001808	0.003002
35	0.008949	0.002285	0.001208	0.000185	0.000554	0.001361	0.000000	0.001097	0.002260
40	0.006219	0.001423	0.000830	0.000110	0.000376	0.000973	0.000000	0.000750	0.001758
45	0.004557	0.000991	0.000616	0.000093	0.000212	0.000744	0.000000	0.000560	0.001342
50	0.003748	0.000732	0.000460	0.000070	0.000138	0.000630	0.000000	0.000477	0.001241
55	0.003231	0.000545	0.000354	0.000049	0.000100	0.000568	0.000000	0.000393	0.001223
60	0.002772	0.000410	0.000328	0.000034	0.000067	0.000540	0.000000	0.000252	0.001141
65	0.002419	0.000347	0.000274	0.000020	0.000077	0.000476	0.000000	0.000214	0.001011
70	0.002062	0.000321	0.000203	0.000019	0.000070	0.000417	0.000000	0.000189	0.000843
75	0.002060	0.000444	0.000224	0.000016	0.000075	0.000401	0.000000	0.000180	0.000720
80	0.002041	0.000431	0.000217	0.000018	0.000085	0.000401	0.000000	0.000173	0.000717
85	0.002041	0.000431	0.000217	0.000018	0.000085	0.000401	0.000000	0.000173	0.000717
gross	0.732447	0.227911	0.093469	0.013457	0.039856	0.105464	0.000000	0.084819	0.167471
crude	0.009658	0.003123	0.001235	0.000181	0.000536	0.001349	0.000000	0.001127	0.002107
m.age	28.5840	25.9573	27.5671	26.2429	26.2648	30.5618	0.0000	27.5496	32.7446

APPENDIX B.2 *Continued.*

migration from m.east to

age	total	par.reg	par.bas	north	east	west	s.west	m.east	medit
0	0.013661	0.003017	0.002919	0.000282	0.001118	0.000869	0.001423	0.000000	0.004034
5	0.010227	0.001822	0.002085	0.000207	0.000744	0.000720	0.001204	0.000000	0.003445
10	0.007461	0.001331	0.001387	0.000136	0.000502	0.000488	0.000864	0.000000	0.002754
15	0.009109	0.002477	0.001593	0.000153	0.000701	0.000522	0.000945	0.000000	0.002718
20	0.014115	0.004637	0.002660	0.000324	0.001288	0.000782	0.001214	0.000000	0.003210
25	0.015966	0.004822	0.003134	0.000380	0.001480	0.000923	0.001434	0.000000	0.003792
30	0.012652	0.003049	0.002526	0.000285	0.001082	0.000806	0.001271	0.000000	0.003633
35	0.008961	0.001813	0.001746	0.000210	0.000710	0.000613	0.000985	0.000000	0.002884
40	0.006536	0.001241	0.001175	0.000127	0.000487	0.000432	0.000795	0.000000	0.002279
45	0.005059	0.000892	0.000889	0.000096	0.000353	0.000322	0.000611	0.000000	0.001896
50	0.004468	0.000663	0.000787	0.000082	0.000291	0.000300	0.000529	0.000000	0.001818
55	0.003973	0.000443	0.000735	0.000062	0.000240	0.000213	0.000479	0.000000	0.001800
60	0.003706	0.000320	0.000628	0.000064	0.000202	0.000158	0.000460	0.000000	0.001875
65	0.003412	0.000236	0.000584	0.000039	0.000189	0.000184	0.000403	0.000000	0.001777
70	0.002630	0.000178	0.000437	0.000014	0.000158	0.000118	0.000359	0.000000	0.001367
75	0.002194	0.000246	0.000368	0.000024	0.000082	0.000046	0.000292	0.000000	0.001135
80	0.002149	0.000362	0.000368	0.000017	0.000075	0.000060	0.000239	0.000000	0.001029
85	0.002149	0.000362	0.000368	0.000017	0.000075	0.000060	0.000239	0.000000	0.001029
gross	0.642152	0.139550	0.121947	0.012589	0.048890	0.038075	0.068723	0.000000	0.212378
crude	0.008751	0.002021	0.001678	0.000180	0.000695	0.000535	0.000919	0.000000	0.002725
m.age	31.4306	27.5892	30.2969	28.4505	28.7254	29.0427	32.6157	0.0000	35.4496

migration from medit to

age	total	par.reg	par.bas	north	east	west	s.west	m.east	medit
0	0.017931	0.005090	0.002212	0.000462	0.001256	0.001445	0.002792	0.004675	0.000000
5	0.012270	0.003032	0.001587	0.000288	0.000825	0.001313	0.002207	0.003018	0.000000
10	0.008588	0.002062	0.001049	0.000183	0.000572	0.001006	0.001633	0.002083	0.000000
15	0.012040	0.003831	0.001245	0.000214	0.000913	0.000935	0.001967	0.002934	0.000000
20	0.020701	0.007573	0.002162	0.000411	0.001706	0.001221	0.002751	0.004878	0.000000
25	0.021555	0.007575	0.002585	0.000511	0.001744	0.001356	0.002774	0.005011	0.000000
30	0.014575	0.004380	0.001909	0.000396	0.001158	0.001210	0.002074	0.003447	0.000000
35	0.009878	0.002487	0.001284	0.000296	0.000780	0.001046	0.001594	0.002391	0.000000
40	0.007383	0.001852	0.000945	0.000195	0.000529	0.000765	0.001316	0.001780	0.000000
45	0.005385	0.001362	0.000664	0.000116	0.000336	0.000484	0.001125	0.001298	0.000000
50	0.004198	0.001040	0.000486	0.000089	0.000227	0.000310	0.000977	0.001068	0.000000
55	0.003437	0.000804	0.000362	0.000064	0.000181	0.000291	0.000791	0.000944	0.000000
60	0.002868	0.000492	0.000305	0.000042	0.000141	0.000276	0.000837	0.000774	0.000000
65	0.002658	0.000441	0.000305	0.000035	0.000116	0.000233	0.000835	0.000693	0.000000
70	0.002356	0.000482	0.000328	0.000046	0.000103	0.000209	0.000603	0.000585	0.000000
75	0.002107	0.000469	0.000261	0.000043	0.000134	0.000102	0.000597	0.000501	0.000000
80	0.002077	0.000482	0.000201	0.000027	0.000159	0.000045	0.000684	0.000478	0.000000
85	0.002077	0.000482	0.000201	0.000027	0.000159	0.000045	0.000684	0.000478	0.000000
gross	0.760414	0.219680	0.090460	0.017234	0.055191	0.061462	0.131205	0.185182	0.000000
crude	0.010066	0.002973	0.001197	0.000229	0.000739	0.000824	0.001659	0.002444	0.000000
m.age	28.8721	27.3258	28.6425	27.5845	27.9030	27.4968	32.9551	28.7907	0.0000

APPENDIX B.3 Age-specific mortality rates (1975) and out-migration rates (average for the period 1968–1975): females.

Mortality rates.

age	par.reg	par.bas	north	east	west	s.west	m.east	medit
0	0.002884	0.003101	0.004346	0.003600	0.002985	0.002888	0.003082	0.003221
5	0.000251	0.000219	0.000314	0.000301	0.000265	0.000322	0.000201	0.000249
10	0.000252	0.000229	0.000204	0.000234	0.000225	0.000257	0.000233	0.000220
15	0.000437	0.000501	0.000489	0.000488	0.000557	0.000571	0.000456	0.000491
20	0.000632	0.000720	0.000609	0.000442	0.000594	0.000601	0.000553	0.000549
25	0.000635	0.000610	0.000724	0.000611	0.000571	0.000655	0.000558	0.000717
30	0.000780	0.000849	0.001045	0.000909	0.000869	0.000744	0.000852	0.000701
35	0.001136	0.001128	0.001825	0.001078	0.001220	0.001160	0.001052	0.001149
40	0.001870	0.002102	0.002977	0.001822	0.001822	0.001509	0.001546	0.001746
45	0.003057	0.003112	0.004297	0.002810	0.002948	0.002469	0.002383	0.002455
50	0.004192	0.004267	0.006197	0.004735	0.004360	0.003841	0.003936	0.003853
55	0.005898	0.006107	0.008242	0.007098	0.005944	0.005562	0.005790	0.005892
60	0.008870	0.009476	0.011792	0.009822	0.009443	0.008125	0.008685	0.007949
65	0.014098	0.014593	0.019605	0.016326	0.015265	0.013829	0.015550	0.013599
70	0.024095	0.025878	0.032548	0.029353	0.025962	0.024211	0.026776	0.023205
75	0.043981	0.047409	0.056378	0.054732	0.048144	0.046119	0.048959	0.041655
80	0.073389	0.084903	0.098124	0.098651	0.089263	0.083690	0.087673	0.079177
85	0.155980	0.169918	0.187928	0.183703	0.178437	0.171681	0.177642	0.162439
gross	1.712185	1.875611	2.188211	2.083580	1.944369	1.841178	1.929633	1.746336
crude	0.008457	0.010160	0.010247	0.009408	0.010462	0.011759	0.009980	0.010672
m.age	79.6283	79.8038	79.1021	79.8758	80.0378	80.1724	80.1660	79.9445

Out-migration rates.

