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Demographic Trends in Germany and their Economic Implications

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Abstract

The present paper explores demographic trends in Germany, as well as the determinants of these trends, and the economic implications of these demographic changes for the country. A detailed spatial analysis reveals substantial differences in the speed and intensity of the processes of population aging and population decline across the German regions. The results indicate that these processes are particularly pronounced in the state of Mecklenburg Western-Pomerania. As a new contribution to the literature, our analysis also sheds light on regional gender imbalances.

JEL Classification: J11, J14, J18, N34

1. Introduction

Population aging is a widespread phenomenon. In the group of countries classified by the United Nations as "more developed", the median age rose from 29.0 years in 1950 to 37.3 in 2000, and is forecast to rise to 45.5 by 2050. Figure 1 provides a classification of 228 countries by the phase in age transition, following Lee et al. (2010). Countries are distinguished by the age group that experiences the greatest increase in the population over a particular period. The classification reveals that the share of the working-age population (ages 25 – 59) is projected to rise for many countries until 2015, and that, from 2015 onwards, the age group 60 and above will experience the greatest increase.

Population aging is also in issue in Germany, as can be seen from Figure 2. Within just two decades, the average age of the German population has increased by about four years. The increase in the average age is associated with a large and steady decline in the population share of the age cohort 30 and below, and an increase in the population share of the age cohort 65 and above.

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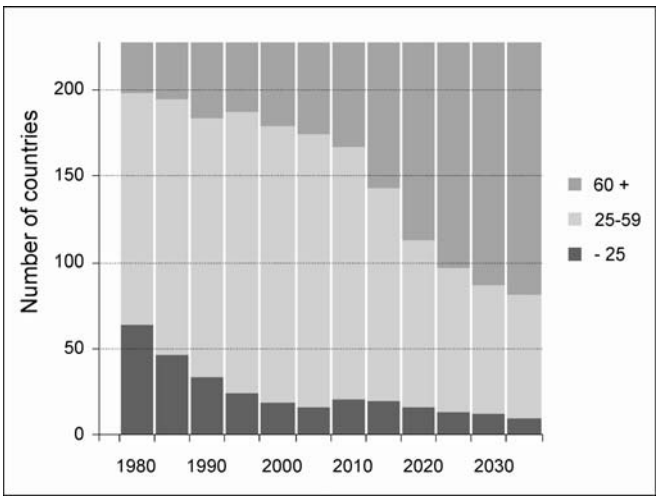
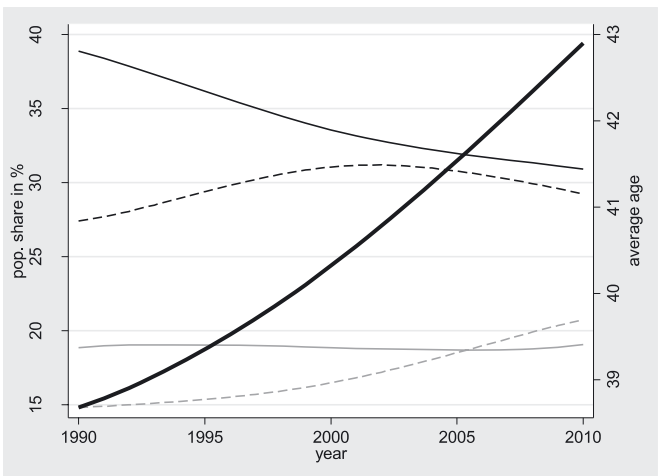


Note: Countries classified based on age group with greatest increase in population.

Source: Adaptation of Fig.1 page 2 by Ronald Lee et al (2010), Data UN Population Division (2009).

Figure 1: Distribution of countries by phase in age transition



Note: Own calculations. Thick solid line: average age. Thin lines: population shares. Black solid: population ages 0–29; black dashed line: population ages 30–49; grey solid line: population ages 50–64; gray dashed line: population ages 65 and older.

Data from the Human Mortality Database.

Figure 2: Inter-temporal changes in the German age structure

At the same time, Germany has also experienced a moderate decline in population size. From a peak level of 82.54 million at the beginning 2002, the population size declined by about 785,000 by the beginning of 2010.[1] According to official projections (Federal Statistical Office, 2009), Germany's population size is likely to fall by another 20 percent by 2060 (projection according to the scenario "W1"[2]).

The factors that underlie population aging and population decline in Germany are low fertility, rising life expectancy, the aging of the large baby boom generation, and low net population influx from abroad (net migration).[3] Since the reunification of Germany, the total fertility rate has stagnated at a level far below replacement, varying in a small range of about 1.3 to 1.4. At the same time, life expectancy at birth increased from about 75 years in 1990 to more than 80 years in 2010. As a result, in 1990, the number of births was about 906,000, while the number of deaths was around 921,000. Two decades later, in 2010, the number of births had fallen by about 25 percent, to 678,000 births, while the number of deaths had declined by around seven percent, to roughly 859,000. Migration has not compensated for the natural population decline. In fact, net migration has declined substantially over the past decade relative to the previous decade.

It is important to note, however, that the speed and intensity of the demographic processes differ across German regions. Germany's new federal states are particularly affected, and, as we will demonstrate, Mecklenburg-Western Pomerania stands out as an extreme case.

From an economic point of view, changes in the population structure are interesting because they have long-lasting implications for the whole economy. The demographic process is likely to affect economic growth,[4] the financial viability of social security systems,[5] labor and capital markets,[6] cross-border capital flows,[7] consumption patterns,[8] the sharing of GDP between working-age and retiree populations,[9] the income and wealth distribution,[10] etc.

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1 Statistics from the German Federal Statistical Office.

2 Specifically, the prognosis ("W1" – lower bound of average population) is based on an expected birth frequency of 1.4 per woman, basic assumptions about life expectancy, and a net migration influx of 100,000 persons per year from 2014 onwards.

3 Socio-medical improvements may further contribute to population aging as these cohorts age (Bloom/McKinnon, 2010).

4 See Prskawetz et al. (2007) for an analysis of EU countries.

5 For an influential comparative study focusing on retirement, see Gruber and Wise (1998).

6 The effects of demographic aging on the German labor market were studied in Börsch-Supan (2003), while the interplay between demographic structure and asset returns were examined in, for example, Poterba (2001).

7 See, for example, Higgins (1998).

At the same time, the quantitative effect of demographic changes on economic outcomes (and vice versa) is still being debated, as "there are in place various feedback mechanisms (notably operative parts of the price system in labor markets and capital markets as well as product markets) that generate offsetting effects" (Disney, 1996, 307).

The most controversial issue discussed in the literature may be the interplay between population aging and economic growth (see Prskawetz et al., 2007, for a review of the recent literature). At the same time, however, the publicly accepted view that aging contributes to deficits in public budgets and undermines the financial stability of (pay-as-you-go) pension and health systems has been challenged. Disney (1996, 307), for example, has argued that these financial problems result from governments and voters who are operating social security systems as Ponzi schemes, rather from demographic change itself. Importantly, the demography-economy nexus is not a one-way street. It is plausible to assume that the causality also runs backwards, and, as was pointed out in the pioneering work of Easterlin et al. (1980), family-related social policies, income taxation, labor market regulations, and social norms are likely to affect fertility decisions and family formation in general.

