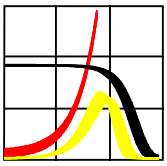

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Running Head: OLD-AGE MORTALITY IN GERMANY

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(6075 words)

Abstract

Recent trends in German life expectancy show considerable improvement. Most of the improvement resulted from decreasing mortality at older ages. Patterns of oldest old mortality (ages 80+) differed significantly between men and women as well as between East and West Germany (the former German Democratic Republic, GDR, and the Federal Republic of Germany in its borders from 1989, FRG, respectively). While West German oldest old mortality decreased since the mid 1970s, comparable improvements in East Germany only became evident during the late 1980s. Yet, East German improvements accelerated after German reunification in 1990, particularly among East German females, attesting to the plasticity of human life expectancy and the importance of late life events. Medical care, individual economic resources and life-style factors are discussed as potential determinants of improvement in old age mortality in Germany.

(135 words)

Old-age Mortality in Germany prior to and after Reunification

Mortality patterns in Germany are an intriguing subject for social scientists. The recent German history offers a unique opportunity to study the effects of political, economic and social factors on mortality changes. Prior to 1945 East and West Germans shared a cultural and historical background that included the political system. Between 1949 and 1989, however, East and West Germans lived under different political and economic systems, a socialist planned economy (East Germany) versus a free-market democracy (West Germany). With German reunification in 1990 the two German populations were again integrated into one political and economic system.

The purpose of this study is to examine recent trends in old age mortality in Germany. We consider the period from 1970 to 1996, and we present mortality indicators separately for the former German Democratic Republic (GDR or East Germany) and the former Federal Republic of Germany (FRG or West Germany). The paper addresses two issues. First, we examine whether and to what degree improvements in life expectancy were determined by improvements in survival at older ages. Secondly, we provide a detailed description of recent trends in mortality among the oldest old (ages 80+). In this context it is of interest to determine whether the changes associated with German reunification in 1990 altered any of the long-term trajectories of oldest old mortality.

Previous research indicated that life expectancy was somewhat different in East and West Germany. Immediately after the war, mortality was higher in East Germany as compared to West Germany (Scholz 1996). However, the situation in East Germany improved quickly. By the early 1950s, mortality in East Germany had

reached the pre-war level and, subsequently, even fell somewhat below West German figures. With regard to the male population, a slight East German lead lasted until the mid 1970s. Mortality for women was about the same in both German states from the early 1950s until the early 1970s.

As of about 1970 mortality trends in East and West Germany diverged (see Figure 1). Life expectancy at birth in East Germany increased with a low gradient for both sexes, while life expectancy in West Germany rose more rapidly. With the collapse of the socialist regime in 1989 and German reunification one year later, life expectancy in East Germany began to increase at an accelerated pace. The improvement in life expectancy was more pronounced for females than for males. However, this general trend towards increased life expectancy was accompanied by a temporary set-back for men. Detailed analyses indicated that male life expectancy actually declined in East Germany immediately before and after reunification. For males, the 1989 level was not reached again until 1992. This short peak in mortality was due to higher death rates in men aged 15 to 65 (Häussler, Hempel, & Reschke, 1995; Dorbritz & Gärtner, 1995). Older age groups did not experience a similar increase in death rates. Mortality for these older age groups continued to improve gradually (Häussler, Hempel, & Reschke, 1995; Schott, Bergmann, & Wiesner, 1995).

--- Insert Figure 1 about here ---

Demographers have documented the remarkable improvements in survival at older ages in developed countries. During the 20th century death rates at older ages have fallen dramatically in many European countries (Kannisto, Lauritsen, Thatcher, & Vaupel, 1994; Vaupel, 1997). Mortality improvements have been greater for females than males, and the pace of improvement has been more rapid in recent

decades than it was in earlier decades. One goal of the present study was to explore whether similar trends can also be observed for the two German states.

In sum, the present study focuses on trends in old age mortality in Germany. In a first step we examine the contribution of different age groups to changes in life expectancy, separately for the two German states and for different time periods (prior to, during, and after reunification). Our goal was to evaluate whether and to what degree improvements in life expectancy were determined by improvements in survival at older ages. In a second step we investigate changes in oldest old mortality (ages 80+) for the period between 1955 and 1996, again separately for the two German states. Utilizing Lexis maps (Andreev, 1999; Vaupel, Zhenglian, Andreev, & Yashin, 1998) we present death rates for each age (80 to 100) and each year (1955 to 1996). Our goal was to obtain a detailed description of trends in old age mortality in Germany in recent decades, and to assess whether these trends were altered by German reunification. In the final section we discuss potential determinants of old age mortality in Germany, with an emphasis on medical and nursing care, individual economic resources, and lifestyle factors.

Data and Methods

The empirical analyses in this paper are based on two sets of data. The changes in mortality patterns in East and West Germany are analyzed based on the data published by the German Statistical Office (Statistisches Bundesamt, 1980-1998). Conventional demographic methods using life table functions are applied in these analyses. A method developed by Pollard is used to analyze the contribution of different age groups to changes in life expectancy at birth (Pollard 1982, 1989). This method is based on the fact that a change in the force of mortality in an age interval ($x + \triangle x$) causes a change in life expectancy at birth equal to:

$$ {}_xp_o e_x \varphi \triangle x $$

where: ${}_xp_o$ is the probability of survival from age 0 to age x.
φ is the change of the force of mortality between period 0 and 1
e_x is the life expectancy at age x.