age	total	migration from par.reg to par.reg	par.bas	north	east	west	s.west	m.east	medit
0	0.024733	0.000000	0.009144	0.000899	0.001236	0.004405	0.003212	0.002605	0.003232
5	0.019915	0.000000	0.007306	0.000651	0.000888	0.003545	0.002697	0.001989	0.002840
10	0.013674	0.000000	0.004980	0.000378	0.000625	0.002362	0.001857	0.001288	0.002184
15	0.012898	0.000000	0.004659	0.000362	0.000692	0.002065	0.001614	0.001354	0.002153
20	0.018092	0.000000	0.006443	0.000605	0.001013	0.002959	0.002234	0.002024	0.002814
25	0.022195	0.000000	0.007601	0.000749	0.001140	0.003834	0.002969	0.002495	0.003405
30	0.019471	0.000000	0.006499	0.000591	0.000890	0.003478	0.002773	0.002124	0.003116
35	0.014243	0.000000	0.004975	0.000394	0.000620	0.002501	0.001995	0.001420	0.002339
40	0.010896	0.000000	0.003903	0.000287	0.000491	0.001783	0.001474	0.001051	0.001906
45	0.010106	0.000000	0.003567	0.000237	0.000420	0.001740	0.001351	0.000910	0.001880
50	0.011746	0.000000	0.004245	0.000218	0.000451	0.002248	0.001552	0.000844	0.002188
55	0.015309	0.000000	0.005715	0.000280	0.000556	0.002903	0.002149	0.000904	0.002801
60	0.018364	0.000000	0.007092	0.000345	0.000557	0.003400	0.002618	0.001077	0.003274
65	0.016977	0.000000	0.006453	0.000311	0.000508	0.003030	0.002462	0.001128	0.003087
70	0.012217	0.000000	0.004377	0.000249	0.000435	0.001975	0.001819	0.000984	0.002378
75	0.009081	0.000000	0.003386	0.000255	0.000279	0.001335	0.001313	0.000786	0.001726
80	0.008364	0.000000	0.003458	0.000219	0.000230	0.001143	0.001118	0.000657	0.001539
85	0.008364	0.000000	0.003458	0.000219	0.000230	0.001143	0.001118	0.000657	0.001539
gross	1.333221	0.000000	0.486301	0.036241	0.056306	0.229250	0.181617	0.121490	0.222016
crude	0.015833	0.000000	0.005701	0.000449	0.000708	0.002744	0.002139	0.001513	0.002578
m.age	39.5183	0.0000	40.1644	35.1749	34.9708	38.8995	40.2457	35.7762	42.0569

 APPENDIX B.3 *Continued.*

age	migration from par.bas to total	par.reg	par.bas	north	east	west	s.west	m.east	medit
0	0.018308	0.007125	0.000000	0.001236	0.001935	0.002870	0.001361	0.002130	0.001651
5	0.013581	0.004296	0.000000	0.000934	0.001372	0.002414	0.001302	0.001656	0.001607
10	0.010149	0.003319	0.000000	0.000650	0.000874	0.001770	0.001005	0.001191	0.001339
15	0.015537	0.007600	0.000000	0.000780	0.001283	0.001943	0.000904	0.001678	0.001350
20	0.023224	0.012275	0.000000	0.001111	0.001930	0.002609	0.001121	0.002530	0.001648
25	0.022279	0.010122	0.000000	0.001154	0.001987	0.002935	0.001522	0.002579	0.001980
30	0.016258	0.005654	0.000000	0.000963	0.001519	0.002657	0.001531	0.002000	0.001934
35	0.011289	0.003424	0.000000	0.000741	0.000991	0.002080	0.001147	0.001369	0.001536
40	0.008451	0.002579	0.000000	0.000515	0.000683	0.001548	0.000861	0.000985	0.001281
45	0.006737	0.002094	0.000000	0.000377	0.000564	0.001150	0.000615	0.000804	0.001133
50	0.006056	0.001735	0.000000	0.000304	0.000504	0.001083	0.000613	0.000677	0.001141
55	0.005660	0.001476	0.000000	0.000264	0.000434	0.001081	0.000667	0.000591	0.001147
60	0.004979	0.001333	0.000000	0.000265	0.000393	0.000951	0.000547	0.000489	0.001000
65	0.004354	0.001316	0.000000	0.000255	0.000311	0.000803	0.000430	0.000420	0.000819
70	0.003930	0.001341	0.000000	0.000262	0.000258	0.000624	0.000392	0.000397	0.000656
75	0.003804	0.001413	0.000000	0.000230	0.000276	0.000586	0.000392	0.000371	0.000535
80	0.003810	0.001371	0.000000	0.000187	0.000300	0.000667	0.000391	0.000398	0.000496
85	0.003810	0.001371	0.000000	0.000187	0.000300	0.000667	0.000391	0.000398	0.000496
gross	0.911080	0.349220	0.000000	0.052072	0.079570	0.142198	0.075955	0.103324	0.108740
crude	0.011773	0.004659	0.000000	0.000673	0.001039	0.001791	0.000939	0.001342	0.001329
m.age	31.7666	29.8986	0.0000	30.8170	29.9693	33.1368	34.6340	30.9697	36.4978

migration from north to

age	total	par.reg	par.bas	north	east	west	s.west	m.east	medit
0	0.013955	0.003932	0.004778	0.000000	0.001127	0.000800	0.000811	0.001131	0.001376
5	0.009848	0.002370	0.003267	0.000000	0.000708	0.000623	0.000773	0.000920	0.001188
10	0.006693	0.001595	0.002041	0.000000	0.000388	0.000438	0.000539	0.000695	0.000997
15	0.009965	0.003348	0.002948	0.000000	0.000672	0.000545	0.000488	0.000893	0.001070
20	0.016589	0.006303	0.004876	0.000000	0.001150	0.000799	0.000654	0.001380	0.001426
25	0.017456	0.005792	0.005324	0.000000	0.001197	0.000930	0.000953	0.001533	0.001727
30	0.012475	0.003303	0.003854	0.000000	0.000773	0.000814	0.000962	0.001226	0.001543
35	0.007950	0.001988	0.002420	0.000000	0.000397	0.000571	0.000646	0.000775	0.001153
40	0.005838	0.001409	0.001758	0.000000	0.000274	0.000424	0.000436	0.000519	0.001017
45	0.004766	0.001130	0.001342	0.000000	0.000200	0.000364	0.000345	0.000415	0.000970
50	0.004632	0.000946	0.001327	0.000000	0.000171	0.000396	0.000395	0.000404	0.000992
55	0.004464	0.000787	0.001289	0.000000	0.000174	0.000378	0.000450	0.000390	0.000997
60	0.003632	0.000574	0.001014	0.000000	0.000172	0.000292	0.000410	0.000295	0.000875
65	0.002931	0.000488	0.000793	0.000000	0.000139	0.000280	0.000282	0.000237	0.000711
70	0.002632	0.000557	0.000743	0.000000	0.000087	0.000248	0.000249	0.000197	0.000550
75	0.002658	0.000553	0.000869	0.000000	0.000097	0.000232	0.000259	0.000183	0.000464
80	0.002813	0.000721	0.000877	0.000000	0.000122	0.000289	0.000223	0.000173	0.000409
85	0.002813	0.000721	0.000877	0.000000	0.000122	0.000289	0.000223	0.000173	0.000409
gross	0.660560	0.182587	0.201989	0.000000	0.039858	0.043571	0.045486	0.057701	0.089368
crude	0.008684	0.002498	0.002663	0.000000	0.000550	0.000540	0.000564	0.000768	0.001101
m.age	31.7758	29.3631	31.0689	0.0000	27.4067	35.9483	35.3537	30.6757	37.1066

APPENDIX B.3 *Continued.*

age	migration from east to								
	total	par.reg	par.bas	north	east	west	s.west	m.east	medit
0	0.014085	0.002905	0.003856	0.000536	0.000000	0.001053	0.001054	0.002245	0.002436
5	0.011321	0.001955	0.002935	0.000495	0.000000	0.000896	0.001019	0.001651	0.002371
10	0.008186	0.001424	0.001990	0.000340	0.000000	0.000612	0.000859	0.001080	0.001880
15	0.009937	0.002459	0.002348	0.000305	0.000000	0.000624	0.000824	0.001476	0.001903
20	0.015233	0.004357	0.003675	0.000403	0.000000	0.000868	0.001034	0.002447	0.002448
25	0.016492	0.004307	0.004078	0.000481	0.000000	0.000982	0.001210	0.002600	0.002833
30	0.013213	0.002817	0.003217	0.000468	0.000000	0.000890	0.001169	0.001941	0.002710
35	0.009457	0.001705	0.002248	0.000375	0.000000	0.000707	0.001001	0.001279	0.002142
40	0.006874	0.001326	0.001546	0.000248	0.000000	0.000543	0.000783	0.000817	0.001612
45	0.005389	0.001025	0.001246	0.000172	0.000000	0.000406	0.000566	0.000613	0.001361
50	0.004728	0.000735	0.001017	0.000125	0.000000	0.000344	0.000533	0.000620	0.001354
55	0.004170	0.000590	0.000843	0.000075	0.000000	0.000306	0.000491	0.000583	0.001281
60	0.003433	0.000463	0.000770	0.000064	0.000000	0.000236	0.000384	0.000423	0.001093
65	0.002688	0.000404	0.000571	0.000055	0.000000	0.000196	0.000325	0.000290	0.000847
70	0.002062	0.000351	0.000440	0.000044	0.000000	0.000141	0.000238	0.000237	0.000611
75	0.002266	0.000405	0.000559	0.000047	0.000000	0.000127	0.000202	0.000306	0.000620
80	0.002520	0.000541	0.000666	0.000043	0.000000	0.000130	0.000229	0.000333	0.000580
85	0.002520	0.000541	0.000666	0.000043	0.000000	0.000130	0.000229	0.000333	0.000580
gross	0.672871	0.141549	0.163351	0.021591	0.000000	0.045960	0.060752	0.096364	0.143304
crude	0.008875	0.001917	0.002163	0.000294	0.000000	0.000607	0.000782	0.001289	0.001824
m.age	30.9296	29.5753	30.0908	27.2377	0.0000	30.2629	33.0558	29.4860	34.0629