The interplay between population structure and the economy also has immediate implications at the micro level. Private households may wonder about their income and pension prospects in an environment in which the retirement phases become longer because of rising life expectancy, and in which policy makers adjust the official retirement age and cut publicly provided pensions. As a response, people may alter their savings and retirement decisions. Meanwhile, private entrepreneurs may have to think about adjusting their business strategies in order to remain successful in an aging society. Such micro-level responses will also be felt at the macro level.

The aim of the present work is not to give a complete review of previous literature on the demography-economy nexus. Rather, we want to examine particular facets of demographic change in Germany, and to point out certain spatial differences. Such a disaggregated view is interesting for a number of reasons. For example, accurate region-specific demographic statistics are an important piece of information for regional policy makers and entrepreneurs who have to make investment decisions. Understanding mortality is important for assessing the redistributive effects of social security, particularly of PAYG pension systems (for the case of Germany, see Schröder, 2011).

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[8] For the inclusion of demographic variables in the demand analysis, see Pollak / Wales (1981).

[9] Disney (2007) empirically explored the interplay between demographic aging and the size of the welfare state, and found a positive association. Another view was expressed in Razin / Sadka / Swagel (2002).

[10] See Pestieau (1989) for a review of the early literature.

The remainder of the paper is organized as follows. Section 2 deals with the demographic patterns in Germany, focusing on the differences between East and West. Section 3 takes a closer look at regional differences by further decomposing the results by federal states. We then focus on the example of Mecklenburg-Western Pomerania, one of the new states[11] that is undergoing a particularly rapid and intense demographic transition. Section 4 offers some concluding remarks.

2. Demographic Trends in Germany – An East-West Comparison

The demographic transition has unfolded very differently in the eastern and western states of Germany. This can be seen from Table 1. Starting at the point of German reunification, the table provides central demographic indicators on fertility, life expectancy, and migration (between Germany and the rest of the world, and also between the new and the old German states).

Two essential statistics pertaining to fertility are tabulated: the total fertility rates (TFR) and the TFR40. Formally, the TFR is the average number of children that would be born to a woman over her lifetime if she were to experience the exact current age-specific fertility rates throughout her lifetime, and assuming she survives from birth through the end of her reproductive life. The TFR40 is based on the sum of the observed fertility rates by age 40 (see the documentations of the Human Fertility Database for details). To illustrate the evolution of life expectancy, region-specific life expectancies at birth (LEB) are provided as a measure.

To explain the role of migration, the net migration rates for Germany, together with East-West net migration rates, are provided. The last two columns report the region-specific dependency ratios; i.e., the fraction of the population ages 65 and above divided by the population ages 20 to 64. This measures the pressure on the productive population by comparing the population not typically in the labor force (the dependent part) with the population typically in the labor force (the productive part).

Fertility

Since reunification, fertility in Germany has been low. In the old states, both the TFR and the TFR40 have fluctuated at a value of around 1.3 to 1.4 over the past two decades. In the new states, fertility is even lower. In 1994, the TFR (TFR40) dropped to a low of 0.778 (0.771), and then slowly adjusted to the

[11] The five so-called "new states" are Brandenburg (BB), Mecklenburg-Western Pomerania (MV), Saxony (SN), Saxony-Anhalt (SN), and Thuringia (TH).

Table 1

Demographic trends in Germany's old and new states

	TFR		TFR40		LEB		Net migration in 1,000 persons		Dependency ratio in%	
Year	East	West	East	West	East	West	Germany	East/West	East	West
1991	0.994	1.426	0.988	1.406	73.22	76.23	602.6	– 165.4	22.4	23.9
1992	0.843	1.412	0.837	1.391	73.84	76.63	776.4	– 90.4	22.5	23.9
1993	0.782	1.400	0.776	1.380	74.29	76.62	462.3	– 55.6	22.5	24.0
1994	0.778	1.353	0.771	1.333	74.62	76.92	315.6	– 34.5	22.8	24.3
1995	0.845	1.345	0.838	1.324	75.06	77.05	398.3	– 31.9	23.2	24.7
1996	0.963	1.406	0.954	1.384	75.48	77.24	281.5	– 24.9	23.5	25.1
1997	1.055	1.448	1.046	1.424	76.15	77.64	93.4	– 28.2	23.8	25.3
1998	1.108	1.419	1.098	1.395	76.72	77.95	47.0	– 46.3	24.1	25.5
1999	1.170	1.411	1.158	1.386	77.16	78.14	202.1	– 58.1	24.4	25.7
2000	1.245	1.423	1.232	1.396	77.46	78.41	167.9	– 76.0	25.1	26.3
2001	1.234	1.384	1.220	1.357	77.93	78.74	274.8	– 97.6	26.1	26.9
2002	1.240	1.373	1.227	1.344	77.95	78.84	218.8	– 80.8	27.1	27.6
2003	1.266	1.365	1.251	1.336	78.16	78.89	142.2	– 58.4	28.2	28.3
2004	1.313	1.377	1.297	1.346	78.71	79.49	81.8	– 51.7	29.4	29.2
2005	1.297	1.357	1.280	1.323	78.94	79.63	81.6	– 49.0	30.9	30.4
2006	1.305	1.342	1.285	1.307	79.23	79.98	25.8	– 54.2	32.4	31.5
2007	1.369	1.376	1.348	1.337	79.50	80.12	45.2	– 54.8	33.9	32.4
2008	1.411	1.380	1.386	1.338	79.60	80.20	-53.6	– 51.0	34.7	32.8
2009	1.406	1.354	1.378	1.311	79.71	80.31	-10.7	—	35.6	33.2
2010	1.461	1.386	1.430	1.340	—	—	130.2	—	36.3	33.5

Note: "East" ("West") refers to the new (old) federal states. Berlin is not included as, for administrative reasons, data for East and West Berlin are no longer differentiated since the year 2000. TFR is total fertility rate, TFR40 is total fertility rate by age 40, while LEB denotes life expectancy at birth (see text for details). The official registers have been corrected for inactive (defunct) profiles since the introduction of an individual tax identification number in 2008/2009 may have undermined the inter-temporal comparability of migration statistics.

Database: Total fertility rates: Human Fertility Database; Life expectancy at birth: Human Mortality Database; Migration saldo: Federal Statistical Office; Dependency ratio: Federal Statistical Office.

level of the old states. Since 2008, the TFR in the new states has overtaken that of the old states.[12] As a comparison, the replacement fertility rate, the total fertility rate at which newborn girls would have an average of exactly one daughter over their lifetimes, is about 2.1 births per woman for industrialized countries. Apparently, even the recently introduced *Elterngeld* (parents' money), a tax-financed payment granted to parents of children born from January 2007 onwards,[13] has, at best, had a small effect on the two fertility indicators.