The method is applied for the whole period under consideration, 1980-1996, as well as broken down into three parts: 1980-1987 (prior to reunification), 1987-1992 (the period of reunification), and 1992-1996 (the period after reunification). The results obtained from this set of analyses are shown in Figures 2 and 3, for males and females separately.

We used the *Kannisto-Thatcher Oldest Old Database* (Kannisto, 1994) to investigate the mortality changes among the oldest old (ages 80+). This database is continuously updated and it includes data on deaths by sex and by single year of age combined with the year of birth. There is no upper limit for age for most of the 31 countries that are presently included in the database. For some countries, however, the age limit is 99 years. The data begin at age 80 and start for most of the countries with the year 1950. The data on deaths are arranged in cohort survival histories, based on the "method of extinct generation" (Vincent, 1951). This method builds up the history of a cohort (its size by age and sex) by summing up the deaths beginning with the oldest individual for a cohort which has died out. The cohort history was chosen because central death rates are most accurately calculated when a closed group of persons is followed up from one exact age to the next, and it is known that accuracy becomes increasingly important when the numbers are very small as is the case at the oldest ages. Kannisto (1994) studied the quality and reliability of German mortality data and concluded that the data on deaths were accurate for both East and West Germany.

In the present study we developed Lexis maps based on these data for ages 80 and over and for the period 1950-1996 (see Figures 4 and 5). Lexis maps can be used to graphically display mortality changes over time and separately for different ages. The maps presented here are based on mortality indicators whose layers differ by color. The colors indicate different death rates in Figure 4 and different death rate ratios in Figure 5.

Results

The Contribution of Older Age Groups

The older age groups contributed most to the improvement of life expectancy at birth for females in East and West (Figure 2). This is reflected in the period 1980-1996 as a whole, as well as when it is broken down into the periods 1980-87 (the period prior to reunification), 1987-92 (the period of turmoil during reunification), and 1992-96 (the period after reunification). Life expectancy at birth for females in East Germany during 1980-1996 improved by 5.3 years. More than 71% of this improvement came from ages 60 and over, and about 31% from ages 80 and over. Life expectancy at birth for females in West Germany improved by 3.4 years. Ages over 60 contributed 61% of this improvement, and ages over 80 contributed 22%. Thus, the contribution from the old ages to the improvement in female life expectancy was quite substantial, particularly in East Germany.

--- Insert Figure 2 about here ---

The period around reunification, 1987-1992, was most important for female mortality improvement in East Germany, while the period 1980-1987 was most important in West Germany. Figure 2 also suggests that female mortality in East Germany, in particular at old ages, started improving prior to reunification. However, it was during 1987-1992 that the pace of this improvement accelerated.

The pattern for males was somewhat different from that of females (Figure 3). There was a negative contribution of young adult ages to the change of e_0 during the period 1980-1996 in East Germany. This negative contribution stems mainly from the period around reunification, 1987-1992, where mortality worsened at almost all adult ages in East Germany (ages 15-65). When compared to the female pattern, another difference is that for males the contribution of old and oldest ages is less prominent in both East and West Germany. During 1980-1996 male life expectancy at birth improved by 3.1 years in East Germany. 62% of this improvement came from ages 60 and over, and 17% from ages 80 and over. In West Germany male life expectancy improved by 3.9 years from 1980 to 1996. Ages over 60 contributed 60% and ages over 80 contributed 9%. Although the pace of improvement of mortality at oldest old ages was slower for males than for females, it is obvious that there was also a considerable improvement in old age mortality among men in both East and West Germany.

--- Insert Figure 3 about here ---

To summarize, Figure 2 and 3 indicate that most of the improvement in overall mortality came as a result of the improvement of mortality at older ages (ages over 60). This pattern was observed for males and for females, in East Germany as well as in West Germany. The pattern was more pronounced for females than for males, and it was more obvious in East than in West Germany.

Oldest Old Mortality

A fair amount of the improvement in mortality in both East and West Germany can be attributed to the oldest old (ages 80+). For females 31% of the improvement in overall mortality in East Germany and 22% in West Germany came from these ages (1980-1996). For males this share was somewhat lower: 17% and 9% of the total

change, respectively, came from the oldest old (ages 80+). A detailed observation of mortality changes at these ages is shown in Figure 4, where central death rates are plotted, separately for East and West Germany as well as for males and females. The period covered is 1955-1996.

--- Insert Figure 4 about here ---

An examination of these historical trends indicates that oldest old mortality improvements in East Germany are present as of the late 1980s. Improvements accelerated in the 1990s, particularly among females. A closer look at the female map for East Germany suggests that around reunification there is an acceleration of improvement for almost all oldest old ages (80+). This explains the high contribution of ages over 80 to changes of life expectancy at birth during 1987-92, as shown in Figure 2.

A different picture is portrayed in West Germany. Female mortality at the oldest ages started to improve in the early 1970s. Here the improvement was gradual and it affected all ages 80 and over. For males the improvement started later, around 1980. Similar to females, improvement was gradual during the remaining period. A distinctive feature for females in both East and West Germany is that we see an improvement of mortality at the very old ages over 95.

Figure 5 shows the ratios of the central death rates in East and West Germany for both males and females. The color red indicates an advantage (lower death rates) in East Germany, the color blue shows an advantage in West Germany. The scale on the right shows the ratio of East/West German central death rates. For example, a ratio of 1.1 indicates that mortality in East Germany is 10% higher than in West Germany.