migration from west to

age	total	par.reg	par.bas	north	east	west	s.west	m.east	medit
0	0.014377	0.005319	0.004178	0.000301	0.000656	0.000000	0.001832	0.000916	0.001176
5	0.008958	0.002701	0.002711	0.000189	0.000467	0.000000	0.001282	0.000622	0.000986
10	0.006195	0.001980	0.001654	0.000128	0.000293	0.000000	0.000991	0.000400	0.000749
15	0.012759	0.006173	0.002847	0.000194	0.000443	0.000000	0.001649	0.000610	0.000843
20	0.021115	0.010612	0.004862	0.000316	0.000749	0.000000	0.002381	0.001069	0.001126
25	0.018791	0.008199	0.004769	0.000348	0.000782	0.000000	0.002187	0.001163	0.001342
30	0.011281	0.003728	0.003104	0.000248	0.000539	0.000000	0.001560	0.000839	0.001264
35	0.006975	0.001991	0.001961	0.000140	0.000337	0.000000	0.001080	0.000534	0.000931
40	0.004998	0.001494	0.001307	0.000100	0.000211	0.000000	0.000878	0.000356	0.000653
45	0.003940	0.001209	0.001030	0.000087	0.000131	0.000000	0.000707	0.000266	0.000511
50	0.003455	0.001083	0.000943	0.000067	0.000075	0.000000	0.000601	0.000211	0.000475
55	0.002921	0.000858	0.000749	0.000061	0.000042	0.000000	0.000565	0.000165	0.000481
60	0.002533	0.000611	0.000672	0.000059	0.000047	0.000000	0.000496	0.000153	0.000495
65	0.002378	0.000594	0.000611	0.000055	0.000068	0.000000	0.000470	0.000156	0.000424
70	0.002351	0.000675	0.000579	0.000053	0.000074	0.000000	0.000476	0.000143	0.000352
75	0.002366	0.000727	0.000677	0.000042	0.000061	0.000000	0.000430	0.000105	0.000325
80	0.002379	0.000685	0.000778	0.000036	0.000046	0.000000	0.000466	0.000098	0.000268
85	0.002379	0.000685	0.000778	0.000036	0.000046	0.000000	0.000466	0.000098	0.000268
gross	0.650752	0.246621	0.171057	0.012299	0.025332	0.000000	0.092583	0.039519	0.063342
crude	0.008474	0.003321	0.002198	0.000158	0.000337	0.000000	0.001167	0.000512	0.000780
m.age	29.5799	27.4427	29.9115	29.7472	26.0497	0.0000	32.6794	29.0399	34.1908

APPENDIX B.3 *Continued.*

age	migration from s.west to: total	par.reg	par.bas	north	east	west	s.west	m.east	medit
0	0.017416	0.005621	0.002332	0.000381	0.000833	0.002647	0.000000	0.002143	0.003458
5	0.011171	0.002719	0.001525	0.000261	0.000614	0.001845	0.000000	0.001365	0.002844
10	0.007550	0.001765	0.000951	0.000169	0.000424	0.001201	0.000000	0.000933	0.002106
15	0.013272	0.005728	0.001480	0.000223	0.000512	0.001480	0.000000	0.001433	0.002417
20	0.022292	0.010378	0.002556	0.000357	0.000872	0.002500	0.000000	0.002281	0.003348
25	0.020606	0.008069	0.002566	0.000374	0.000942	0.002723	0.000000	0.002251	0.003682
30	0.012638	0.003545	0.001672	0.000255	0.000663	0.001903	0.000000	0.001504	0.003096
35	0.008009	0.001933	0.001081	0.000157	0.000427	0.001196	0.000000	0.000954	0.002261
40	0.005728	0.001333	0.000745	0.000114	0.000282	0.000902	0.000000	0.000682	0.001670
45	0.004368	0.000932	0.000539	0.000091	0.000193	0.000782	0.000000	0.000521	0.001309
50	0.003866	0.000846	0.000429	0.000057	0.000148	0.000618	0.000000	0.000469	0.001300
55	0.003639	0.000763	0.000396	0.000043	0.000132	0.000545	0.000000	0.000373	0.001387
60	0.003307	0.000635	0.000361	0.000040	0.000104	0.000557	0.000000	0.000299	0.001310
65	0.002942	0.000586	0.000304	0.000029	0.000088	0.000502	0.000000	0.000318	0.001115
70	0.002678	0.000578	0.000309	0.000039	0.000097	0.000437	0.000000	0.000277	0.000942
75	0.002653	0.000596	0.000321	0.000048	0.000088	0.000411	0.000000	0.000286	0.000903
80	0.002405	0.000577	0.000309	0.000026	0.000072	0.000379	0.000000	0.000225	0.000817
85	0.002405	0.000577	0.000309	0.000026	0.000072	0.000379	0.000000	0.000225	0.000817
gross	0.734730	0.235909	0.090918	0.013437	0.032822	0.105032	0.000000	0.082697	0.173915
crude	0.009040	0.002996	0.001113	0.000166	0.000405	0.001274	0.000000	0.001017	0.002068
m.age	29.3324	26.5879	28.7841	26.5578	27.2885	30.2361	0.0000	28.4613	33.8106

migration from m.east to

age	total	par.reg	par.bas	north	east	west	s.west	m.east	medit
0	0.013923	0.003005	0.003037	0.000312	0.001130	0.000905	0.001423	0.000000	0.004112
5	0.010267	0.001877	0.002114	0.000243	0.000722	0.000754	0.001178	0.000000	0.003380
10	0.007343	0.001332	0.001403	0.000155	0.000532	0.000506	0.000828	0.000000	0.002588
15	0.009645	0.002747	0.001697	0.000167	0.000729	0.000464	0.000909	0.000000	0.002931
20	0.015226	0.004937	0.002832	0.000286	0.001218	0.000686	0.001363	0.000000	0.003904
25	0.016010	0.004597	0.003120	0.000328	0.001265	0.000875	0.001560	0.000000	0.004265
30	0.011867	0.002759	0.002275	0.000233	0.000873	0.000784	0.001295	0.000000	0.003647
35	0.008298	0.001588	0.001543	0.000163	0.000616	0.000571	0.000964	0.000000	0.002853
40	0.006190	0.001120	0.001091	0.000102	0.000420	0.000425	0.000739	0.000000	0.002293
45	0.004865	0.000848	0.000855	0.000066	0.000324	0.000300	0.000583	0.000000	0.001889
50	0.004568	0.000698	0.000731	0.000079	0.000301	0.000221	0.000515	0.000000	0.002023
55	0.004414	0.000579	0.000721	0.000062	0.000264	0.000201	0.000514	0.000000	0.002074
60	0.004005	0.000402	0.000759	0.000035	0.000252	0.000170	0.000465	0.000000	0.001922
65	0.003508	0.000372	0.000650	0.000036	0.000235	0.000155	0.000412	0.000000	0.001649
70	0.002929	0.000445	0.000465	0.000025	0.000167	0.000160	0.000357	0.000000	0.001309
75	0.002602	0.000448	0.000447	0.000019	0.000111	0.000143	0.000305	0.000000	0.001129
80	0.002607	0.000476	0.000529	0.000012	0.000099	0.000120	0.000315	0.000000	0.001057
85	0.002607	0.000476	0.000529	0.000012	0.000099	0.000120	0.000315	0.000000	0.001057
gross	0.654365	0.143524	0.123993	0.011677	0.046782	0.037798	0.070193	0.000000	0.220397
crude	0.008375	0.001915	0.001592	0.000157	0.000615	0.000488	0.000885	0.000000	0.002723
m.age	31.9708	28.8780	30.9881	26.4352	29.3515	30.2100	33.1963	0.0000	35.2986

APPENDIX B.3 *Continued.*

migration from medit to

age	total	par.reg	par.bas	north	east	west	s.west	m.east	medit
0	0.018062	0.005094	0.002157	0.000407	0.001311	0.001417	0.002793	0.004883	0.000000
5	0.012239	0.003161	0.001544	0.000267	0.000857	0.001216	0.002093	0.003101	0.000000
10	0.008369	0.002031	0.001058	0.000199	0.000568	0.000844	0.001663	0.002006	0.000000
15	0.011968	0.003797	0.001192	0.000218	0.000765	0.000741	0.002164	0.003091	0.000000
20	0.019651	0.007369	0.002000	0.000399	0.001227	0.000967	0.002840	0.004850	0.000000
25	0.019697	0.007127	0.002237	0.000418	0.001192	0.001207	0.002829	0.004688	0.000000
30	0.013249	0.003910	0.001568	0.000266	0.000816	0.001230	0.002215	0.003243	0.000000
35	0.008724	0.002168	0.001066	0.000203	0.000567	0.001007	0.001582	0.002131	0.000000
40	0.006277	0.001611	0.000720	0.000135	0.000355	0.000658	0.001232	0.001567	0.000000
45	0.004872	0.001297	0.000504	0.000087	0.000249	0.000417	0.001017	0.001301	0.000000
50	0.004004	0.000987	0.000435	0.000083	0.000219	0.000315	0.000958	0.001007	0.000000
55	0.003501	0.000780	0.000419	0.000067	0.000198	0.000264	0.000897	0.000877	0.000000
60	0.003356	0.000718	0.000373	0.000054	0.000181	0.000246	0.000912	0.000872	0.000000
65	0.003176	0.000711	0.000343	0.000048	0.000158	0.000236	0.000884	0.000795	0.000000
70	0.003020	0.000749	0.000349	0.000040	0.000140	0.000198	0.000810	0.000735	0.000000
75	0.003177	0.000745	0.000362	0.000039	0.000138	0.000198	0.000906	0.000788	0.000000
80	0.003148	0.000752	0.000374	0.000068	0.000142	0.000172	0.000874	0.000765	0.000000
85	0.003148	0.000752	0.000374	0.000068	0.000142	0.000172	0.000874	0.000765	0.000000
gross	0.748183	0.218796	0.085367	0.015325	0.046128	0.057532	0.137713	0.187322	0.000000
crude	0.009091	0.002709	0.001032	0.000186	0.000565	0.000696	0.001629	0.002272	0.000000
m.age	30.2507	28.7468	30.0644	28.7806	27.6555	29.4303	34.5336	29.9549	0.0000

Appendix C

THE MULTIREGIONAL LIFE TABLE (MALES)