Life expectancy

Unlike fertility, life expectancy at birth (LEB) has steadily increased over the last two decades, particularly in Germany's new states. In 1991, people living in the old states had an LEB that was about three years higher than that of their counterparts in the new states (76.23 vs. 73.22 years). Since then, LEB increased by about four years in the old and 6.5 years in the new states, and the spatial LEB divide has almost disappeared. In 2009, for example, the LEB was 80.31 years in the old states and 79.71 years in the new states.[14]

Migration

A net population influx of several hundred thousand people in the early years after reunification (column "Net migration, Germany") should have had a mitigating effect on the speed of population aging, and a stabilizing effect on population size in Germany. In the early 1990s, the net influx amounted to 776,400 people (1992). Over the past decade, however, the net influx has become smaller, and was even slightly negative in 2008 and 2009, though it was positive again in 2010. It cannot be ruled out that the substantial fluctuations since 2008 are a statistical artifact rather than a real-world phenomenon: since the introduction of a unique individual tax identification number in 2008/2009, official registers have been corrected for inactive (defunct) profiles. These ex officio removals also affect migration statistics.

A central determinant for the demographic transition in the old and new states is migration within the borders of Germany (column "Net migration, East/

[12] Goldstein/Kreyenfeld (2011) showed that much of the TFR decline in the early years after reunification can be attributed to postponements of births, although "there was also a real reduction in lifetime childbearing" (466). The rise in period fertility in the East – as expressed by the TFR – in later years resulted, according to Goldstein/Kreyenfeld (2011), "from lower levels of childlessness and a recuperation in the progression to second birth" (466).

[13] The level of *Elterngeld* granted increases according to the level of net earnings before the child's birth. About two-thirds of the former salary is granted for up to a year. Per month, the minimum transfer amount is EUR 300 and the maximum is EUR 1,800.

[14] More detailed information on life expectancy in the new states is provided in Scholz (2011).

West"). The political events in the former German Democratic Republic led to the initial wave of East-to-West migration. In 1991, the new states experienced a net outflow of around 165,000 residents. Although the net outflow subsequently declined, the new states have experienced a net outflow of about 50,000 persons per year over the past decade. Empirical studies have suggested that the people who are migrating from East to West are, increasingly, young and educated (e.g., Fuchs-Schündeln / Schündeln, 2009, Section 3 in the present work), a trend which has accelerated the process of population aging in the new states.

Dependency ratio

The demographic changes outlined above have also affected the dependency ratio. Between 1991 and 2010, the dependency ratio in the old states rose substantially, from 23.9 percent to 33.5 percent. The increase in the new states has been even more intense. Whereas in 1991 there were 224 people ages 65 and older (dependent part) to 1,000 people ages 20 to 64 (productive part); by 2010, the corresponding ratio was 363 older people to 1,000 working-age people.

From an economic point of view, the dependency ratio is particularly interesting. It immediately affects governmental expenditures for health infrastructure and public pensions, the labor markets, the demand for goods and services, etc. Importantly, it can also be viewed as an indicator of the burden / need of / for intergenerational resource redistribution (see Disney, 1996, p. 17): because elderly people have usually withdrawn from the labor market, their consumption expenditures exceed their contribution to the total marketable output. Typically, these consumption expenditures are financed by accumulated private savings and public pension entitlements. Both the German pension and health system are of the PAYG type, meaning that today's entitlements are financed out of current contributions (and taxes). In PAYG social security programs, a rising dependency ratio, ceteris paribus, means a higher financial burden for each actual contributor, which raises "doubts about the sustainability and economic attractiveness of the system for later generations" (Schröder, 2011). While the German government has recently passed a law guaranteeing that PAYG pension contribution rates will not exceed a certain level, the rising dependency rate will put pressure on PAYG contribution rates for health care and other forms of care, potentially increasing the relative price of labor.

3. Demographic Trends at the State Level

Germany has a federal structure with different governmental layers, the federal (*Bund*), the state (*Bundesland*), the district (*Kreise*), and the local level (*Gemeinde*). Our spatial analysis looks at the state level, with a focus on Meck-

lenburg-Western Pomerania (MV),[15] a state located in the northeast that was formed through the merger of the GDR regions (*Bezirke*) of Rostock, Schwerin, and Neubrandenburg. MV is particularly interesting both for demographers and economists, as the demographic and economic risks faced by the state are high, and are likely to reinforce each other. The demographic transition took place rather quickly there and was particularly intense, creating economic conditions that threaten MV's economic future: the unemployment rate is one of the highest in Germany (more than 11 percent in year 2011), the population density is the lowest of all the states (about 1,600,000 inhabitants; or about 71 inhabitants per square kilometer), and its structure is rural, with relatively few industrial centers.[16]

Fertility

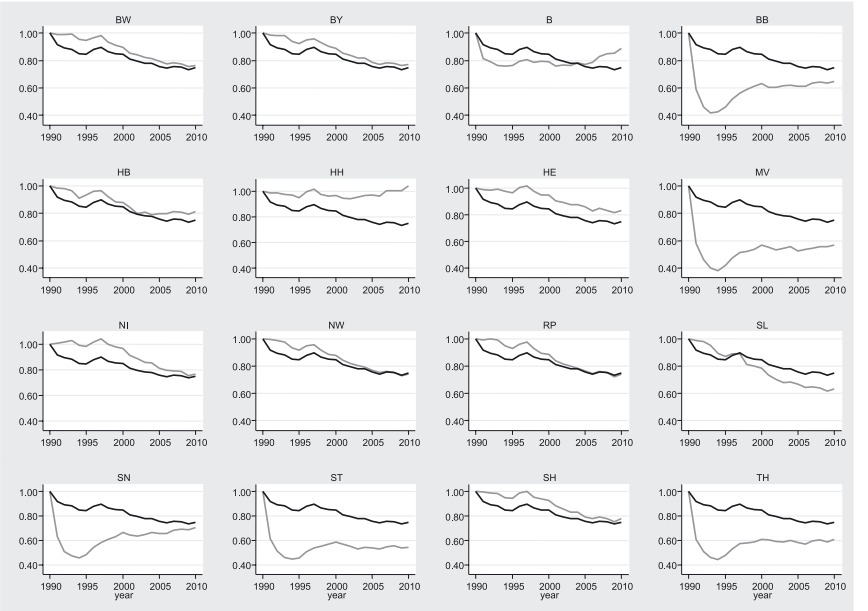
We start the state-level analysis with a look at fertility. Birth and fertility rates, as well as information on the timing of birth, serve as indicators. Figure 3 depicts the state-specific numbers of births together with the federal level birth rate, with the 1990 level serving as the reference, normalized to one (100%). For most states, the number of births dropped substantially in the early 1990s. The dip is more pronounced in the new states than in the old states, and it is particularly large in Mecklenburg-Western Pomerania: in 1994, the number of births was only 40 percent of the 1990 level. In 1990 (and in earlier years) MV had registered the highest number of births relative to population of all the federal states. The following figures illustrate the magnitude of the decline: the number of live births in MV (Germany) was 23,503 (905,675) in 1990, compared with 8,934 in 1994 (769,603). Despite a recovery of MV's birth rate during the late 1990s, it has never reached more than 60 percent of its initial level.

