Adding the subnational dimension to the systematic analysis of the longevity revolution: Opportunities and challenges in establishing a subnational Human Mortality Database

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The establishment and development of the Human Mortality Database (UCB and MPIDR 2015, Wilmoth et al. 2007) over the last two decades has substantially contributed to improve our understanding of cross-national and temporal variation in the longevity revolution. However, in many countries the national level masks substantial variation at the sub-national regional level, and historical research provides strong support for the view that this was even more true in historical times (Bengtsson and van Poppel 2011, Kibele et al. 2015). The subnational perspective allows to identify vanguard and laggard regions in the longevity revolution and how their position has shifted over time. In addition, having access to comparative subnational data for many countries would enable researchers to explore to what degree mortality variation was and is characterized by variation between and within countries (see also Klüsener et al. 2014). This potentially allows to identify whether the longevity revolution is predominantly driven by processes with a national-level dimension (e.g., health and economic policies) that are likely to decrease variation in mortality risks across subnational regions, or by factors with a regional dimension (e.g., economic conditions, lifestyles, climate).

In order to demonstrate potentials and challenges of establishing a subnational Human Mortality Database (HMD), we present outcomes of a pilot project on Germany.[1] In the first part we will discuss solutions for methodological challenges that arise due to the fact that some assumptions of the HMD methodology are likely to be violated when working with subnational level data. In addition, we will discuss other challenges such as changes in state borders and subnational administrative regional boundaries over time, which have occurred frequently in Germany similarly as in many other countries of Central and Eastern Europe. In the second part we present long-term regional mortality trends for Germany. Over the last 25 years, the natural experiment of the German reunification and the subsequent mortality convergence between East and West Germany have been in the focus of scientific and public debates. However, the position of Germany in central Europe makes it not only interesting for research on factors that contribute to mortality variation between Eastern and Western Europe, but also for research investigating the North-South dimension of mortality disparities. In the latter dimension, remarkable trends are observable as well. While the Scandinavian countries have for a long time been at the forefront of the longevity revolution in Europe, they have recently lost this position to European countries

[1] It is relevant to note that two national-level datasets of the HMD had been derived by applying HMD methodology on regional-level data and then aggregating the adjusted regional data to derive the national-level data. This approach has been followed for Canada and Japan. However, in these cases standard HMD methodology is applied, while our pilot project on Germany is for the first time assessing to what degree HMD assumptions are violated when applying HMD methodology on regional-level data to derive regional information on levels and trends in mortality.

located further south such as France and Italy. Existing research on long-term trends in spatial mortality variation in Germany suggests that the country experienced several divergence and convergence processes of which some had a North-South and others an East-West dimension. These processes were also supported by the federal structure of the country in which, e.g., public health care is until today coordinated at the level of the federal states.

In terms of the methodological challenges, one main focus will be on exploring whether methods to improve the measurement of old-age mortality as implemented in the Human Mortality Database for national-level data can also be used for creating a subnational Human Mortality Database. These methods include the extinct-cohorts method (Vincent, 1951; Wilmoth et al. 2007). A particular challenge of the extinct-cohorts method is that it is based on the assumption that there is no selective in- and out-migration above age 80. We are currently exploring to what degree this assumption is also realistic when working with regional-level data, or whether we need to implement additional adjustments that account for migration. In the German case, we face particularly problems with the Germany city states (Berlin, Bremen and Hamburg). These states record very high outmigration rates to other federal states of Germany at ages above 80. These old-aged migrants seem to a large degree moving to areas adjacent to the city states, but located in the neighbouring German states. This is demonstrated in Fig. 1 for the city state of Hamburg and the state Schleswig-Holstein which comprises the northern part of the suburban belt around Hamburg. As outmigration from Hamburg is rather low for women aged 70-80, there are reasons to be concerned that the high migration rates among the 80+ are selective by health and marital status. At ages above 80, the share of widowed and frail persons is substantially increasing, and this group might be overrepresented in moves from Hamburg to the surrounding areas, where they could move to younger children that live with their families in the suburban belt or to retirement homes. That such selectivity is of concern, is also supported by the fact that migration intensities at ages 80+ are much higher among females compared to males (data not shown), as at least frail married males are more likely to still be cared for by the wife. Thus, the rather high life expectancy levels of females in German city states at age 80 over the last decades (Fig. 2) might at least to some degree be an artefact of health-selective outmigration moves at old age. Until the EPC we will assess the impact of selective migration on the high life expectancy levels at old age in German city states.