C.1 Expected Numbers of Survivors at Exact Age x: the Life History of the 1975 Birth Cohort

C.2 Expectations of Life by Place of Residence

APPENDIX C.1 Expected numbers of survivors at exact age x: the life history of the 1975 birth cohort.

age	initial region of cohort			anywhere in france					
***	***********************			******************					
	total	par.reg	par.bas	north	east	west	s.west	m.east	medit
0	380498.	75354.	72935.	34115.	36845.	53152.	32751.	43283.	32063.
5	372775.	71943.	72360.	31891.	35490.	52254.	32644.	43253.	32939.
10	372044.	68793.	72620.	31084.	34859.	53018.	33495.	43577.	34597.
15	371327.	66869.	72347.	30566.	34369.	53481.	34068.	43652.	35975.
20	369151.	68362.	71002.	29639.	34015.	52327.	33837.	43564.	36405.
25	366001.	73322.	69089.	28200.	33678.	49681.	32703.	43632.	35695.
30	363379.	75669.	68188.	26845.	33047.	48037.	32039.	43852.	35702.
35	360419.	73638.	67763.	25814.	32274.	47966.	32313.	43914.	36737.
40	355883.	70661.	66882.	24864.	31486.	48067.	32737.	43589.	37597.
45	348409.	67644.	65260.	23818.	30453.	47474.	32881.	42850.	38029.
50	336867.	64138.	63050.	22471.	29097.	46065.	32520.	41592.	37933.
55	320288.	59436.	60168.	20718.	27252.	44003.	31741.	39602.	37367.
60	298148.	52619.	56600.	18552.	24866.	41650.	30498.	37027.	36335.
65	266647.	43025.	51837.	15894.	21879.	38172.	28523.	33011.	34307.
70	224534.	32848.	44806.	12533.	17957.	32909.	25064.	27720.	30696.
75	172771.	23973.	34907.	8816.	13297.	25556.	19973.	21184.	25065.
80	114768.	15747.	23185.	5323.	8397.	16782.	13603.	13925.	17805.
85	60677.	8794.	12132.	2576.	4240.	8593.	7209.	7250.	9885.

age initial region of cohort par.reg

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age	total	par.reg	par.bas	north	east	west	s.west	m.east	medit
0	75354.	75354.	0.	0.	0.	0.	0.	0.	0.
5	73917.	64418.	3494.	322.	488.	1738.	1245.	960.	1252.
10	73780.	57915.	5676.	545.	792.	2931.	2118.	1630.	2173.
15	73643.	53963.	6889.	686.	976.	3646.	2640.	2018.	2824.
20	73271.	50780.	7705.	812.	1198.	4085.	3007.	2384.	3301.
25	72717.	47082.	8579.	989.	1543.	4531.	3352.	2921.	3720.
30	72235.	42688.	9642.	1200.	1902.	5165.	3811.	3555.	4271.
35	71669.	38686.	10509.	1358.	2148.	5803.	4288.	4039.	4838.
40	70830.	35695.	11003.	1435.	2286.	6247.	4627.	4305.	5233.
45	69417.	33250.	11166.	1460.	2342.	6447.	4831.	4427.	5495.
50	67203.	30873.	11116.	1440.	2332.	6448.	4910.	4443.	5641.
55	64026.	28127.	10933.	1375.	2259.	6358.	4909.	4352.	5713.
60	59798.	24575.	10695.	1275.	2132.	6293.	4889.	4183.	5756.
65	53669.	19898.	10301.	1134.	1942.	6085.	4784.	3851.	5674.
70	45381.	15055.	9311.	927.	1648.	5472.	4368.	3330.	5271.
75	35162.	10878.	7439.	670.	1250.	4348.	3565.	2599.	4414.
80	23560.	7056.	5006.	414.	805.	2893.	2463.	1736.	3187.
85	12683.	3881.	2650.	205.	416.	1500.	1322.	919.	1791.

APPENDIX C.1 *Continued.*

age ***   initial region of cohort par.bas
****

age	total	par.reg	par.bas	north	east	west	s.west	m.east	medit
0	72935.	0.	72935.	0.	0.	0.	0.	0.	0.
5	71508.	2553.	64889.	427.	681.	1029.	508.	800.	621.
10	71379.	3726.	60487.	713.	1106.	1844.	969.	1337.	1197.
15	71230.	4433.	57498.	891.	1376.	2402.	1295.	1705.	1630.
20	70816.	5853.	53679.	1068.	1718.	2833.	1558.	2105.	2001.
25	70174.	8291.	48253.	1299.	2196.	3303.	1827.	2681.	2324.
30	69666.	10119.	43331.	1535.	2632.	3851.	2176.	3285.	2736.
35	69089.	10629.	39964.	1705.	2905.	4401.	2553.	3723.	3211.
40	68183.	10602.	37500.	1798.	3046.	4823.	2854.	3978.	3581.
45	66675.	10413.	35313.	1833.	3084.	5038.	3047.	4105.	3842.
50	64431.	10076.	33191.	1806.	3034.	5072.	3136.	4119.	3997.
55	61260.	9482.	30870.	1720.	2907.	4998.	3168.	4028.	4087.
60	57009.	8492.	28212.	1581.	2708.	4882.	3152.	3855.	4127.
65	50996.	7012.	24973.	1383.	2425.	4614.	3054.	3506.	4030.
70	42982.	5400.	20917.	1114.	2020.	4075.	2764.	2992.	3701.
75	33115.	3982.	15960.	800.	1515.	3215.	2246.	2317.	3081.
80	22019.	2646.	10452.	492.	970.	2138.	1554.	1544.	2223.
85	11639.	1499.	5387.	244.	497.	1110.	837.	816.	1249.

age initial region of cohort north
*** **********************************

age	total	par.reg	par.bas	north	east	west	s.west	m.east	medit
0	34115.	0.	0.	34115.	0.	0.	0.	0.	0.
5	33163.	696.	785.	30756.	193.	142.	142.	202.	247.
10	33088.	1007.	1264.	29172.	308.	267.	265.	356.	450.
15	33034.	1180.	1542.	28166.	364.	357.	361.	452.	611.
20	32868.	1578.	1849.	26751.	463.	455.	452.	564.	756.
25	32608.	2345.	2307.	24566.	639.	569.	542.	745.	894.
30	32372.	3027.	2809.	22362.	800.	711.	648.	950.	1065.
35	32081.	3311.	3160.	20709.	907.	864.	773.	1114.	1244.
40	31546.	3381.	3325.	19420.	959.	984.	875.	1216.	1387.
45	30713.	3362.	3381.	18244.	965.	1054.	943.	1271.	1492.
50	29448.	3265.	3367.	16960.	948.	1082.	983.	1286.	1556.
55	27701.	3085.	3288.	15455.	909.	1090.	1005.	1266.	1603.
60	25430.	2777.	3159.	13692.	846.	1091.	1011.	1220.	1634.
65	22369.	2298.	2939.	11610.	759.	1055.	986.	1115.	1607.
70	18312.	1772.	2564.	9061.	633.	950.	897.	956.	1480.
75	13562.	1303.	2012.	6317.	473.	756.	730.	742.	1228.
80	8678.	862.	1344.	3785.	302.	505.	504.	496.	881.
85	4450.	486.	708.	1815.	154.	262.	271.	262.	492.

APPENDIX C.1 *Continued.*

age initial region of cohort east
*** *********************************

age	total	par.reg	par.bas	north	east	west	s.west	m.east	medit
0	36845.	0.	0.	0.	36845.	0.	0.	0.	0.
5	36020.	539.	717.	110.	33361.	177.	221.	393.	501.
10	35934.	850.	1183.	193.	31407.	341.	407.	643.	910.
15	35855.	1037.	1467.	240.	30097.	459.	540.	801.	1213.
20	35612.	1367.	1728.	282.	28598.	574.	651.	981.	1432.
25	35320.	2024.	2125.	357.	26422.	715.	770.	1275.	1632.
30	35065.	2663.	2612.	449.	24052.	873.	913.	1617.	1884.
35	34775.	2947.	2981.	520.	22209.	1030.	1072.	1859.	2158.
40	34359.	3020.	3183.	561.	20859.	1162.	1206.	1990.	2377.
45	33613.	3022.	3250.	577.	19652.	1247.	1295.	2052.	2519.
50	32473.	2963.	3237.	570.	18431.	1277.	1342.	2057.	2596.
55	30805.	2821.	3172.	543.	17000.	1270.	1363.	2012.	2625.
60	28520.	2546.	3049.	499.	15291.	1250.	1356.	1923.	2605.
65	25390.	2108.	2832.	437.	13271.	1194.	1304.	1747.	2497.
70	21171.	1626.	2467.	351.	10751.	1063.	1169.	1488.	2256.
75	16045.	1197.	1935.	250.	7877.	843.	944.	1148.	1852.
80	10456.	794.	1296.	152.	4923.	562.	649.	762.	1318.
85	5438.	450.	685.	75.	2455.	291.	348.	401.	733.

age *** initial region of cohort west

age	total	par.reg	par.bas	north	east	west	s.west	m.east	medit
0	53152.	0.	0.	0.	0.	53152.	0.	0.	0.
5	52107.	1412.	1099.	86.	174.	48328.	482.	239.	287.
10	52007.	1943.	1719.	144.	283.	46159.	805.	407.	547.
15	51915.	2266.	2095.	182.	360.	44706.	1030.	521.	753.
20	51589.	3248.	2580.	239.	501.	42081.	1326.	667.	947.
25	51092.	5076.	3368.	332.	748.	37755.	1708.	930.	1177.
30	50690.	6350.	4173.	435.	969.	34012.	2047.	1238.	1465.
35	50234.	6581.	4671.	508.	1092.	31880.	2292.	1467.	1745.
40	49546.	6478.	4905.	549.	1156.	30452.	2464.	1597.	1946.
45	48435.	6306.	4971.	569.	1178.	29071.	2587.	1665.	2088.
50	46735.	6059.	4931.	567.	1164.	27519.	2639.	1685.	2171.
55	44338.	5688.	4801.	543.	1119.	25676.	2636.	1657.	2217.
60	41252.	5079.	4595.	503.	1044.	23623.	2581.	1591.	2235.
65	36872.	4172.	4286.	444.	936.	20949.	2450.	1453.	2181.
70	31109.	3200.	3766.	362.	782.	17558.	2184.	1249.	2008.
75	23971.	2352.	2969.	262.	588.	13390.	1761.	973.	1677.
80	15853.	1561.	1990.	161.	376.	8682.	1215.	653.	1214.
85	8282.	880.	1056.	79.	193.	4388.	654.	347.	684.