In sum, after the sharp drop in the number of births in the new states in the early 1990s, a recovery could be seen by the end of that decade, and the numbers have stagnated since then. In 2010, the state-specific birth numbers in the new states were about 60 percent of the 1990 level. Most of the old states experienced a steady and moderate decline in the number of births over the observation period. In the metropolises of Berlin and Hamburg, the trend has reversed since the early years of the 2000s, due in large part to the influx of younger women (see below).

Another fertility indicator is the TFR. Analogously to Figure 3, Figure 4 provides the state-specific levels relative to 1990. The TFRs evolved rather differently in the new and the old states. In the new states, we again observe a sharp drop in the early years after reunification, and a recovery thereafter, so that, by

15 For further evidence on MV's demographic transition, see Muth et al. (2010).

16 The two largest cities are Rostock, with about 200,000 people; and Schwerin, with about 95,000 residents.



Note: Own presentation. Gray line refers to the state; black line refers to Germany. Definition of acronyms: BW: Baden-Wuerttemberg; BY: Bavaria; B: Berlin; BB: Brandenburg; HB: Bremen; HH: Hamburg; HE: Hessen; MV: Mecklenburg-Western Pomerania; NI: Lower Saxony; NW: North Rhine-Westphalia; RP: Rhineland Palatinate, SL: Saarland; SN: Saxony; ST: Saxony-Anhalt; SH: Schleswig-Holstein; TH: Thuringia. Data from the German Federal Statistical Office (destatis).

Figure 3: Normalized state-specific total numbers of births relative to 1990

2010, the TFRs of the new states were only slightly behind the German average. For example, in 1990 Mecklenburg-Western Pomerania had the highest TFR of all states, at 1.61. But by 1994, it had the lowest, falling by about 54 percent to 0.74 children per woman.

In the old states, the picture is less homogeneous. In the West, the state-specific TFRs generally declined until the mid-1990s, and have been slowly recovering since then. However, the TFRs in 2010 were mostly lower than in 1990. There are, however, some exceptions. The TFRs for Hamburg (in 2010), Hessen (late 1990s, and since 2007), and Lower Saxony (2000) have sometimes exceeded the initial level.

In Figures 3 and 4, two results stand out. Despite a pronounced decline in the TFRs in the new states in the early 1990s, the 2010 fertility rate in Germany was only slightly lower than in 1990 (about four percent). The decline also exhibited little spatial variation, although it was slightly stronger in the new states. However, the absolute number of births in Germany decreased steadily

over the whole observation period, by about 25 percent, with persistent spatial differences. The decline was particularly large in the new states, while the birth numbers in the metropolises Hamburg and Berlin were rather stable, most likely because of migration (see below).

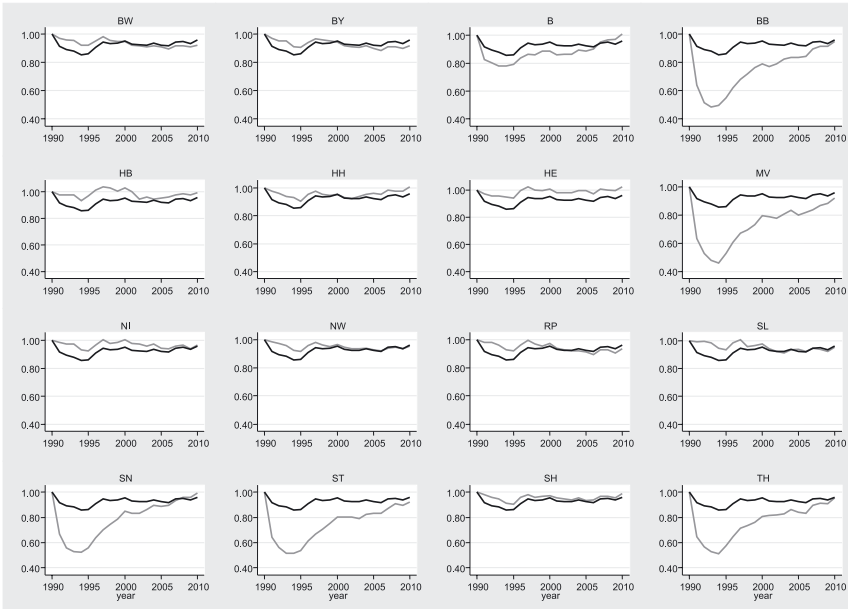


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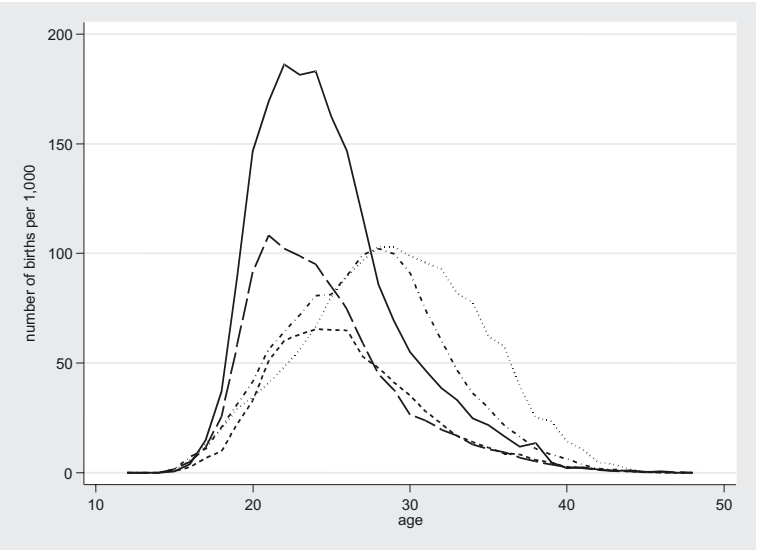
Figure 4: Normalized state-specific total fertility rates relative to the year 1990

The timing of births has also changed, as Figure 5, which shows the number of births as a function of mothers' ages, illustrates. Due to a lack of data, our analysis focuses on Mecklenburg-Western Pomerania. For expositional reasons, distributions are provided for selected years for the period from 1985 to 2010. The figure corroborates striking changes in both the locus and the curvature of the distributions. In the early years of the observation period, the distributions were high on the left side, and the mode is at the mothers' age of around 22. Over time, distributions had become flatter and more symmetrical. By 2010, the mode had increased by about seven years to about 29 years, indicating a substantial rise in mothers' ages at the birth of a child. In sum, by 2010, the fertility distribution in MV and in the old states had become rather similar.



