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Decomposition of demographic effects on the german pension system

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ABSTRACT

The paper analyses the impact of demographic developments on the German pension system until the year 2060. The projections are simulated for a range of assumptions on the latest demographic trends and on the labour market and comprise the latest pension legislation. As a central innovation, we present a decomposition approach which allows identifying the isolated effects of mortality, fertility and migration developments on the dynamics of the German pension system. We show that the past population structure – driven by past fertility changes – and future mortality improvements will be the most important factors shaping the development of the German pension system. The results have a number of implications for effective and sustainable pension reforms.

1. Introduction

In the coming decades, Germany will face a significant process of population aging. The changes in the population structure with a prominent increase in the share of elderly people raise concerns on the future viability of social transfer systems. In particular, the financial sustainability of the German Statutory Pension System ("*Gesetzliche Rentenversicherung*", GRV) is challenged as its primary pay-as-you-go (PAYG) financing scheme puts a major burden on the working population. The increase of the share of older people in Germany caused by the diminution of the size of the working population and a growing number of older people – undermines the revenue side of the GRV while expenditures for pension benefits rise simultaneously.

Several questions arise; given the demographic development in the next 40 years, how will contribution and replacement rates of the German pension system change? If pension reforms are necessary to retard those changes what will be the main demographic factors of this future development to be addressed by the reforms.

An identification of adequate reform strategies requires a detailed analysis of the factors that affect the budget of the GRV. Interestingly, when analysing pension systems, population ageing is predominantly regarded as a change of the population structure without a further analysis of the underlying demographic mechanisms that determine that change. An ageing population results from the interplay of fertility, migration and the development of life expectancy. It seems obvious that, for example, mortality as the main driving force of demographic change in the future would necessitate other reform measures of the pension system than migration or fertility. Also, past changes of these demographic factors influence population ageing as they shaped the population structure of today.

Next to the understanding of the impact of population ageing on the German pension system at large, our contribution is to complement the existing literature[1] by isolating the influence of single demographic variables on the GRV. We therefore develop a decomposition approach by adapting well-known analysis strategies e.g. used by sensitivity analysis in order to enrich the analysis of the impact of population ageing on the German pension system. We combine specifically conceptualised demographic scenarios to disentangle the single effects of fertility, mortality, migration and the actual population structure on central parameters of the GRV. The decomposition refers to 2010 as the reference year and the starting point of our projection. We chose this year in order not to confound the demographic effects with later changes in the pension legislation. The analysis and our presented long-run projections for Germany rest upon actual demographic and labour market trends and the latest pension legislation of 2017. To account for the large degree of uncertainty that underlies forecast results of the distant future with different independent scenarios, we simulate how sensitive our resulting pension system parameters react to variations of

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[1] See e.g. Holthausen et al. (2012), Werding (2013b) and Börsch-Supan et al. (2016).

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labour market and demographic developments. These results give rise to a number of proposals to be taken into account in upcoming pension reforms.

The paper comprises five sections. In Section 2 we describe the simulation model including the incorporated economic and demographic assumptions. The results of the pension projection are presented together with a brief sensitivity analysis and a comparison to the existing literature in Section 3. Section 4 focuses on the decomposition of the impact of demographic determinants. We introduce our decomposition approach and present the results for the impact of the actual population structure and the future impact of mortality, fertility and migration. Section 5 concludes.

2. The pension simulation model

The focus of our simulation model is on the impact of population ageing on the German Statutory Pension System as it is financed by a pay-as-you-go scheme that strongly reacts to changes in the population structure. The GRV is the most prevalent old-age provision for a majority of the German population (Kortmann and Heckmann, 2012).[2] Aspects of additional (funded) private and occupational pension plans are not incorporated in the model. Within the German PAYG system in general current contributions have to meet the current expenditures. In a given year t the simplified budget ignoring further costs and subsidies is as follows:

$$C_t \cdot cr_t \cdot W_t = P_t \cdot rr_t \cdot W_t. \quad (1)$$

The contributions are paid by contributors (number of contributors $= C$) according to the contribution rate (cr) on average gross wage income (W). The pensioners (number of pensioners $= P$) receive benefits according to the replacement rate (rr) of the current average gross wage income (W). Eq. (1) highlights the importance of the population as the number of pensioners and contributors is the major determinant of the budget. To balance the budget, the German pension legislation arranges an adjustment of the contribution rate:

$$cr_t = \frac{P_t}{C_t} \cdot rr_t.$$

Our model simulates the pension legislation of 2017 in detail and provides a flexible framework for the analysis of the coming developments of the pension system. The reference year of our decomposition and the starting point for our projection is 2010. We decided to use this early date as it is prior to the phase-in of a legislated increase in retirement ages starting in 2012. With this setup we prevent a bias of the evaluation of demographic effects. With a later reference year, increasing retirement ages would counteract the impact of demography and our decomposition results would also include the effects of legislative changes. The model combines several different demographic and economic scenarios. We treat all scenarios as independent from each other and assume a homogeneous population. Potential systematic individual behavioural responses to different pension system parameters or effects of the population size on employment rates and wages or differences in education and its effects on labour market behaviour are not modelled.[3] Furthermore, differences in demographic and in labour force developments and differences in the specific pension legislation between Eastern and Western Germany are not modelled. First, we introduce the projection of future population developments by describing assumptions on fertility, mortality and migration. Second, we explain the projection method of labour force participation rates and further assumptions on the labour market, wages and the determination of the number of pensioners. Third, we model the revenues and expenditures of the GRV.

2.1. Demographic development

The population projection is essential for quantifying the impact of mortality, fertility and migration on the future pension system development. It provides the basis for the decomposition of demographic effects as the decomposition approach draws on combining various demographic assumptions. The underlying scenarios for our calculations are guided by demographic scenarios provided by the “13th coordinated population projection for Germany” (Federal Statistical Office, 2015a). Additionally we updated actual data available for migration and fertility for the years 2013 to 2015.

2.1.1. Fertility

In our model we use period data on age-specific fertility rates that can be summarised by the total fertility rate (TFR). The total fertility rate measures the average number of children per woman.

Our *baseline scenario* refers to a total fertility rate reaching 1.6 children per woman in 2028 and remaining at that level until 2060. This characterises the fertility scenario G2 of the official projections (Federal Statistical Office, 2015a, p. 31 ff.)[4] It is assumed that fertility below age 30 stabilises while fertility rates above age 30 will rise further. We prefer a higher TFR for the baseline scenario as actual trends indicate increasing fertility rates so that fertility decisions are rather postponed than lowered. A period TFR of 1.6 appears more realistic than lower rates (Goldstein and Kreyenfeld, 2011; Federal Statistical Office, 2015b, 2016a).

An alternative *low fertility scenario* refers to a total fertility rate converging to 1.4 children per woman in 2028 and remaining at that level until 2060. This is comparable to the G1 assumption of Federal Statistical Office (2015a). But in contrast to the official projection we include the latest data on TFR up to 2015 so that fertility decreases slightly after a short rise of the TFR to 1.50 in 2015 (Federal Statistical Office, 2015b, 2016a). For a comparison of the potential impact of fertility we also consider a hypothetical *high fertility scenario*. Here, we assume that fertility in Germany in 2025 reaches a TFR of 2.01 the same level as observed in France in the year 2010 (HFD, 2012). This setup allows us to discuss more distinct fertility changes than actual trends are indicating.

2.1.2. Life expectancy

We use the underlying period rates of age- and sex-specific mortality that refer to the life expectancy scenarios provided by the Federal Statistical Office (Federal Statistical Office, 2015a). Our *baseline scenario* assumes an increase in life expectancy at birth by 6.0 years for women and 7.0 years for men until 2060 so that a newborn girl is expected to live 88.8 years and a newborn boy 84.8 years. A *high life expectancy scenario* assumes that life expectancy at birth reaches 90.4 years for women and 86.7 years for men in 2060.[5]

2.1.3. Migration

Three different assumptions on yearly net migration numbers are included in the model to capture the high political and geo-political uncertainty of future developments. We use the latest age-specific immigration and emigration data for women and men provided by the Federal Statistical Office (Federal Statistical Office, 2016c, 2017).

Our *baseline scenario* includes a decreasing net migration starting

[2] In the year 2011 in Western Germany, around 89 percent of the male and 86 percent of the female population above age 65 had an own GRV pension. In Eastern Germany this share was about 99 percent for men and women.

[3] This is another potential source of uncertainty. Increasing contribution rates might have feedback effects on participation rates, especially those of part-time workers and low income earners as analysed by Chetty et al. (2011).

[4] This describes a slower fertility increase than assumed in the previous official projection (Federal Statistical Office, 2009, 2013b; Pötzsch, 2010).

[5] The previous official projection in 2009 utilised scenarios with higher life expectancies at birth of 89.2 (91.2) years for women and 85.0 (87.7) years for men (Federal Statistical Office, 2009).