APPENDIX C.1 *Continued.*

age	total	par.reg	par.bas	north	east	west	s.west	m.east	medit
***	initial region of cohort s.west								
0	32751.	0.	0.	0.	0.	0.	32751.	0.	0.
5	32125.	871.	399.	56.	153.	424.	29299.	340.	584.
10	32066.	1192.	656.	95.	262.	693.	27626.	546.	994.
15	31993.	1385.	812.	120.	327.	863.	26517.	680.	1288.
20	31784.	1985.	998.	146.	422.	1029.	24783.	873.	1549.
25	31511.	3146.	1314.	198.	584.	1262.	22028.	1173.	1805.
30	31283.	3983.	1680.	264.	734.	1531.	19555.	1462.	2075.
35	31051.	4161.	1941.	311.	820.	1748.	18099.	1649.	2322.
40	30712.	4107.	2084.	334.	865.	1883.	17207.	1740.	2492.
45	30172.	3992.	2147.	343.	880.	1947.	16486.	1779.	2598.
50	29283.	3822.	2157.	340.	866.	1952.	15728.	1775.	2642.
55	27999.	3565.	2126.	326.	828.	1916.	14866.	1729.	2642.
60	26205.	3173.	2064.	302.	769.	1862.	13787.	1648.	2600.
65	23631.	2607.	1958.	267.	687.	1752.	12394.	1490.	2477.
70	20084.	2001.	1746.	216.	573.	1544.	10505.	1267.	2233.
75	15636.	1468.	1388.	155.	430.	1220.	8159.	980.	1836.
80	10504.	972.	937.	96.	276.	815.	5444.	651.	1314.
85	5561.	548.	498.	47.	142.	425.	2821.	343.	736.

age initial region of cohort m.east

*** **********************************

age	total	par.reg	par.bas	north	east	west	s.west	m.east	medit
0	43283.	0.	0.	0.	0.	0.	0.	43283.	0.
5	42506.	647.	626.	60.	240.	186.	305.	39576.	865.
10	42425.	976.	1034.	106.	385.	350.	551.	37508.	1514.
15	42344.	1199.	1283.	136.	477.	464.	720.	36073.	1992.
20	42078.	1671.	1537.	167.	605.	570.	882.	34261.	2385.
25	41724.	2557.	1936.	232.	831.	713.	1058.	31677.	2720.
30	41430.	3321.	2396.	308.	1060.	898.	1261.	29088.	3099.
35	41118.	3608.	2741.	363.	1199.	1082.	1453.	27183.	3488.
40	40640.	3670.	2938.	398.	1270.	1224.	1602.	25769.	3768.
45	39845.	3648.	3015.	413.	1295.	1306.	1706.	24518.	3945.
50	38614.	3550.	3018.	412.	1282.	1335.	1759.	23223.	4036.
55	36771.	3352.	2969.	397.	1235.	1336.	1774.	21652.	4057.
60	34327.	3006.	2871.	369.	1153.	1319.	1751.	19856.	4002.
65	30674.	2484.	2693.	327.	1035.	1259.	1679.	17373.	3824.
70	25852.	1913.	2379.	266.	866.	1125.	1506.	14340.	3458.
75	19899.	1407.	1883.	191.	652.	894.	1222.	10807.	2844.
80	13220.	934.	1267.	118.	416.	595.	845.	7010.	2034.
85	6975.	530.	672.	58.	213.	309.	455.	3599.	1138.

APPENDIX C.1 *Continued.*

age *** initial region of cohort   medit

age	total	par.reg	par.bas	north	east	west	s.west	m.east	medit
0	32063.	0.	0.	0.	0.	0.	0.	0.	32063.
5	31429.	808.	351.	73.	199.	229.	443.	742.	28583.
10	31366.	1183.	601.	117.	317.	433.	753.	1150.	26811.
15	31313.	1405.	760.	144.	392.	583.	964.	1402.	25664.
20	31133.	1881.	928.	173.	509.	701.	1179.	1730.	24033.
25	30857.	2801.	1206.	227.	715.	834.	1420.	2229.	21423.
30	30637.	3519.	1544.	293.	897.	996.	1627.	2655.	19106.
35	30401.	3714.	1796.	340.	994.	1159.	1785.	2881.	17732.
40	30067.	3708.	1945.	369.	1044.	1291.	1904.	2993.	16813.
45	29538.	3652.	2018.	380.	1058.	1363.	1985.	3033.	16050.
50	28681.	3530.	2034.	376.	1040.	1379.	2023.	3004.	15295.
55	27388.	3318.	2010.	360.	994.	1359.	2020.	2905.	14423.
60	25608.	2971.	1954.	332.	922.	1331.	1971.	2751.	13376.
65	23047.	2447.	1855.	292.	823.	1264.	1872.	2477.	12017.
70	19643.	1883.	1656.	236.	685.	1122.	1671.	2099.	10290.
75	15380.	1387.	1322.	170.	513.	890.	1346.	1618.	8132.
80	10478.	921.	894.	105.	329.	592.	929.	1072.	5635.
85	5650.	520.	476.	52.	170.	306.	502.	564.	3061.

APPENDIX C.2 Expectations of life by place of residence.

age ***	region of residence at age x par.reg *************************************								
	total	par.reg	par.bas	north	east	west	s.west	m.east	medit
0	70.11031	40.10379	9.50963	1.08297	1.76681	5.35036	4.09623	3.45363	4.74689
5	66.49235	40.63552	8.23435	0.91620	1.47423	4.56983	3.54703	2.92028	4.19490
10	61.66755	39.43495	7.12280	0.77877	1.26041	3.89267	3.04311	2.46629	3.66855
15	56.81747	36.90174	6.41896	0.69034	1.12990	3.47309	2.72760	2.19550	3.28034
20	52.10740	34.08989	5.85422	0.61067	0.99367	3.17005	2.47434	1.95187	2.96270
25	47.49933	31.97792	5.11860	0.49380	0.79426	2.76096	2.16077	1.60494	2.58808
30	42.84345	30.59901	4.16761	0.34528	0.56771	2.18543	1.72534	1.16389	2.08917
35	38.21469	28.94827	3.28599	0.22378	0.39159	1.64883	1.29623	0.79252	1.62749
40	33.64809	26.45719	2.61963	0.15352	0.27889	1.26927	0.99863	0.56256	1.30842
45	29.27651	23.44098	2.16453	0.11173	0.20648	1.03738	0.80898	0.42152	1.08490
50	25.15013	20.22549	1.84798	0.08345	0.15688	0.89972	0.68736	0.32551	0.92375
55	21.24864	17.08634	1.56836	0.06505	0.12078	0.76976	0.59898	0.25401	0.78536
60	17.51104	14.28524	1.23211	0.04747	0.08912	0.57841	0.46687	0.19438	0.61744
65	14.18836	12.11710	0.79929	0.03014	0.05808	0.34250	0.29992	0.12583	0.41550
70	11.32765	10.26695	0.39674	0.01534	0.03062	0.15741	0.15712	0.06763	0.23585
75	8.82713	8.31292	0.18598	0.00786	0.01602	0.07173	0.07677	0.03474	0.12113
80	6.82783	6.53513	0.10892	0.00479	0.01004	0.04046	0.04323	0.01918	0.06609
85	5.07943	4.91351	0.06148	0.00264	0.00561	0.02274	0.02446	0.01081	0.03817

APPENDIX C.2 *Continued.*

age region of residence at age x par.bas
*** *************************************

age	total	par.reg	par.bas	north	east	west	s.west	m.east	medit
0	69.51026	7.95001	44.53997	1.40502	2.40065	4.12042	2.54221	3.23919	3.31278
5	65.82315	6.93628	44.17766	1.19447	2.05917	3.56594	2.21093	2.76954	2.90916
10	60.91724	6.26972	41.97724	1.02287	1.79503	3.05755	1.88808	2.40228	2.50449
15	56.02602	5.83329	38.91902	0.91562	1.62107	2.71018	1.66496	2.14709	2.21478
20	51.31622	5.06944	36.36506	0.80396	1.40541	2.40060	1.46428	1.87116	1.93630
25	46.74105	3.68599	35.05278	0.64428	1.08778	1.97093	1.21352	1.46593	1.61984
30	42.02841	2.26816	33.90945	0.45894	0.73983	1.46894	0.91119	1.01355	1.25834
35	37.33430	1.40312	31.90211	0.30814	0.47189	1.02631	0.63567	0.66736	0.91971
40	32.80938	0.93022	29.15321	0.20327	0.29831	0.68877	0.42776	0.43986	0.66798
45	28.53858	0.62646	26.04987	0.12980	0.19033	0.46974	0.29485	0.29028	0.48724
50	24.47147	0.40866	22.74710	0.08241	0.12751	0.33346	0.21446	0.19485	0.36301
55	20.62031	0.26348	19.44827	0.05183	0.08554	0.23303	0.15029	0.12761	0.26027
60	17.00368	0.17401	16.24587	0.03281	0.05337	0.15124	0.09979	0.07803	0.16856
65	13.73033	0.12128	13.25729	0.02256	0.03297	0.08813	0.05939	0.04749	0.10123
70	10.83069	0.08977	10.53486	0.01436	0.02090	0.04819	0.03280	0.03033	0.05948
75	8.32630	0.06419	8.13720	0.00849	0.01417	0.02831	0.01954	0.02028	0.03413
80	6.28535	0.04357	6.16627	0.00530	0.00837	0.01804	0.01181	0.01306	0.01893
85	4.73526	0.02503	4.66725	0.00293	0.00469	0.01020	0.00674	0.00738	0.01104