In addition to these challenges related to the HMD methodology, we also have to address the problem that Germany experienced drastic changes in its external borders and internal administrative boundaries over the last 150 years. Here we have to work carefully with territorial adjustment factors to account for changes in the boundaries. Another big problem is that due to the federal nature of the country, data accessibility and quality varies across its sub-regions over time. As to the temporal scope of the subnational database, it seems that for many subnational territories of Germany it will be possible to obtain time series from the mid-19th century until today. However, the time period for which we can prepare data in full compliance with the

standards as applied in the HMD and for a time constant geography will probably only cover the period 1980-2013.

Our first findings on long-term trends in North-South disparities in mortality provide support for the view that similarly to the pan-European pattern we also observe in Germany that the northern states had for long been the German vanguard regions in the longevity revolution, but have forfeited this position to southern Germany in recent decades (see also Kibele et al. 2015). In Fig. 3 we show life expectancy levels for females in north German states (Schleswig-Holstein, Bremen and Hamburg) have developed in comparison to the levels in the current German vanguard region of Baden-Württemberg. In addition, we added to this plot life expectancy trends for the two Scandinavian countries of Denmark and Sweden and for the Netherlands and France, which are again put in comparison to the ones observed in Baden-Württemberg. Fig. 3 demonstrates that the life expectancy shifts in the relative position of the northern German states in comparison to the levels recorded in Baden-Württemberg exhibits many similarities with the shifts that Denmark, the Netherlands and Sweden experienced. However, these shifts occurred in the northern German states a bit earlier compared to the other European countries. As a next step we will look in detail in trends in life expectancy at different ages.

Conclusion and Outlook

The preliminary outcomes of our pilot project on setting up a subnational HMD for Germany provide support for the view that adding the subnational dimension to the systematic analysis of the longevity revolution can enrich our understanding of factors driving this process. However, they also show that standard HMD-methods need to be modified as assumptions that seem to be viable at the national level do not necessarily hold in all cases at the regional level. This is, e.g., the case for the assumption of no selective migration after age 80 that seems particularly problematic if big cities form own regions. Our analysis of long-term mortality trends in the German states demonstrated that the current shift from a North-South- to a South-North gradient across Europe has also occurred within Germany. This suggests that this shift is at least in part also driven by factors with a regional dimension.