--- Insert Figure 5 about here ---

The Lexis maps for both sexes indicate that East and West Germany had similar levels of oldest old mortality (ratios close to 1.0) until about 1970. The female advantage of West Germany started in the 1970s, while the male advantage started in the 1980s. For females the gap diverged further in the 1980s. Oldest old mortality in East Germany was sometimes 30% higher than in West Germany. The male map shows that the divergence in the 1980s was not as pronounced as it was for females. Male mortality among the oldest old in East Germany was sometimes 20% higher than in West Germany.

There appears to be a time lag of about five to ten years between female and male changes, with mortality changes for females preceding changes for males. This lag was observed in West Germany when female mortality started improving in the 1970s while male mortality followed this improvement in the 1980s (see Figures 4 and 5). Similarly, in East Germany the rapid improvement of female mortality at the end of the 1980s and in the early 1990s is now being experienced by males in the last years of 1990s (see Figure 4).

For both sexes the East-West German gap was wider in the 1980s and it seems to be closing in the 1990s. Interestingly, the disappearance of the large West German advantage is most salient for the very old ages (ages over 90). It is even more emphasized among centenarians. Table 1 lists the absolute and relative number of centenarians (ages 100 and over) in 1990 and 1996, separately for East and West Germany as well as for women and men.

--- Insert Table 1 about here ---

During the period from 1990 to 1996 there was a rapid increase in the number of centenarians in both parts of Germany. However, the increase was more pronounced in East Germany. During 1990-1996 the number of female centenarians

in East Germany increased by a factor of 2.51 (184 centenarians in 1990 versus 461 centenarians in 1996). The number of female centenarians in West Germany in that same period increased only by a factor of 1.88. Similarly, the increase in the number of male centenarians was more pronounced in East Germany (factor 1.49) than it was in the West (factor 1.13).

Discussion

It is tempting to attribute the apparent closing of the old age mortality gap between East and West Germany to the historical drama of political reunification. Putting an obvious cause to an obvious trend has a certain prima facie plausibility. However, the old-age patterns we have presented suggest that some of the mortality improvements in East Germany actually started prior to reunification. We also observed considerable similarities between the two German states that were only gradually affected by reunification. For example, it appears that after 1970 the increase in life expectancy was dominated by the prolongation of life at older ages in both German states. Another similarity between East and West Germany was that improvements in old age mortality were greater among women than men.

This is not to say that reunification did not have any impact, or that differences between East and West Germany were negligible. One profound difference between the two German states was that improvements in old age mortality prior to reunification were much slower in East than in West Germany. Mortality at ages 80 and above started to decline in West Germany in the mid 1970s. Not until ten years later did old age mortality begin to decrease in East Germany. And it occurred at a slower pace. German reunification in 1990 had little, if any, effect on the long-term trend of oldest old mortality in West Germany. In contrast, East German death rates at the oldest ages decreased markedly after 1990. It appears that this decrease after

reunification was not only a continuation of a trend started earlier, but that it reflects an accelerated pace of improvement in old age mortality in East Germany. What are the determinants of late-life mortality that might explain the patterns observed in the two German states? We restrict our discussion to four major factors: migration, medical and nursing care expenditures, economic resources and lifestyle factors.

Migration

Some scholars (Häussler, Hempel, & Reschke, 1995; Dinkel, 1999) highlight a so-called "positive migration effect." They argue that between 1945 and 1961, when the Berlin Wall was built, many young adults and their families left East Germany and moved to West Germany while the elderly and unfit stayed. There is considerable empirical support for a healthy migration hypothesis in general (Fox, Goldblatt, & Adelstein, 1982). However, to our knowledge there is no empirical evidence that migration of the young and healthy in fact contributed to the difference in old-age mortality between East and West Germany.

In contrast, Schott, Wiesner, Casper, and Bergmann (1994) focus on a so-called "negative migration effect." They argue that after the war millions of refugees fled from the Soviet army and most of them eventually settled down in West Germany. The hardship they met on their way to West Germany may have weakened their physical constitution, which in the long run may have contributed to higher mortality rates in West Germany. We are not aware that this hypothesis has been tested empirically. Both the positive and the negative migration hypothesis seem plausible, but no firm conclusions can be drawn in the absence of empirical support for either hypothesis. It is also possible that both hypotheses are true but that their effects cancel out.

Medical and Nursing Care

An analysis of the differences in the welfare regimes of East and West Germany may help to explain observed mortality patterns. This is particularly true for the oldest age groups, which strongly depend on welfare transfers. In general, the welfare regime of the former German Democratic Republic can be characterized as "means tested" and "service heavy." That is, the welfare regime was targeted at fulfilling the basic needs of individuals and it operated primarily through the provision of services. In addition, this welfare system focused on the young and middle-aged population.

In contrast, the West German welfare regime can be characterized as "status preserving" and "transfer heavy." That is, the West German welfare system focused on preserving the status of individuals when they were confronted with hardships, and it operated primarily through monetary payments. It has been argued that the status preserving and transfer heavy West German system disproportionately favored the elderly (Hockerts, 1998; Lampert, 1996; Manow-Borgwardt, 1994).

Transfer payments to the elderly - i.e., pension payments and health care expenditures - were several times higher in West than in East Germany (Statistisches Bundesamt, 1994; Verband Deutscher Rentenversicherungsträger, 1999). However, an exact comparison is difficult because both countries defined their statistics differently. Relative trends in social expenditures may give a better picture of the extent of services rendered to the elderly population. Between 1970 and 1989 expenses for medical care quadrupled in West Germany. But even in the former German Democratic Republic, where the economy eventually went bankrupt (Ritschl, 1995), health care expenditures more than tripled during the same period. It is noteworthy that increases in medical expenditures rose steeper between 1986-1988 than before (Statistisches Bundesamt, 1994). As women make more use of medical

services than men, they might have benefited more from medical care improvements in East Germany before reunification.