age region of residence at age x north
*** **

age	total	par.reg	par.bas	north	east	west	s.west	m.east	medit
0	67.46915	5.27329	5.88039	46.38949	1.56581	1.80378	1.68733	2.09962	2.76945
5	64.19231	4.55089	5.03274	46.11560	1.31147	1.52397	1.44725	1.78419	2.42619
10	59.23241	4.08157	4.38732	43.45923	1.12963	1.30563	1.23910	1.52149	2.10843
15	54.25030	3.80157	3.99976	39.91201	1.04128	1.16789	1.09120	1.36223	1.87437
20	49.39697	3.32099	3.53767	36.87900	0.90095	0.99639	0.93445	1.18579	1.64173
25	44.57207	2.44041	2.77023	34.93066	0.65216	0.76677	0.74234	0.91391	1.35561
30	39.64273	1.50091	1.86144	33.14998	0.40341	0.53159	0.54542	0.61988	1.03011
35	34.79625	0.88299	1.17423	30.63659	0.22266	0.34809	0.37577	0.39493	0.76099
40	30.29428	0.54014	0.78166	27.53978	0.12193	0.23163	0.25745	0.25258	0.56910
45	26.06630	0.33636	0.53154	24.18150	0.07818	0.16071	0.18443	0.16286	0.43071
50	22.17538	0.21991	0.36372	20.84243	0.05215	0.11615	0.13221	0.11048	0.33833
55	18.55582	0.13888	0.24771	17.64401	0.03285	0.07880	0.09010	0.07317	0.25030
60	15.16829	0.08242	0.15085	14.60597	0.02024	0.04746	0.05571	0.04366	0.16199
65	12.10879	0.05107	0.08439	11.78723	0.01083	0.02636	0.03151	0.02645	0.09094
70	9.58367	0.03395	0.04928	9.40823	0.00467	0.01196	0.01452	0.01606	0.04500
75	7.51985	0.02510	0.02984	7.41603	0.00267	0.00544	0.00661	0.01121	0.02295
80	5.77598	0.01856	0.02121	5.71084	0.00109	0.00225	0.00507	0.00496	0.01200
85	4.23793	0.01026	0.01158	4.20204	0.00059	0.00124	0.00279	0.00270	0.00672

APPENDIX C.2 *Continued.*

age region of residence at age x east

age	total	par.reg	par.bas	north	east	west	s.west	m.east	medit
0	68.88728	4.36990	5.18778	0.84030	46.95578	1.96147	2.13189	3.16460	4.27555
5	65.34728	3.77074	4.44384	0.70841	46.47167	1.67517	1.83461	2.68735	3.75550
10	60.45042	3.30922	3.85631	0.59616	44.14469	1.42097	1.56173	2.33115	3.23019
15	55.54306	3.01690	3.48946	0.53410	40.92580	1.25562	1.37506	2.10704	2.83907
20	50.87404	2.64800	3.12675	0.48055	37.92559	1.08229	1.21104	1.87024	2.52958
25	46.20110	1.98379	2.51866	0.38089	35.85563	0.83561	0.99737	1.47984	2.14931
30	41.42978	1.23498	1.74015	0.25506	34.19794	0.58386	0.75260	0.99383	1.67135
35	36.67696	0.73570	1.11399	0.15603	31.90327	0.39788	0.52818	0.62360	1.21831
40	32.02043	0.46734	0.71442	0.09126	28.87068	0.26010	0.35491	0.40046	0.86124
45	27.65681	0.30013	0.47933	0.05247	25.53807	0.16317	0.24279	0.26370	0.61714
50	23.54221	0.18554	0.33049	0.02993	22.09742	0.10343	0.16801	0.17892	0.44847
55	19.71698	0.10563	0.21351	0.01760	18.77281	0.06789	0.11008	0.11506	0.31441
60	16.18919	0.05831	0.12467	0.00961	15.61329	0.04451	0.06322	0.07099	0.20459
65	12.95288	0.03602	0.07004	0.00402	12.62754	0.02411	0.03324	0.03993	0.11800
70	10.19452	0.02334	0.04242	0.00157	10.01648	0.01155	0.01698	0.02194	0.06024
75	7.87673	0.01763	0.02965	0.00071	7.76946	0.00606	0.00958	0.01364	0.02999
80	6.00993	0.01388	0.02111	0.00078	5.93930	0.00225	0.00693	0.00809	0.01759
85	4.44523	0.00780	0.01170	0.00043	4.40577	0.00125	0.00385	0.00446	0.00998

age region of residence at age x west

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age	total	par.reg	par.bas	north	east	west	s.west	m.east	medit
0	69.26109	6.49982	5.49890	0.56371	1.19841	48.41013	2.93114	1.73926	2.41971
5	65.55171	5.60076	4.65289	0.46740	1.02109	47.72032	2.54567	1.44567	2.09790
10	60.64193	5.11944	4.11253	0.40661	0.90586	44.76331	2.25637	1.24951	1.82830
15	55.71885	4.81329	3.77983	0.37049	0.82896	41.10588	2.05963	1.12552	1.63525
20	51.01587	4.08885	3.31417	0.31519	0.69989	38.42995	1.78062	0.96631	1.42088
25	46.42382	2.68689	2.46847	0.22248	0.47294	37.43439	1.33755	0.69741	1.10368
30	41.70617	1.39415	1.53034	0.13215	0.26118	36.32388	0.88747	0.41842	0.75858
35	37.03346	0.77751	0.92273	0.07850	0.14582	33.76032	0.59629	0.24155	0.51075
40	32.52368	0.49670	0.58498	0.04778	0.08383	30.39167	0.41542	0.14683	0.35647
45	28.24215	0.32683	0.38249	0.02784	0.04814	26.83687	0.27815	0.09042	0.25141
50	24.23030	0.21292	0.25369	0.01652	0.02897	23.29292	0.18696	0.05561	0.18271
55	20.47017	0.12595	0.16807	0.01035	0.01623	19.86192	0.12422	0.03361	0.12983
60	16.85271	0.07588	0.11193	0.00663	0.00885	16.46140	0.08059	0.02166	0.08576
65	13.60235	0.05574	0.07081	0.00425	0.00538	13.33978	0.05501	0.01553	0.05585
70	10.67632	0.04311	0.04269	0.00218	0.00308	10.50507	0.03499	0.01081	0.03439
75	8.14842	0.03196	0.02693	0.00056	0.00155	8.03494	0.02416	0.00761	0.02070
80	6.13055	0.01998	0.02019	0.00001	0.00122	6.05770	0.01577	0.00465	0.01102
85	4.60013	0.01141	0.01141	0.00001	0.00068	4.55871	0.00890	0.00262	0.00638

APPENDIX C.2 *Continued.*

age — region of residence at age x s.west

age	total	par.reg	par.bas	north	east	west	s.west	m.east	medit
0	70.30620	6.60332	3.83668	0.55478	1.47709	3.51894	46.24479	3.09494	4.97566
5	66.66983	5.74289	3.20616	0.45848	1.25877	2.95202	46.12416	2.61201	4.31534
10	61.81796	5.29450	2.80207	0.39247	1.08247	2.56181	43.66584	2.28068	3.73811
15	56.97827	5.01834	2.56391	0.35453	0.97986	2.32739	40.34660	2.06843	3.31920
20	52.38054	4.32071	2.23180	0.31178	0.83943	2.06074	37.92822	1.77599	2.91189
25	47.88763	2.88113	1.61969	0.22757	0.59819	1.59721	37.28032	1.30341	2.38010
30	43.31104	1.49769	0.97029	0.13213	0.35738	1.04939	36.73205	0.81656	1.75554
35	38.66207	0.79078	0.56725	0.07164	0.20457	0.66096	34.65241	0.48628	1.22818
40	34.06639	0.46732	0.35260	0.04182	0.11581	0.43847	31.48172	0.30562	0.86303
45	29.58298	0.28837	0.22361	0.02648	0.06263	0.29915	27.87585	0.19715	0.60974
50	25.35280	0.18198	0.14179	0.01563	0.03681	0.20842	24.19484	0.12828	0.44507
55	21.31071	0.11626	0.09019	0.00869	0.02271	0.14392	20.53419	0.07852	0.31623
60	17.53752	0.07659	0.05820	0.00472	0.01451	0.09703	17.03033	0.04484	0.21130
65	14.07502	0.05288	0.03517	0.00257	0.01049	0.06179	13.75133	0.02815	0.13264
70	11.04844	0.03778	0.02097	0.00163	0.00697	0.03880	10.84515	0.01766	0.07947
75	8.41895	0.02852	0.01413	0.00098	0.00480	0.02463	8.28734	0.01105	0.04751
80	6.28389	0.01742	0.00859	0.00064	0.00316	0.01527	6.20230	0.00666	0.02984
85	4.71783	0.01000	0.00490	0.00036	0.00177	0.00860	4.67117	0.00376	0.01727

age region of residence at age x m.east
*** ***************************************