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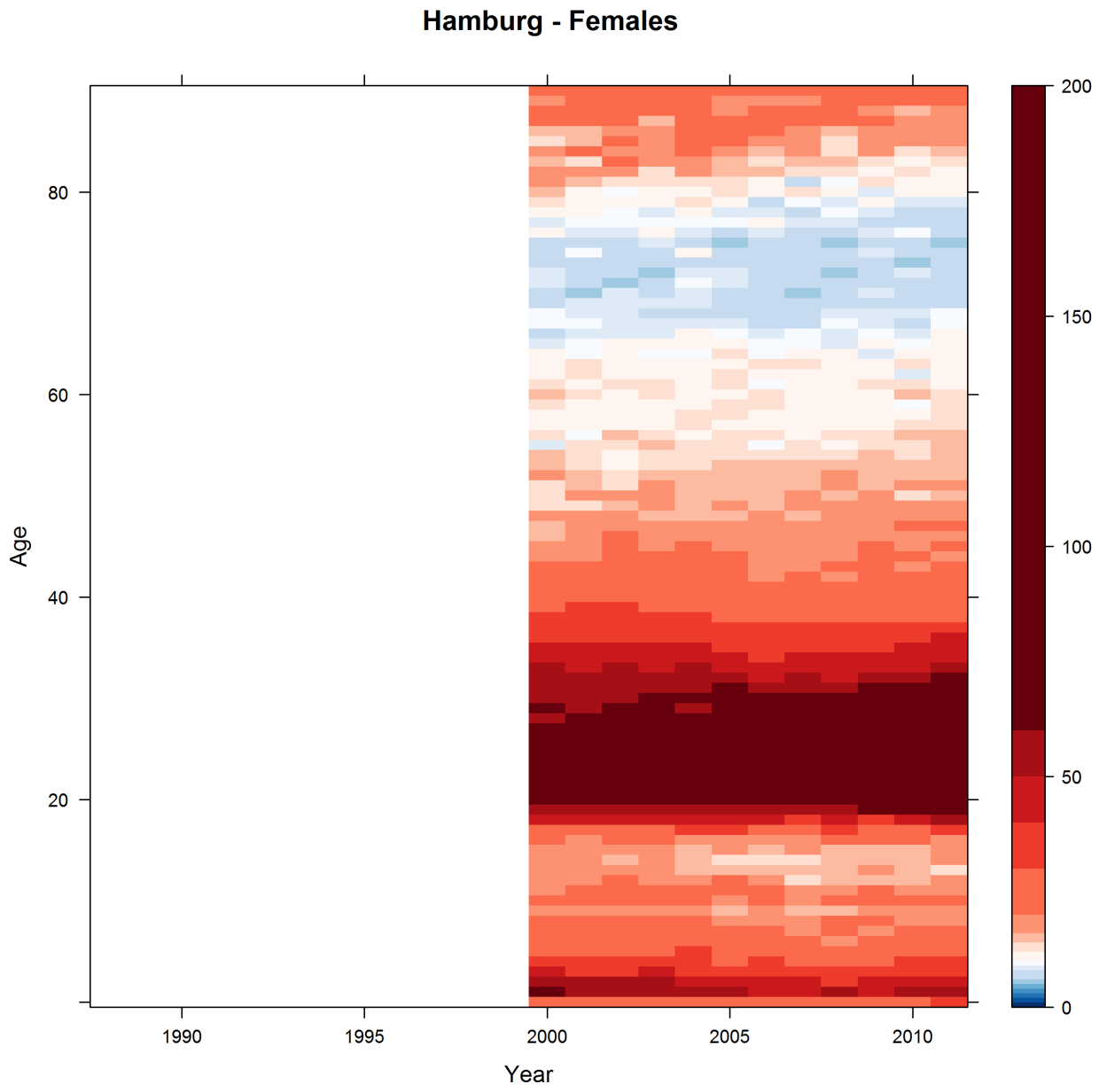
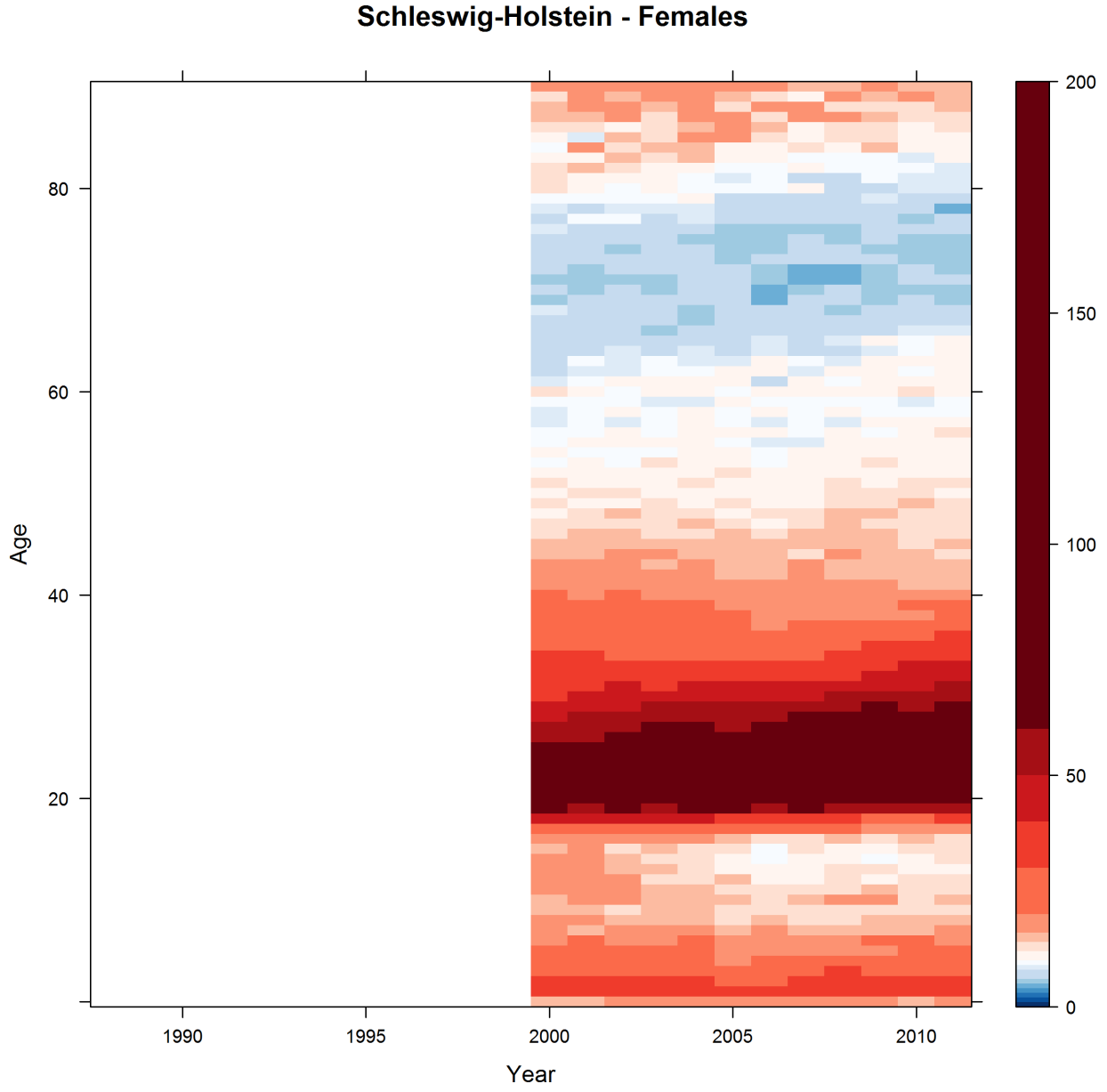
Fig. 1: Internal migration rates per 1000 inhabitants by age 2001-2013
(migration from and to other German states)