Starting in 1970 the former German Democratic Republic tried to improve the supply of old age care (Ziesemer, 1990; Bardehle & Voß, 1990; Schönfeld, 1990). Although the number of places in nursing homes increased from 96,000 in 1970 to 140,000 in 1988, it was still the case that more than 100,000 applicants could not be admitted to homes because of a lack of space. Further, the quality of care in those institutions remained relatively low. Regular medical check ups and rehabilitation were not possible (Schmidt, 1990), and there was a chronic shortage of trained nurses.

Children who wanted to care for their frail parents were faced with several obstacles. Women were the major caregivers, and in East Germany nearly all women participated in the labor force. Giving up employment in order to care for an old parent implied that these women had to give up their social security benefits. There was also no market for social services or medical aid that could be relied upon, and appropriate apartments for frail elderly people were scarce.

With respect to old age mortality, it was probably crucial that the former German Democratic Republic did not keep pace with the international medical progress that took place in the field of chronic diseases. The fight against chronic diseases, from which many elderly people suffer, is capital-intensive. Many scholars argue that the lack of economic dynamism is one of the main reasons why the health care regime of East Germany started to fall behind in the 1970s. The lack of domestic innovations and the lack of foreign currency to buy new innovations from the West led to a stratified, rationing health care system (Volpp, 1991). After reunification in 1990, the shortage of adequate medical equipment and treatment became obvious (Bause & Matauschek, 1990; Sachverständigenrat für die Konzertierte Aktion im

Gesundheitswesen, 1991). About 17% of hospitals were rundown to a greater or lesser extent, 30% of the beds used in clinics were beyond repair, and medical technology was trailing behind Western standards by 15 to 20 years (Mielck 1991). It was estimated that 1.5 billion DM would be needed to update the medical technology (Becker, 1990). Further, the available amount of nearly 2,000 different drugs was not considered adequate, given the fact that 40,000 drugs were on the market in West Germany. Experts also estimated that the need for dialysis was only met in 38% of all cases, and the demand for kidney transplants and open-heart surgery was met in only 50% of all cases (Arnold & Schirmer, 1990; Korbanka, 1990; Thiele, 1990).

Studies on mortality from conditions amenable to medical intervention confirm that medical resource deficiencies are decisive (Velkova, Wolleswinkel-Van den Bosch, & Mackenbach, 1997). It is well documented that a lack of appropriate medical care has immediate effects on mortality at older ages. We can speculate that the financial weakness of the socialist health care system in East Germany was one of the main reasons why improvements in old age mortality were relatively slow prior to reunification. After reunification the Western health care system was quickly installed in East Germany. Consequently, the accelerated improvement in old age mortality described above occurred.

Economic Resources

Pension payments made up the largest share of social expenditures in both German states. Due to the different welfare regimes, however, both the absolute amount and the relative increase was much smaller in East than in West Germany prior to 1989. Comparing the average income of households, we see that in both German states pensioners have considerably less income than people in the work

force. In 1985, a household with a retired head had 36% in East Germany and 65% in West Germany of the income of a household with an employed head, respectively.

After reunification the West German pension scheme was transmitted to the East Germany, which made the retired people one of groups that benefited most from the transformation. In 1990 the monthly pension of an East German retired employee was 40% that of his or her West German counterpart. This income gap diminished quickly in the following years. In 1999 an East German pensioner receives on average 87% of what a West German pensioner gets (Presse- und Informationsamt der Bundesregierung, 1999). Particularly women from East Germany have benefited because they had, on average, considerably longer working biographies than their West German counterparts.

The shift from a relatively deprived to a relatively privileged living situation probably affected the health and mortality of the oldest old. There is an extended literature on socioeconomic differentials in mortality (Hummer, Rogers, & Eberstein, 1998) that suggests that individual resource availability increases health chances and, ultimately, survival. It is quite likely that the increased individual resources and opportunities that came with reunification have also contributed to the accelerated decline in death rates in the East Germany.

Life-style Factors

The interaction between material resources, health, and longevity is probably mediated through various behavioral choices. Demographers and epidemiologists focus on eating and drinking habits, smoking behavior and exercise. Pre-unification comparisons between East and West German nutritional habits revealed a significantly lower consumption of milk, vegetable oil and fat, fresh vegetables and tropical fruits in East Germany, while the intake of sausages, baked goods, butter and spirits was

significantly higher. The calorie intake in East Germany was also considerably higher for fat and lower for carbohydrates (Winkler, Holtz, & Döring, 1992a, 1992b; Thiel & Heinemann, 1996).

After 1989 consumption patterns changed. Individuals in East Germany consumed more carbohydrates, vitamins, calcium, and potassium. Consumption of fresh fruits increased while the intake of baked goods and meat decreased (Winkler, Brasche, & Heinrich, 1997). These consumption patterns may help to explain both why old age mortality patterns in East and West Germany diverged before reunification and why they then converged after reunification. One cannot, however, come to a conclusive interpretation here, since the nutritional studies cited above all involved individuals at younger ages.

There is evidence to suggest that older people rarely change their eating habits (Brockmann, 1998). Rather than improving their diet, they tend to avoid food that is difficult to chew, such as fresh fruit and vegetables. On the other hand, many people above the age of 80 do not cook for themselves. Some live in institutions, others make use of food delivery services. In this way, elderly people in East Germany might well have profited from a better food supply after reunification without actually changing their individual behavior.