age	total	par.reg	par.bas	north	east	west	s.west	m.east	medit
0	69.91368	4.47551	4.10853	0.50156	1.65177	1.74428	2.39532	49.28480	5.75191
5	66.13731	3.86122	3.47137	0.41913	1.40232	1.45843	2.05362	48.42682	5.04439
10	61.24926	3.44643	3.00605	0.35915	1.22904	1.23388	1.75658	45.84140	4.37673
15	56.35125	3.16214	2.71787	0.32264	1.12083	1.09327	1.55811	42.50470	3.87169
20	51.68731	2.71468	2.39978	0.28468	0.98568	0.94537	1.35561	39.58221	3.41930
25	47.09029	1.93300	1.86548	0.21204	0.74621	0.72424	1.09413	37.62040	2.89479
30	42.38776	1.14171	1.25622	0.13391	0.47788	0.48605	0.79220	35.84908	2.25071
35	37.66299	0.66234	0.80384	0.08174	0.29362	0.30897	0.54550	33.32335	1.64363
40	33.05451	0.40094	0.52227	0.04837	0.18466	0.19477	0.37540	30.13040	1.19771
45	28.64556	0.24333	0.35536	0.03101	0.11936	0.12586	0.25587	26.62951	0.88527
50	24.45612	0.14629	0.24742	0.02009	0.07895	0.08224	0.17782	23.04068	0.66263
55	20.55639	0.08586	0.16811	0.01234	0.05119	0.04838	0.12209	19.58418	0.48425
60	16.81972	0.05257	0.10693	0.00752	0.03224	0.02886	0.08084	16.17422	0.33654
65	13.57315	0.03357	0.06689	0.00350	0.01998	0.01819	0.05027	13.16704	0.21371
70	10.68653	0.02301	0.03778	0.00156	0.01081	0.00808	0.03006	10.45403	0.12119
75	8.21428	0.01880	0.02259	0.00122	0.00473	0.00324	0.01676	8.07657	0.07037
80	6.19981	0.01450	0.01421	0.00060	0.00278	0.00233	0.00930	6.11382	0.04226
85	4.60514	0.00822	0.00796	0.00033	0.00154	0.00131	0.00522	4.55644	0.02412

APPENDIX C.2 *Continued.*

age *** region of residence at age x medit
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age	total	par.reg	par.bas	north	east	west	s.west	m.east	medit
0	70.39853	6.22390	3.67542	0.63313	1.81983	2.48951	3.84034	5.54364	46.17276
5	66.83228	5.40513	3.09583	0.51813	1.56545	2.11756	3.33647	4.70445	46.08926
10	62.00896	4.86486	2.67961	0.44554	1.38985	1.78268	2.90055	4.13607	43.80981
15	57.13850	4.51951	2.42241	0.40313	1.27778	1.54746	2.59826	3.77208	40.59789
20	52.49764	3.93082	2.11809	0.35699	1.11235	1.32849	2.25925	3.29221	38.09945
25	48.04879	2.77855	1.58977	0.27256	0.80474	1.02768	1.77417	2.48386	37.31744
30	43.49200	1.61167	1.00366	0.17456	0.49169	0.71265	1.26657	1.63209	36.59912
35	38.89229	0.95888	0.62066	0.10632	0.29546	0.47096	0.90422	1.06830	34.46749
40	34.33062	0.61776	0.39356	0.06095	0.17499	0.28982	0.64997	0.70739	31.43618
45	29.87003	0.39036	0.24467	0.03460	0.10226	0.17200	0.46284	0.46664	27.99666
50	25.63438	0.24644	0.15390	0.02127	0.06256	0.10702	0.32452	0.31565	24.40303
55	21.67746	0.15445	0.09794	0.01274	0.04020	0.07208	0.22404	0.21139	20.86462
60	17.97789	0.09566	0.06432	0.00773	0.02574	0.04593	0.15936	0.13564	17.44353
65	14.62681	0.06822	0.04381	0.00528	0.01713	0.02676	0.10503	0.08687	14.27371
70	11.58423	0.04900	0.02854	0.00384	0.01202	0.01426	0.06199	0.05273	11.36185
75	8.92425	0.03226	0.01574	0.00223	0.00914	0.00520	0.04145	0.03162	8.78663
80	6.70442	0.02049	0.00845	0.00103	0.00624	0.00195	0.02795	0.01916	6.61916
85	5.17101	0.01221	0.00502	0.00059	0.00362	0.00116	0.01645	0.01121	5.12075

Appendix D

A NOTE ON THE ESTIMATION OF THE AGE-SPECIFIC TRANSITION PROBABILITIES AND MIGRATION RATES

The crucial problem in the calculation of a multiregional life table lies in estimating the age-specific transition probabilities from which all the other multistate life table functions originate. For this purpose, there exist two alternative approaches depending on the source of the migration information available.

D1 ALTERNATIVE APPROACHES

Migration information can be obtained either from a population register or from a population census. But, as is well known, these two sources provide different types of migration data, because they rely on different conceptualizations of the "passage" from one region to another.

The population register data reflect interregional passage as an instantaneous event – a separation from one region to join another – in much the same way as a birth or a death. The population census data, on the other hand, view interregional passage as a change in an individual's region of residence between two points in time. These two conceptualizatons lead to the classical notions of *migration* and *migrant* whose contrast has been discussed in full detail by Courgeau (1973).

Thus the approach used to estimate age-specific transition probabilities depends on whether data come from population registers or from population censuses. The two approaches are generally referred to as the *movement* and *transition* approaches (Ledent 1980a).

D2 MOVEMENT AND TRANSITION APPROACHES: AN OVERVIEW

In the past, various methods have been proposed for estimating age-specific transition probabilities from both the movement and transition perspectives. (For an extensive review of these methods, see Ledent and Rees 1980.)

In the case of the movement approach, the observed migration (and mortality) information is first converted into exposure/occurrence rates, which for convenience are serried into age-specific rate matrices $\mathbf{M}_x$. In a second step, these rate matrices are transformed into the desired age-specific transition probabilities $\mathbf{p}_x$. The formula commonly used for deriving $\mathbf{p}_x$ from $\mathbf{M}_x$ is a matrix formula originally proposed by Rogers and Ledent (1976) and is referred to as "Option 3" in Willekens and Rogers (1978). This formula has actually been used within the context of the IIASA Comparative Migration and Settlement Study whenever the migration data were taken from population registers: see, for example, the reports on Finland (Rikkinen 1979), Sweden (Andersson and Holmberg 1980), the German Democratic Republic (Mohs 1980), the Netherlands (Drewe 1980), and the USSR (Soboleva 1980).

In the case of the transition approach, the usual estimation procedure parallels that of the movement approach. The raw migration (and mortality) information is first converted into age-specific migration (and mortality) rates, which are then transformed into the desired transition probabilities by using adequate scalar formulas. The formulas typically used for effecting the latter transformation were originally proposed by Rogers (1975a) and are referred to as the "Option 1" method in Willekens and Rogers (1978). Unfortunately, because they implicitly assume that an individual cannot make more than one move per interval, these formulas lead to an overestimation of the total survival probabilities. Therefore, to preserve the accuracy of the mortality statistics appearing in a multiregional life table, the Option 3 formula is generally substituted for the Option 1 formulas (Ledent and Rees 1980). The Option 3 formula has been used in the IIASA Comparative Migration and Settlement Study whenever the migration data were taken from population censuses; see, for example, the reports on the United Kingdom (Rees 1979) and Canada (Termote 1980).

D3 AN IMPROVED METHODOLOGY FOR IMPLEMENTING THE TRANSITION APPROACH*

Implementation of the transition approach given above raises a problem, which has been widely overlooked until recently: the proper measurement of the "migration" rates derived from the input data.

A thorough examination of this problem reveals that there is, in fact, no single definition that could underlie the measurement of the requested migration rates. Thus it appears preferable to adopt an alternative procedure, which relies on statistics that one can unambiguously measure from the available data.

Below, we propose a procedure for the implementation of the transition approach, which heavily borrows from a method initially developed by Rogers (1975a) referred to as the "Option 2" method in Willekens and Rogers (1978). In brief, the proposed procedure starts by converting the observed migration and mortality information into survivorship proportions, which for convenience are serried into age-specific matrices $\mathbf{S}_x$. Then the survivorship proportion matrices are transformed into the desired age-specific transition probabilities $\mathbf{p}_x$.

The only feature that in fact distinguishes our procedure from the Option 2 method lies in the choice of the formula allowing the transformation of the survivorship proportion matrices into the transition probability matrices. The formula proposed by Rogers (1975a, pp. 85, 86) for the purpose of such a transformation leads, in most instances, to unacceptable results, which can be traced to some stringent underlying assumptions. As a

*The methodology outlined in this subsection represents the initial development of a methodology that has recently been improved (Ledent 1980b, Ledent and Rees 1980).

viable alternative, we suggest the use of a formula that simply averages the observed survivorship proportions of two consecutive age groups. The average could be an arithmetic one as proposed by Rees and Wilson (1977), but we prefer a geometric average (for which an explicit formula will be shown).

Note that, if the substitution of this new geometric averaging formula improves the reliability of the Option 2 method, basic difficulties inherent to the method remain in existence in our proposed procedure. First, the length of the observation period for migration not only must be equal to the width of each interval (the geometric averaging formula implicitly assumes this) but also must coincide with the intercensal period (to make the measurement of the survivorship proportions feasible from the data available).

Second, since the mortality information is implicitly introduced through the census information (changes of residence during the intercensal period and initial population), we conclude that the mortality statistics calculated in the ensuing multiregional life table are likely to be less accurate than those obtained from a multiregional life table based on conventional mortality data. In light of this, it appears necessary to modify the methodology outlined above so as to directly introduce independent mortality information.

The next section describes a possible amended method, which was actually used in the present report for the calculation of the age-specific transition probabilities.

D4 A BRIEF DESCRIPTION OF THE ESTIMATION METHOD USED IN THE FRENCH CASE STUDY

The estimation method described below is, in fact, a rather general method that avoids most of the difficulties inherent in the procedure just outlined. The only remaining limitation is that the observation period for migration must equal the width of each age group. (A recent refinement of the present methodology (Ledent 1980b, Ledent and Rees 1980) allows for the removal of this last limitation.) Thus this estimation method is not directly applicable to the case of France where the length T of the observation period (1968–1975) is 7 years, whereas the width n of each age interval is 5 years. However, in case of T and n being similar (as 7 and 5 are), the method can still be applied if properly amended.