Females - Out-migration from Hamburg

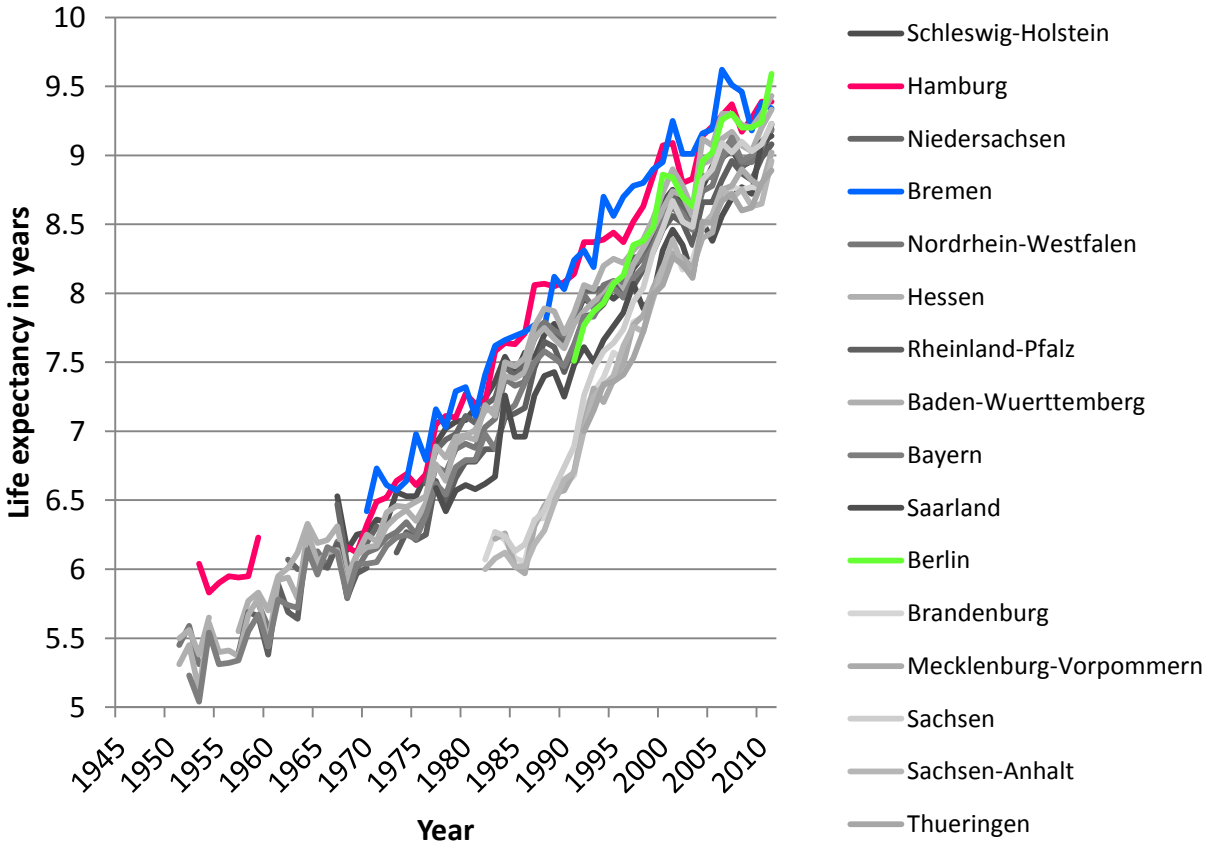


Females - In-migration to Schleswig-Holstein



Source: Federal Statistical Office of Germany; own calculations.