Conclusion

During the past two decades there were substantial improvements in old age mortality in both German states. Improvements for women were more pronounced than for men. Improvements in West Germany seem to follow a gradual, long-term trend. Improvements in East Germany were accelerated after reunification, and it appears that the East-West German gap in old age mortality is closing. This effect of

German reunification on old age mortality in East Germany attests to the plasticity of human life expectancy at older ages and to the importance of late-life events.

Some Germans are wary about the considerable costs and problems that came with reunification and wonder what reunification will ultimately bring. Old age mortality is just one of many aspects of human development that might be used to evaluate the effects of reunification, and this aspect seems to suggest that reunification did have a beneficial effect: death rates of the oldest old in East Germany fell considerably after reunification. The specific mediating factors for this effect remain unknown, but it is likely that improvements in the health care system played a major role. It is also likely that there was not only one mediating factor. Rather, we believe that reunification and the many changes that came with it affected old age mortality through various pathways including individual economic resources and life-style factors.

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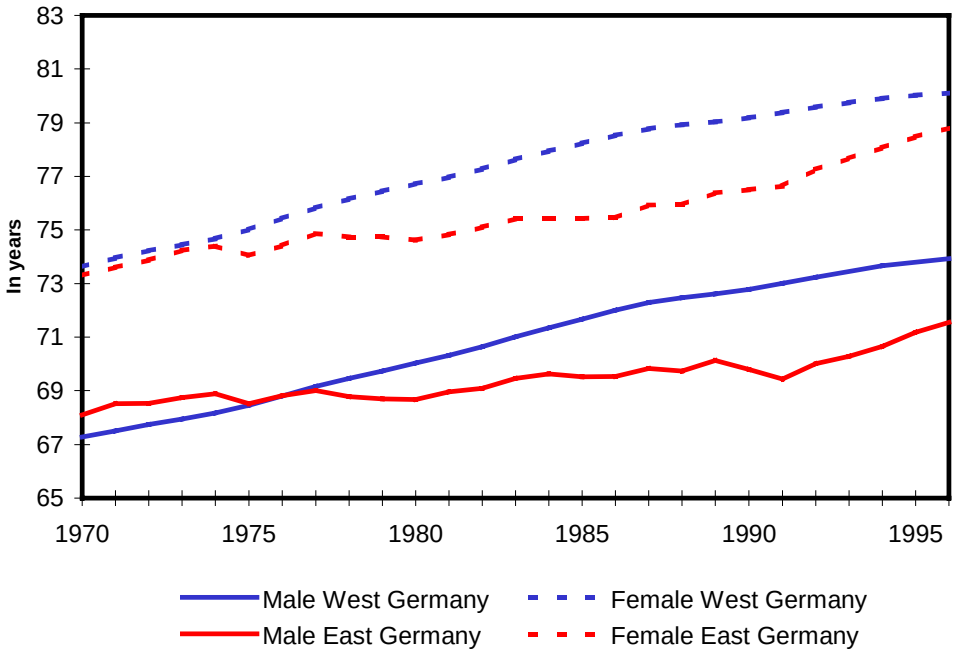
Table 1

Centenarians in East and West Germany: 1990 and 1996

	Number 100+			100+ per Million Population		
	Male	Female	Total	Male	Female	Total
East 1990	47	184	231	6.1	21.9	14.3
East 1996	70	461	531	9.3	58.1	34.4
West 1990	408	1798	2206	13.3	55.0	34.8
West 1996	459	3377	3836	14.2	99.1	57.8

Source: Authors' calculations based on data from the Kannisto-Thatcher Oldest Old Database (Kannisto, 1994).

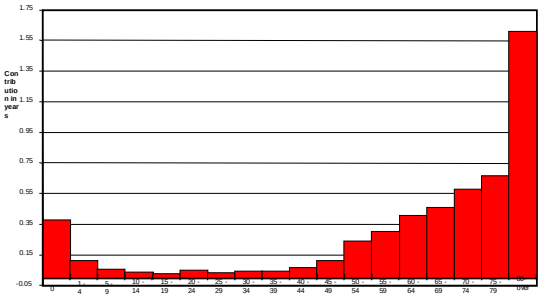
Figure 1. Life expectancy at birth in East and West Germany, 1970-1996



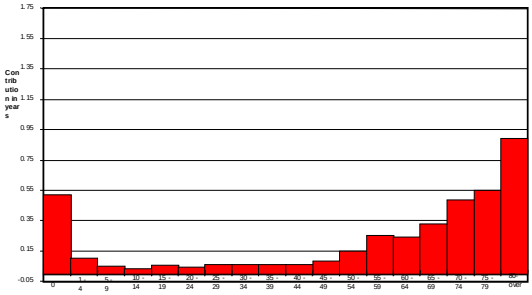
Source: Authors' calculations based on data from Statistisches Bundesamt, 1980-1998.

Figure 2. Contribution of different ages to changes of life expectancy at birth-Females.