Note: Own calculations. Solid line: year 1985; long dashed: year 1991; short dashed: year 1994; short dashed dotted: year 2002; dotted: year 2010. Data from the Statistical Office Mecklenburg-Western Pomerania.

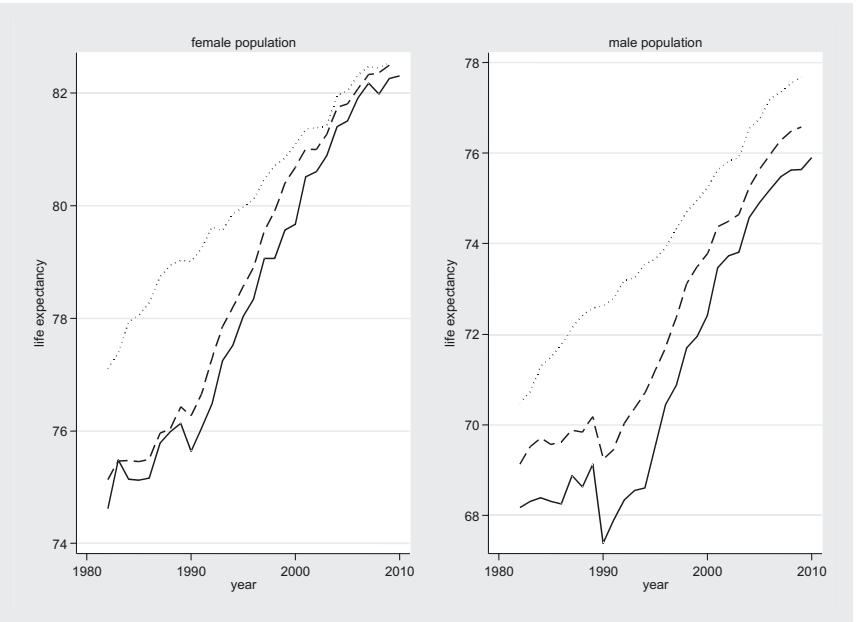
Figure 5: Age-specific numbers of births per 1,000 females in Mecklenburg-Western Pomerania

Life expectancy

Another central demographic indicator is life expectancy. Figure 6 contrasts the inter-temporal evolution of the gender-specific life expectancies in Mecklenburg-Western Pomerania (solid line) with the life expectancies in the new (dashed line) and old German states (dotted line).

In 1990, life expectancy exhibited substantial spatial differences. For women, it was 75.6 years in Mecklenburg-Western Pomerania, 76.3 years in the new states, and about 79.0 years in the old states. In the same year, the respective numbers for the male population were 67.4, 69.2, and 72.6 years. Since then, life expectancy has risen in all of the German regions, and the spatial divide has become smaller. The catch-up process was especially accelerated for the female population, among whom spatial differences had nearly vanished by as early as 2005. The 2010 life expectancy was 82.5 years for women in the old states, 82.5 years for women in the new states, and 81.9 years for women in Mecklenburg-Western Pomerania. For the male population, spatial differences prevail. In 2010, the life expectancy in the old states (77.7 years) was about one year higher than in the new states (76.6 years), and was more than two years higher than in MV (75.3 years). The more rapid catch-up process for

females relative to males may be explained by their greater readiness to make use of the improvements in the health care infrastructure in the new states after reunification (e.g., Kibele / Scholz (2009a, 2009b)). Among the possible reasons for the lower life expectancy in Mecklenburg-Western Pomerania are the high rates of unemployment and of commuting, as these are factors that tend to lead to a deterioration in health.[17]



Note: Own calculations. Solid line: Mecklenburg-Western Pomerania; dashed: new Länder; dotted: old states. Data from Statistical Office Mecklenburg-Western Pomerania.

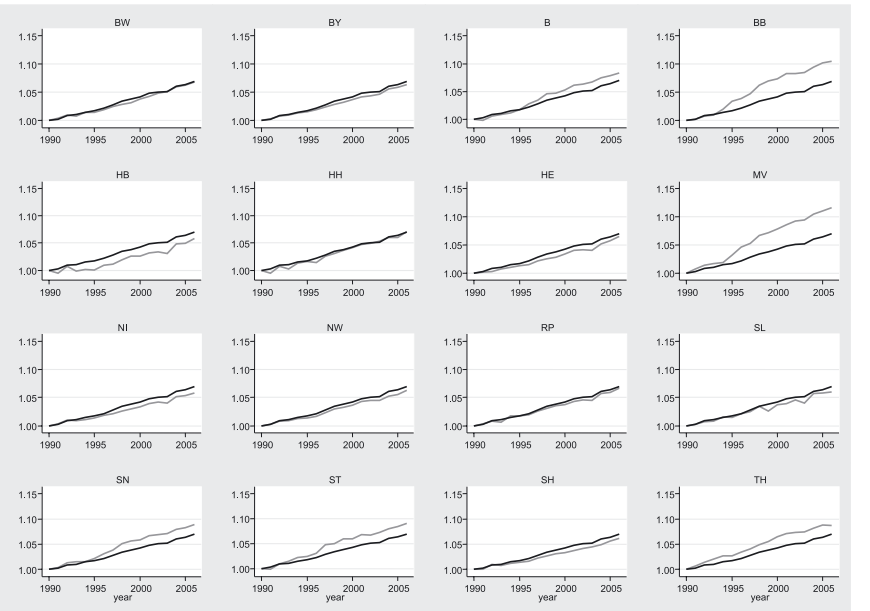
Figure 6: Region-specific life expectancy in years

To complete the picture, Figures 7a and 7b provide the state-specific normalized life expectancies (LEBs), differentiated by males (Figure 7a) and females (Figure 7b).[18] As a benchmark, black lines indicate the gender-specific trends

[17] Scholz et al. (2010) found a negative association between unemployment / labor market performance and the life expectancy of active men in Germany (ages 35 – 55). Their analysis suggested that the spatial divide in life expectancies disappears after controlling for unemployment and nationality. See also Scholz and Schulz (2009).