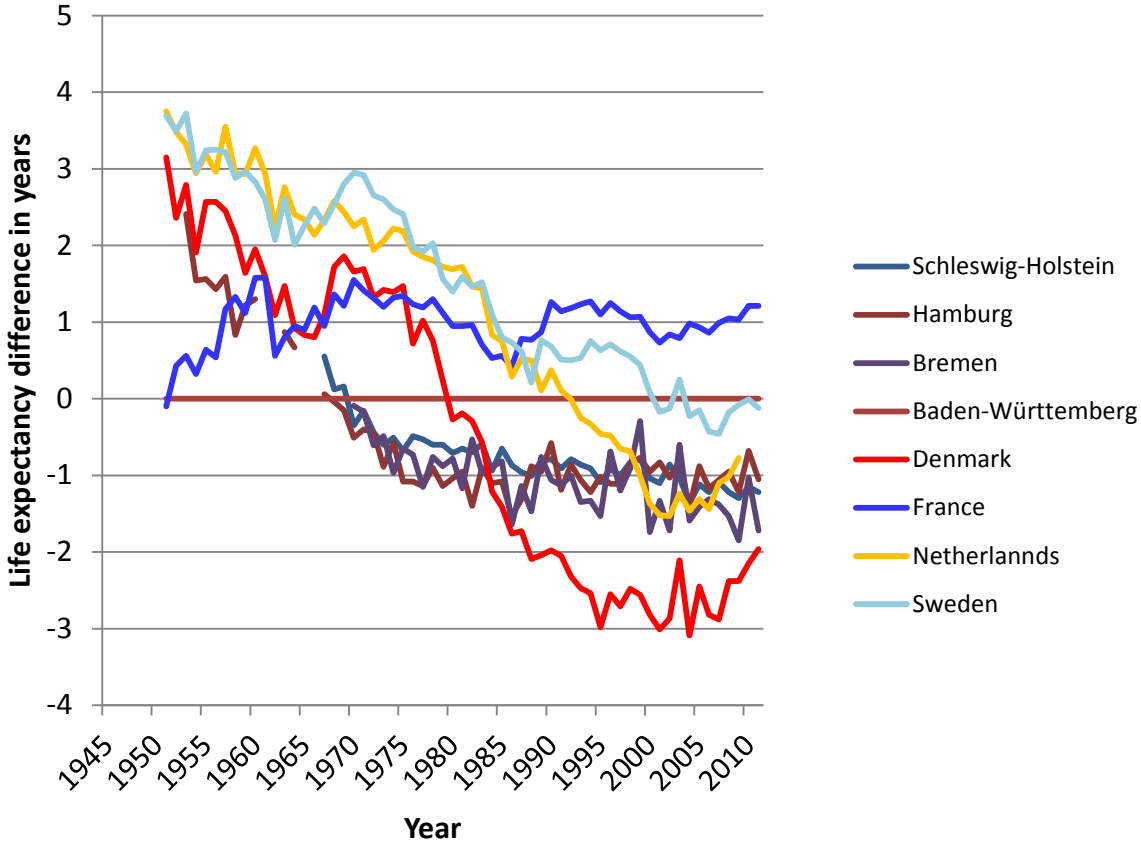
Fig. 2: Life expectancy of females at age 80 in German states 1950-2011



Note: Life expectancy data is based on death rates (mx) and qx by Chiang. We use five-year-age-groups up to 90+ and a separate age group for children under age 1. For life expectancy above 90 we take for the eastern and western German states the life expectancy for eastern or respectively western Germany as derived in the HMD. The value for a0 is also derived from the HMD values for eastern or respectively western Germany.

Source: Federal Statistical Office of Germany; own calculations.

Fig. 3: Life expectancy of females at age 0 in German States and selected neighboring countries



Note: Data for German states is based on death rates (mx) and qx by Chiang. We use five-year-age-groups up to 90+ and a separate age group for children under age 1. For life expectancy above 90 we take for the eastern and western German states the life expectancy for eastern or respectively western Germany as derived in the HMD. The value for a0 is also derived from the HMD values for eastern or respectively western Germany. Data for other European states is derived from the Human Mortality Database.

Source: Human Mortality Database, Federal Statistical Office of Germany; own calculations.