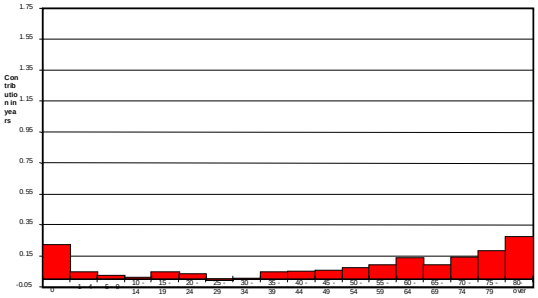
East Germany 1980-1996



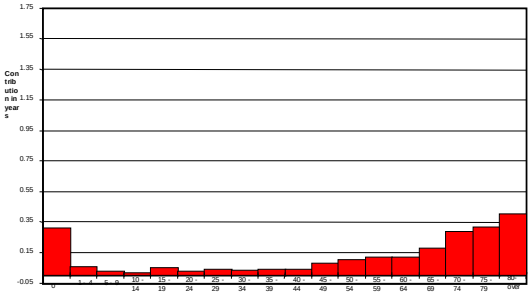
West Germany 1980-1996



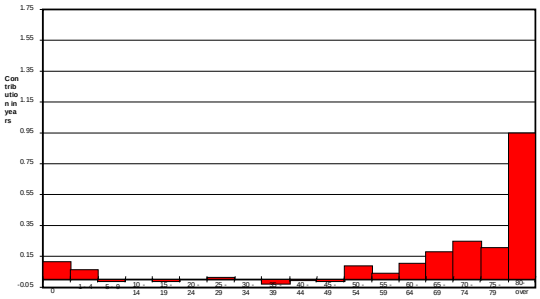
East Germany 1980-1987



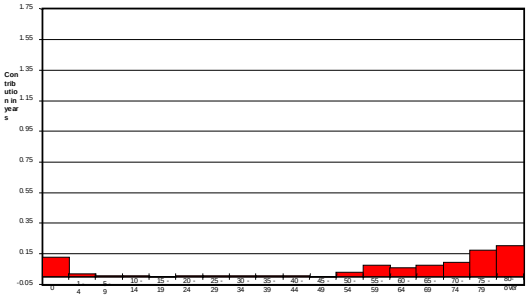
West Germany 1980-1987



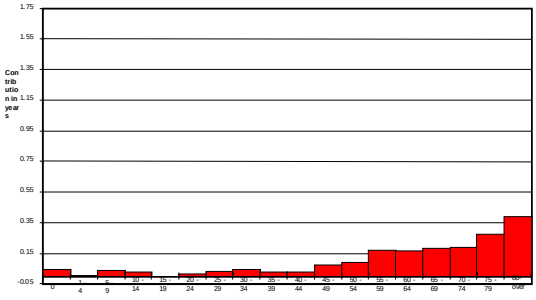
East Germany 1987-1992



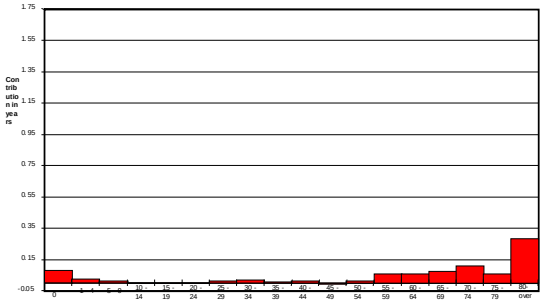
West Germany 1987-1992



East Germany 1992-1996



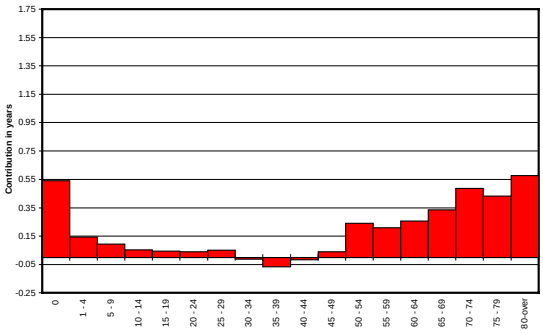
West Germany 1992-1996



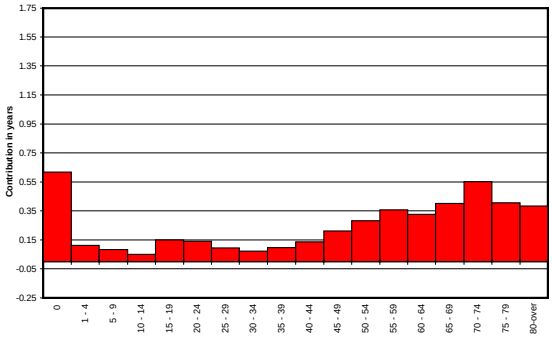
Source: Authors' calculations based on data from Statistisches Bundesamt, 1980-1998.

Figure 3 Contribution of different ages to changes of life expectancy at birth - Males.