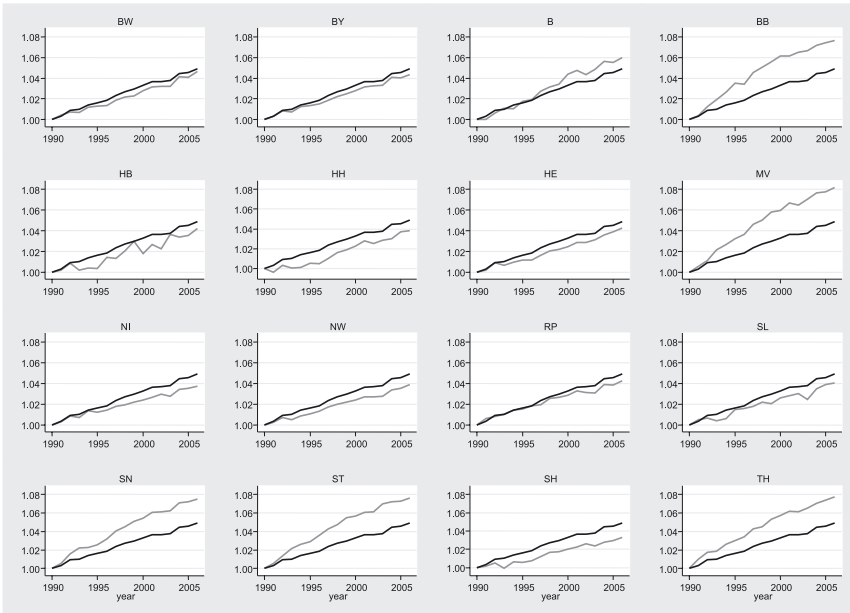
[18] For spatial patterns of mortality in Germany and individual-level determinants, see also Kibele (2012) and Shkolnikov et al. (2007). In particular, Shkolnikov et al. (2007) provided empirical evidence on mortality and life expectancy differentials by level of pension, health insurance, occupational group, and residence for the male population ages 65 and older.

for Germany as a whole. Over the observation period (1990 to 2006), the LEB rose by about seven percent for the male population, and by almost five percent for the female population. The relative increase was more pronounced in the new federal states, and, again, Mecklenburg-Western Pomerania stands out. The male population of MV benefitted from the rise in life expectancy more than the men in any other state, with an increase of 11.6 percent between 1990 and 2006. The increase among the female population of MV was more than eight percent. Despite the rapid rise of LEB in MV and in the other new states, some state-specific differences remain. For the male population in 2006, the LEB ranged between 78.57 years in Baden-Wuerttemberg and 75.14 years in Saxony-Anhalt. For the female population, LEB was highest in Hessen (82.71 years) and was lowest in Saarland (81.25 years).



Note: Own presentation. Gray line refers to the state; black line refers to Germany. Definition of acronyms: BW: Baden-Wuerttemberg; BY: Bavaria; B: Berlin; BB: Brandenburg; HB: Bremen; HH: Hamburg; HE: Hessen; MV: Mecklenburg-Western Pomerania; NI: Lower Saxony; NW: North Rhine-Westphalia; RP: Rhineland Palatinate, SL: Saarland; SN: Saxony; ST: Saxony-Anhalt; SH: Schleswig-Holstein; TH: Thuringia. Data from the Statistical Offices of the Länder. Computation according to Human Mortality Database methodology.

Figure 7a: Normalized state-specific life expectancy of the male population relative to the year 1990



Note: Own presentation. Gray line refers to the state; black line refers to Germany. Definition of acronyms: BW: Baden-Wuerttemberg; BY: Bavaria; B: Berlin; BB: Brandenburg; HB: Bremen; HH: Hamburg; HE: Hessen; MV: Mecklenburg-Western Pomerania; NI: Lower Saxony; NW: North Rhine-Westphalia; RP: Rhineland Palatinate, SL: Saarland; SN: Saxony; ST: Saxony-Anhalt; SH: Schleswig-Holstein; TH: Thuringia. Data from the Statistical Offices of the Länder. Computation according to Human Mortality Database methodology.

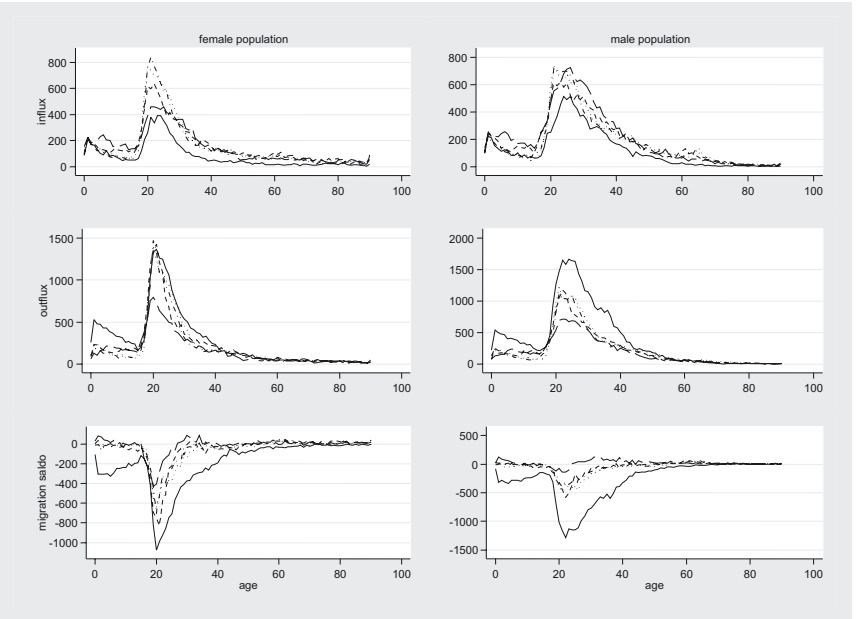
Figure 7b: Normalized state-specific life expectancy of the female population relative to the year 1990

Inter-state Migration

The number of people migrating from one federal state to another, together with the migrants' personal characteristics, have affected regional population sizes and population compositions in terms of age and gender. Unfortunately, because we lack the data that would allow us to provide statistics on state-level migration rates for all German states, we cannot paint a complete picture. Instead, we will confine ourselves to describing the state that is the focus of the present analysis, Mecklenburg-Western Pomerania. Figure 8 provides information on MV's population in- and outflows, and the net migration for selected years since 1990. All of the statistics are differentiated by age and gender.

The analysis of the age structure of the individuals migrating to (influx) and emigrating from MV (outflow) the state shows that most of them are in their twenties and early thirties, and are therefore either in education or at the very

beginning of the employment phase. The basic principle is that the average emigrant is older than the average immigrant, and that men tend to change residence at slightly higher ages than women.



Note: Own calculations. Solid line: year 1990; long dashed: year 1995; short dashed: year 2000; short dashed dotted: year 2005; dotted: year 2008. Data from the Statistical Office Mecklenburg-Western Pomerania.

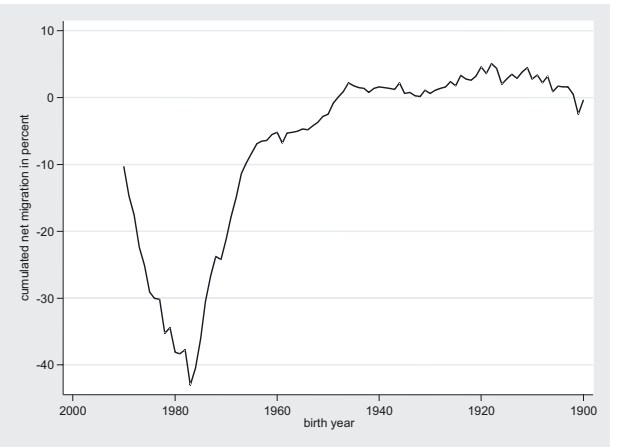
Figure 8: Age-specific migration in Mecklenburg-Western Pomerania

Comparing influxes and outflows, we find that the differences are minor at older ages (45 and above), while the influx is substantially lower than the outflow at younger ages (around 20 – 40). As a result, MV effectively loses part of its population at fertile ages each year. Over time, the net outflow has become smaller both for the male and the female population. Today, Mecklenburg-Western Pomerania is losing a smaller number of young people than in the early years after reunification. However, substantial imbalances remain for women.[19]

The cumulated net effect on MV's population size between 1990 and 2009 is corroborated in Figure 8. The cumulated net effects are differentiated by birth cohorts, taking the initial population in 1990 as a reference. For example,

[19] The asymmetries in migration patterns also cause non-negligible gender imbalances in the new states, as will be shown in the subsequent section.