Let us first consider the common situation in which the migration information available from a population census consists of a set of figures ${}^iK_x^j$ representing the number of those aged x to $x + n$ (at the time of the census) who are living in region j at the time of the census and were living in region i some $T = n$ years earlier. Then we can simply derive from these a set of transition proportions conditional on survival ${}^i\bar{S}_{x-n}^j$ using

$$ {}^i\bar{S}_{x-n}^j = {}^iK_x^j / \sum_k {}^iK_x^k \tag{D1}$$

This formula defines the proportion of those who, among the people aged x to $x + n$ in region j at the time of the census, were living in region i n years earlier. (In the case of x equaling zero, such a proportion refers to those born in region i during the observation period and surviving in region j at the time of the census.) Note here the presence of stayer streams (that is, those people who live in the same region at the start and end of the observation period) in the sum appearing in the denominator of the above formula. As pointed out by Ledent and Rees (1980), this allows for an adequate closure of the multiregional system considered, which contrasts with the closure by default implicit in the transition approach implemented, as indicated in section D2.

After gathering the age-specific conditional transition proportions into matrices $\bar{\mathbf{S}}_x$, the geometric averaging method mentioned earlier can be used to derive a set of age-specific matrices $\bar{\mathbf{p}}_x$ of transition probabilities conditional on survival. Explicitly, we obtain $\bar{\mathbf{p}}_x$ from

$$\bar{\mathbf{p}}_x = (\bar{\mathbf{S}}_{x-n}\,\bar{\mathbf{S}}_x)^{1/2} \qquad \text{for all } x \neq 0 \tag{D2}$$

and, in the case of the first age group, from

$$\bar{\mathbf{p}}_0 = (\bar{\mathbf{S}}_{-n}^2\,\bar{\mathbf{S}}_0)^{1/2} = \bar{\mathbf{S}}_{-n}\,\bar{\mathbf{S}}_0^{\;1/2} \tag{D3}$$

where $\bar{\mathbf{S}}_{-n}$ is the conditional transition proportion matrix relating to those born during the observation period. (It is squared because it relates to people who, on the average, were alive half the duration of this period.)

The next step consists of transforming the conditional matrices $\bar{\mathbf{p}}_x$ into the unconditional matrices $\mathbf{p}_x$ by introducing the independent mortality information. This transformation can be implemented by use of

$$\mathbf{p}_x = \bar{\mathbf{p}}_x\,\mathbf{p}_x^\sigma \tag{D4}$$

where $\mathbf{p}_x^\sigma$ is a diagonal matrix of survival probabilities whose elements are similar to the survival probabilities of an ordinary life table, i.e.,

$$\mathbf{p}_x^\sigma = [\mathbf{I} - n/2(\hat{\mathbf{M}}_x^\delta)]\,[\mathbf{I} + n/2(\hat{\mathbf{M}}_x^\delta)]^{-1} \tag{D5}$$

where

$\mathbf{I}$ is an identity matrix
$\hat{\mathbf{M}}_x^\delta$ is a diagonal matrix of mortality rates

Note that, in principle, the transformation of $\bar{\mathbf{p}}_x$ into $\mathbf{p}_x$ is not at all straightforward because the mortality rates involved in (D5) are not conventionally defined rates. This follows from the simplicity of equations (D4) and (D5) for which there is evidently a price to pay. The ensuing mortality pattern can no longer be regarded as being specific to the region in which deaths actually occur but must be viewed as being specific to the region of residence at the exact age $x = 0, n, 2n, \ldots$ immediately before the actual age of death.

In practice, however, because the mortality rates ${}^i\hat{M}_x^\delta$ differ little from the conventional mortality rates ${}^iM_x^\delta$, it is acceptable to substitute the latter for the former in (D5), which allows for a rapid but reliable estimation of $\mathbf{p}_x^\sigma$ and then $\mathbf{p}_x$.*

Recall that the estimation procedure just described is applicable only to the case of an observation period length T and an age group width n being equal. As already mentioned, this procedure can still be used if T is slightly different from n; this necessitates modifying slightly the estimation of the transition proportions conditional on survival.

In brief, if the migration data relate to a T-year period ($T \neq n$), the use of formula (D1) leads to T-year transition proportions conditional on survival ($\bar{\mathbf{S}}_{x-T}^+$). If n does not

*Note that a more recent version of this estimation procedure (Ledent 1980b) does not necessitate such a substitution. Rather, it uses an iterative procedure to simultaneously produce estimates of $\mathbf{p}_x$ and $\hat{\mathbf{M}}_x^\delta$.

equal T, we can obtain estimates of the 5-year conditional proportions $\bar{\mathbf{S}}_{x-n}$ requested on the right-hand side of (D2) from the simple approximate formula

$$\bar{\mathbf{S}}_{x-n} = (\bar{\mathbf{S}}^{+}_{x-T})^{n/T} \qquad \text{(D6)*}$$

whose rationale lies in the multiplicative rather than additive character of migration transition probabilities (Rogers 1968, Rees 1977).

In our application of the above methodology to the case of France, formula (D6) – with $n = 5$ and $T = 7$ – was used for all age groups except the first two. A modified formula had to be established for the first two age groups. This was necessary, because in France, the migrations or transitions relating to those born during the observation period are obtained by comparing the region of residence at the end of the period with *the place of residence of the mother at the beginning of the period*:

$$\bar{\mathbf{S}}_{-5} = (\bar{\mathbf{S}}^{+}_{-7})^{5/14} \qquad \text{(D7)}$$

and

$$\bar{\mathbf{S}}_{0} = (\bar{\mathbf{S}}^{+}_{-2})^{39/49} \qquad \text{(D8)}$$

D5 ESTIMATION OF THE AGE-SPECIFIC MIGRATION RATES

As pointed out by several authors (Rees 1977, Ledent 1980b), the definition and measurement of annual migration rates from transition data (from a population census) is a problem for which there currently exists no satisfactory solution.

Whenever this problem arose in the IIASA Comparative Migration and Settlement Study (e.g., the UK (Rees 1979) and Canadian (Termote 1980) case studies), annual destination-specific migration rates were simply calculated from

$${}^{i}\hat{M}^{j}_{x} = {}^{i}K^{j}_{x}/(T\hat{P}^{i}_{x}) \qquad \text{(D9)}$$

where

${}^{i}K^{j}_{x}$ is the number of people aged x to $x + n$ (where n is the width of the age group) in region j at the time of the census who were in region i T years earlier (T being the length of the observation period)

$\hat{P}^{i}_{x}$ is the average population x to $x + n$ living in region i during the observation period taken as the arithmetic average of the relevant populations at the beginning and end of the observed periods

Owing to the existence of multiple and return migrations, which tend to increase with T, the value of the annual migration rates defined by (D9) is not independent of T but, for a given country, tends to decrease with T. To put it differently, the value of the migration rate calculated from (D9) differs from the migration rate that would be obtained

*Note that, computationally, the raising of a matrix to a fractional power can be easily performed by taking advantage of the method proposed by Waugh and Abel (1967).

as an occurrence/exposure rate, if a population register existed (the discrepancy between the two rates increasing with T). Noting that the discrepancy is likely to be small for $T = 1$, however, we are thus led to conclude that the countries in the IIASA Comparative Migration and Settlement Study can be classified into two groups within which the values of the migration rates are comparable:

(a) a first group comprising those countries based on migration information coming from a population register or from a population census with $T = 1$
(b) a second group consisting of those countries based on migration information coming from a population census with $T = 5$

All of the 17 member countries belong to one of these groups. The only exception is France where the migration information comes from a population census with $T = 7$.

Of course, formula (D9) could have been used to derive age-specific migration rates for that country, but these rates would have been based on 7 years and thus not be comparable with the migration rates of, for example, the second group of countries distinguished above.

Fortunately, the methodology used for calculating the multiregional life table in the case of France does not require a direct estimation of such rates from the data. As a result, we can derive estimates of the age-specific migration rates from the age-specific transition probabilities of the multiregional life table. The advantage of this is clear. Since the transition probabilities relate to 5-year age groups, the estimates of the migration rates thus obtained are based on 5 years and thus are directly comparable with the migration rates estimated from (D9) for the second group of IIASA countries.

Under certain circumstances (see Ledent 1978), transition probabilities on the one hand and migration and death rates on the other are linked by

$$\mathbf{P}_x = \{\mathbf{I} - n[\hat{\mathbf{M}}_x^m + 1/2(\hat{\mathbf{M}}_x^\delta)]\}\{\mathbf{I} + n/2(\hat{\mathbf{M}}_x^\delta)\}^{-1} \tag{D10}$$

in which

$\hat{\mathbf{M}}_x^\delta$ is the diagonal matrix of nonconventional rates defined earlier
$\hat{\mathbf{M}}_x^m$ is a matrix of migration rates arranged as follows

$$\hat{\mathbf{M}}_x = \begin{bmatrix} \sum_{j\neq 1} {}^1\hat{M}_x^j & -{}^2\hat{M}_x^1 & & \\ -{}^1\hat{M}_x^2 & \sum_{j\neq 2} {}^2\hat{M}_x^j & & \\ \vdots & & \ddots & \\ -{}^1\hat{M}_x^n & & & \sum_{j\neq n} {}^n\hat{M}_x^j \end{bmatrix} \tag{D11}$$

It is readily established from (D10) that

$$\hat{\mathbf{M}}_x = [\mathbf{I} - n/2(\hat{\mathbf{M}}_x^\delta)] - \mathbf{P}_x[\mathbf{I} + n/2(\hat{\mathbf{M}}_x^\delta)] \tag{D12}$$

Finally, substituting (D4) yields

$$\hat{\mathbf{M}}_x = (\mathbf{I} - \overline{\mathbf{P}}_x)[\mathbf{I} - n/2(\hat{\mathbf{M}}_x^{\delta})] \tag{D13}$$

a formula used to derive the age-specific migration rates used in sections 2 and 3 of this report.

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(continued overleaf)

NATIONAL CASE STUDIES *(continued)*

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