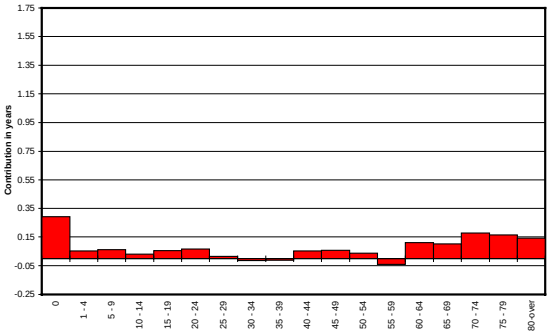
East Germany 1980-1996



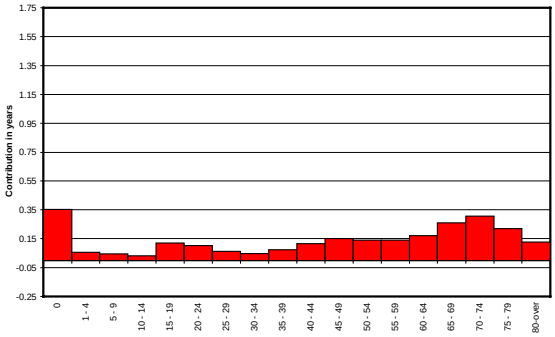
West Germany 1980-1996



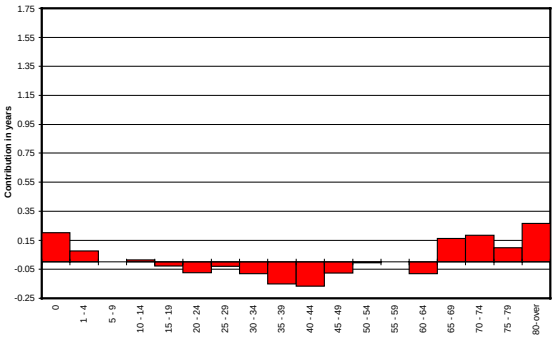
East Germany 1980-1987



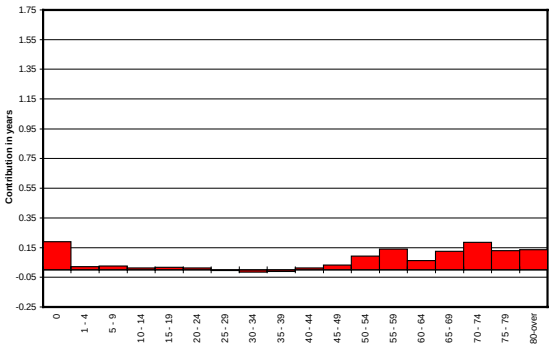
West Germany 1980-1987



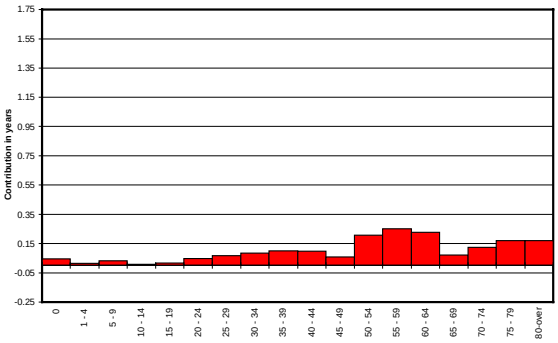
East Germany 1987-1992



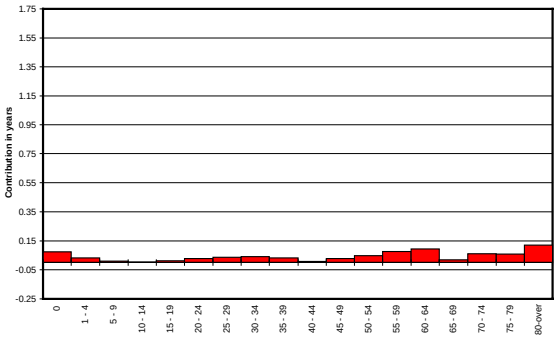
West Germany 1987-1992



East Germany 1992-1996

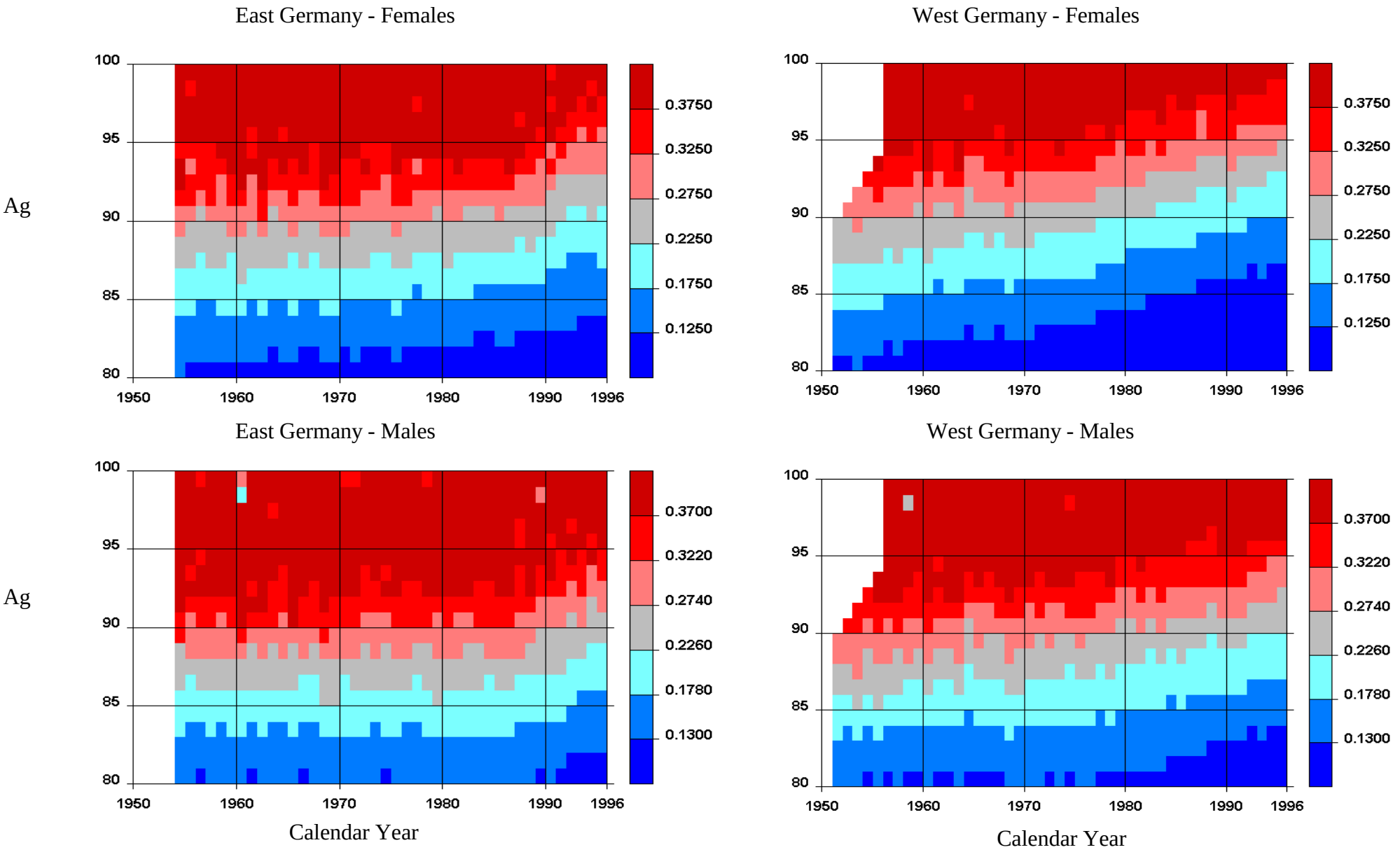