"-40.5%" for the cohort born in 1976 indicates that this cohort has become 40.5 percent smaller than it was in 1990 due to a net outflow to other regions. It is apparent from the figure that Mecklenburg-Western Pomerania has experienced a substantial net outflow of younger birth cohorts in the last two decades. For the cohorts born later, the picture is different. Among these older cohorts, a slight cumulated net influx can even be observed. The strong net outflow of younger people, together with the moderately positive net influx of older people, directly contribute to population aging in Mecklenburg-Western Pomerania.



Note: Own calculations. Cumulated changes relative to January 1, 1990. Data from the Statistical Office Mecklenburg-Western Pomerania.

Figure 9: Age-specific cumulated net migratio for Mecklenburg-Western Pomerania, 1990 – 2009

Gender imbalances

An indicator of gender imbalance is the sex ratio, or the ratio of males to females (at a particular age) in a population. The *natural* sex ratio at birth is about 1.05; i.e., about 105 boys per 100 girls. Due to the higher mortality among males, the male surplus declines with age, and turns into a female surplus around age 50.

Unusual sex ratios at younger ages have been observed in several Asian countries,[20] largely due to preferences among Asian parents for male rather than female descendants, coupled with medical innovations (which provide parents with the option of sex-selective abortion). Another possible reason for a gender imbalance is selective migration. For example, male-dominated local

20 See Park / Cho (1995) for an early review of the empirical literature.

industries or sectors (e.g., the petrochemical industry or military) may lead to an unnaturally high share of men of middle ages in a region. Conversely, the presence in an area of female-dominated industries or sectors (e.g., tourism, fashion, or services) may lead to a female-majority gender imbalance.

Unnatural gender imbalances in Germany have attracted scant attention in the literature.[21] This is surprising, as unbalanced sex ratios may affect family formation, and may cause significant negative externalities. For example, gender imbalance may result in social unrest, especially if there are large numbers of young males unable to find spouses. Figure 10 provides the sex ratios for Mecklenburg-Western Pomerania (black line) and its counties (gray line) for 2010, differentiated by age cohorts. Under natural conditions, the sex ratio would steadily fall in age, starting off at a level of around 1.05 for the first age cohort (ages zero to four). Instead, in MV the sex ratio increases over the first six age cohorts. At 1.16 for the age cohort 25 – 34, it is unnaturally high. Selective migration is the most likely explanation for this gap: young and highly educated females have tended to move from the new to the old states in greater numbers than their male peers.[22] In some counties of MV, the deviations from natural sex ratios have become even more pronounced, exceeding 1.3 for the age cohorts 20 – 24 (Mecklenburg-Strelitz and Parchim), 25 – 29 (Uecker-Randow), and 30 – 34 (Wismar). Accordingly, an unnatural male surplus is observed among the population at fertile ages.

Forecast

We conclude the state-level analysis with some demographic projections, starting off with population pyramids,[23] and then proceeding with predictions about state-specific population sizes.

As was shown in the previous paragraphs, the German population, especially in the new states, is undergoing a rapid demographic transition. To illustrate the aggregate effect on the age structure, Figure 11 provides population pyramids for the years 1985 and 2010, together with a projection for 2030, both for Germany as a whole (upper panel), and for Mecklenburg-Western Pomerania.[24] Each figure provides two back-to-back graphs, one showing the number of males and the other the number of females in a particular age group. In each

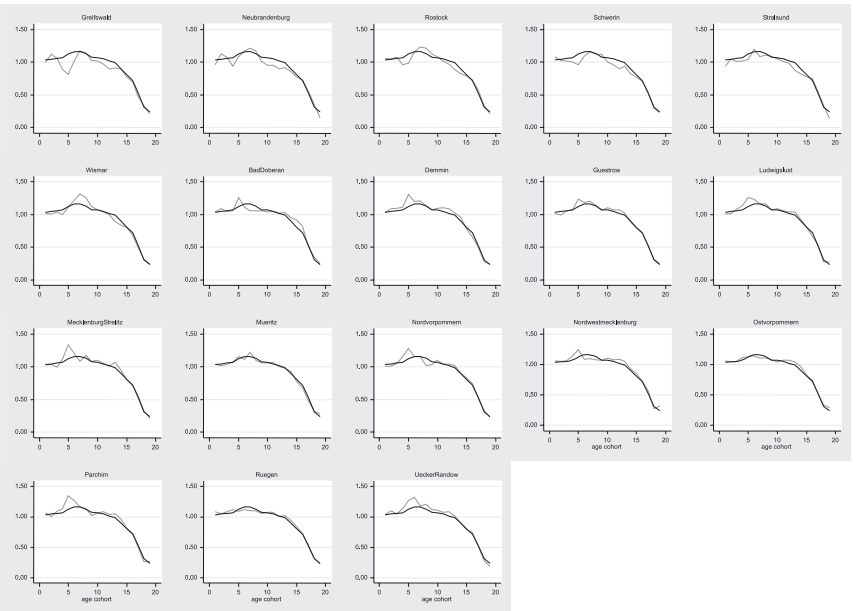
[21] A rare exception is the study by Kröhnert / Vollmer (2011) on gender imbalances in the new states. They find a substantial deficit of females in the age group 18 to 29: i.e., 89 females per 100 males in the East, which is equivalent to a sex ratio of 1.12.

[22] Empirical studies include Raffelhüschen (1992); Burda (1993); Schwarze (1996); Hunt (2000); Fuchs-Schündeln / Schündeln (2009); Zaiceva (2010).

[23] District-level projections for MV are provided in Scholz et al. (2011).

[24] In 1985, the data for Germany ("FRG") also include the population of the former GDR.

year, the total number of males relative to females serves as the basis (=100 percent) for isolating the structural changes of the gender-specific age distributions.