West Germany 1992-1996



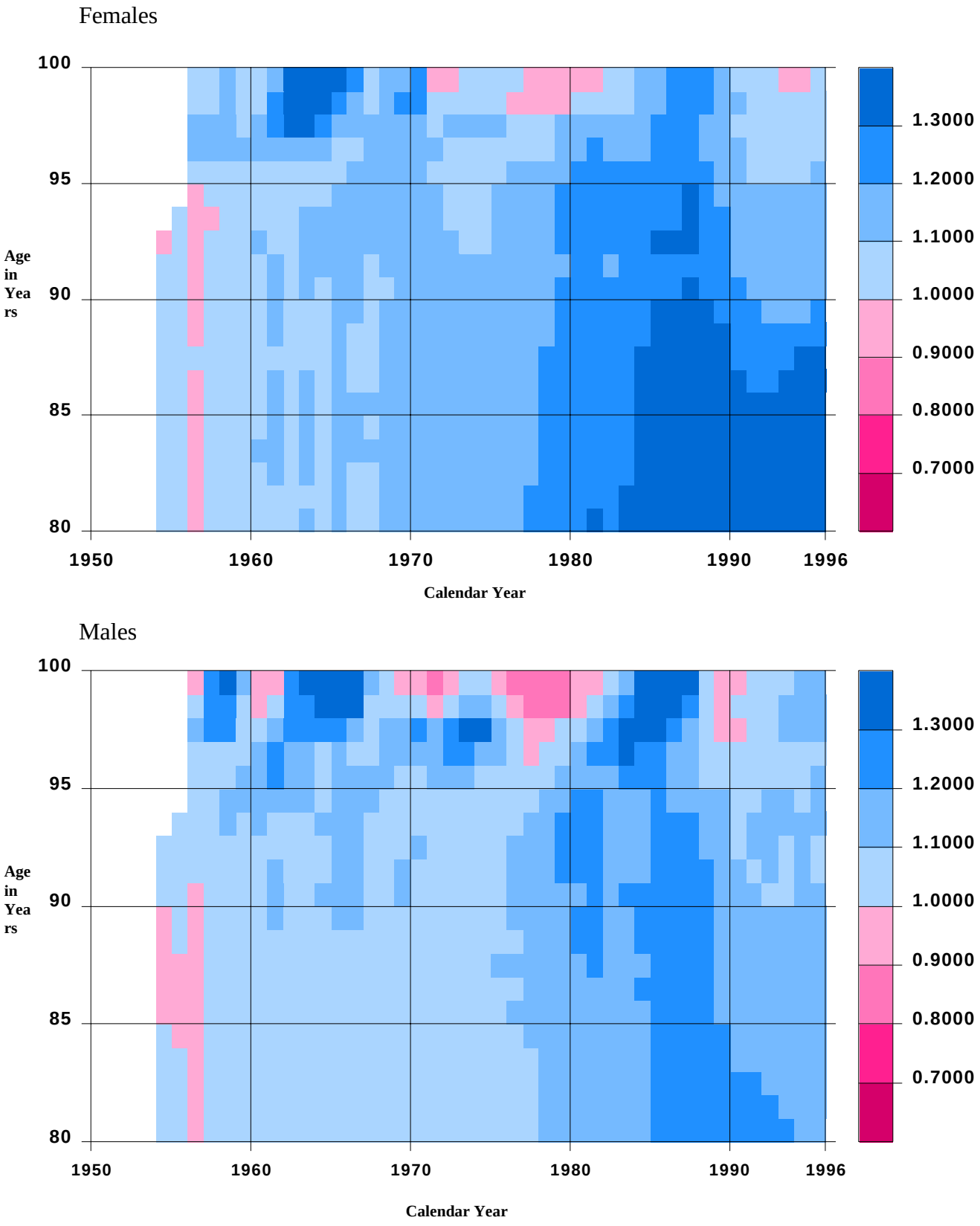
Source: Authors' calculations based on data from Statistisches Bundesamt, 1980-1998.

Figure 4. Central Death Rates for East and West Germany for Ages 80 and over, 1950-1996



Source: Authors' calculations based on Kannisto-Thatcher Oldest Old Database

Figure 5. Death Rate Ratios of West/East Germany. Ages 80 over.



Note: A weighted average smoothing method is applied for these two maps.
Source: Same as Figure 4.