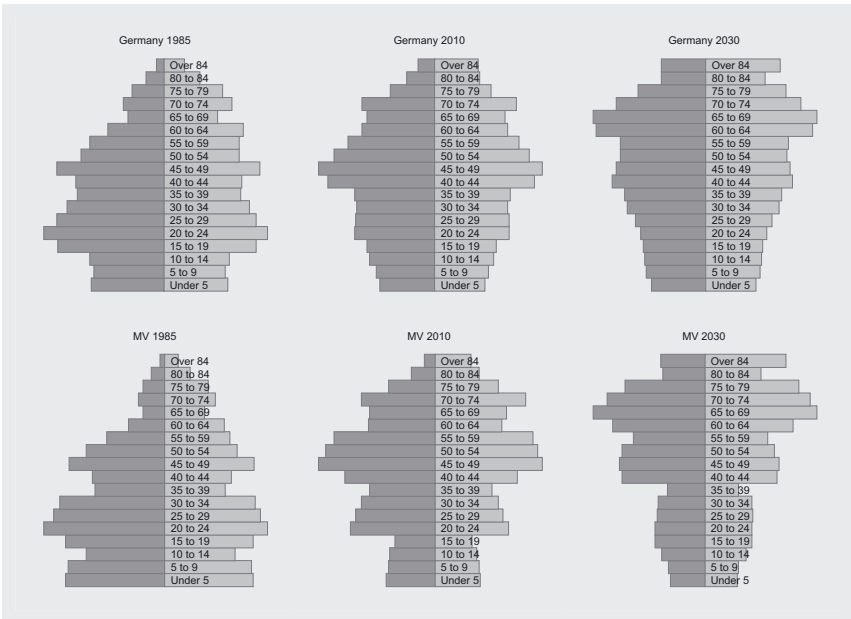
Note: Own calculations. Black line: Mecklenburg-Western Pomerania; gray line: district. Definition of age cohorts: cohort 1: 0 to 4 years; 2: 5–9; 3: 10–14; 4: 15–19; 5: 20–24; 6: 25–29; 7: 30–34; 8: 35–39; 9: 40–44; 10: 45–49; 11: 50–54; 12: 55–59; 13: 60–64; 14: 65–69; 15: 70–74; 16: 75–79; 17: 80–84; 18: 85–89; 19: 90 and above. Data from the Statistical Office Mecklenburg-Western Pomerania.

Figure 10: Age-specific sex ratios in districts of Mecklenburg-Western Pomerania

In 1985, the population pyramids still had a relatively broad base, although the number of younger people below age 15 was already relatively small compared to the age cohorts 20–29. Demographers refer to such a pyramid as "constrictive," which suggests that the country will have a graying population.[25] Indeed, 25 years later, the pyramid's basis has further eroded, while peo-

[25] Three prototypical types of population pyramids can be distinguished: a constrictive, an expansive, and a stationary pyramid. The constrictive pyramid is typical for highly developed countries. The expansive pyramid is typical for developing countries, and represents a large number of people in the younger age categories because of high birth rates, and a small number of people at older ages due to harsh living conditions and a

ple in their forties have become a dominant population subgroup. In MV, the erosion of the basis is particularly extreme. According to the year 2030 projections, the population pyramids for Germany and MV are basically standing on their heads: The population share of the age cohorts 0 – 19 will have further deteriorated, while people in their late sixties and early seventies will have become the dominant age cohort. For MV, this upside-down reorientation will mean a rise in the average age from 34.9 in 1985 to about 51.7 in 2030, and a reduction in population size from 1.96 to 1.45 million.



Note: Own calculations. Data for Germany from the Federal Statistical Office (2009, scenario W0). Data for Mecklenburg-Western Pomerania from the Statistical Office Mecklenburg-Western Pomerania.

Figure 11: Population pyramid for Germany and Mecklenburg-Western Pomerania – normalized

We conclude the spatial analysis with official population size predictions through 2060. These are displayed in Figure 12, with the population size in 2009 serving as the reference. The prediction for Germany is indicated by a black line, while the gray lines are the state-specific predictions. According to the projection, Germany is likely to lose 20 percent of its 2009 population by

short life expectancy. The stationary pyramid is characterized by about equal numbers of people at all ages (except for very old ages). Stationary pyramids are typical for countries with relatively low but constant birth rates and a high life expectancy, such as Sweden.

2060. Thus, the projected population decline is systematically greater in the new *Länder*. The population size of Hamburg is, however, rather robust. The city-state will continue to benefit from migration, and is expected to lose only about 5.7 percent of its 2009 population by the year of 2060. Meanwhile, the projections for the new states are rather dramatic, especially for Thuringia, Brandenburg, and Mecklenburg-Western Pomerania. For these three states, population size is expected to fall by about 40 percent.

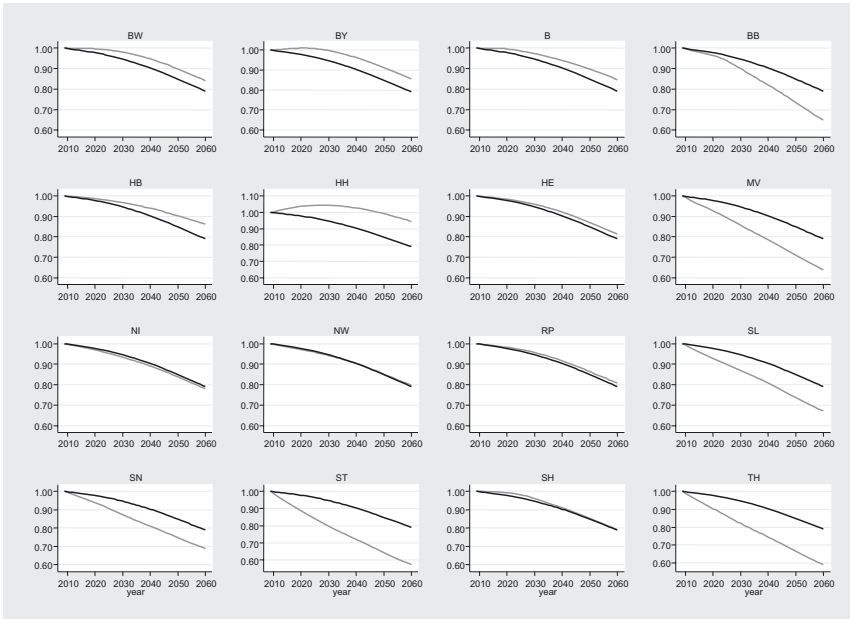


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Figure 12: Predictions of state-specific population sizes relative to 2009

4. Concluding Remarks

The present work has described the demographic changes in Germany, paying particular attention to spatial differences. As in many other countries, Germany's population is aging and its population is likely to shrink in the coming decades. At the same time, however, both the speed and the intensity of the demographic transition exhibit substantial spatial differences. In the new states,

the demographic transition has been more intense, reinforced through selective East-to-West migration after reunification (in response to high unemployment) and low numbers of birth (most likely in response to the drastic changes in general living conditions). In both respects, Mecklenburg-Western Pomerania has turned out to be a rather extreme case.

We have also identified a demographic challenge that has received scant attention in previous demographic analyses: unusually large gender imbalances in the new states for the 20–34 age group. For example, in Mecklenburg-Western Pomerania, the sex ratio (men to women) for the aforementioned age group is about 1.15. Some district-level sex ratios even exceed 1.3.

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