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Die Entwicklung der Rentenlücke und das Sparverhalten deutscher Haushalte

Axel Börsch-Supan, Tabea Bucher-Koenen, Irene Ferrari, Vesile Kutlu-Koc und Johannes Rausch

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MEA DISCUSSION PAPERS

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Zusammenfassung:

Die MEA-Studie befasst sich mit der zukünftigen Entwicklung der sogenannten Rentenlücke. Zum einen werden am Beispiel des Standardrentners Simulationsrechnungen unter unterschiedlichen Annahmen durchgeführt. Zum anderen untersucht die MEA-Studie das Sparverhalten deutscher Haushalte und die individuellen Möglichkeiten, die Rentenlücke zu schließen, anhand der repräsentativen Datensätze SAVE (Sparen und AltersVorsorge in Deutschland) und SHARE-RV, der in Zusammenarbeit mit der Gesetzlichen Rentenversicherung entwickelten deutschen Sub-Stichprobe des Surveys of Health Ageing and Retirement in Europe. Die Standardprognosen als auch die Berechnungen mit Haushaltsdaten zeigen deutlich, dass eine kapitalgedeckte Zusatzrente das Sinken der gesetzlichen Rente einigermaßen abfedern kann: Im Durchschnitt sind Haushalte so abgesichert, dass sie auch bei einem länger anhaltenden niedrigen Zinsniveau die Rentenlücke füllen können. Durch das derzeit niedrige Zinsniveau wird es jedoch für einige Haushalte schwieriger, die Lücke vollständig zu schließen. Haushalte, die dies nicht können, weil sie bislang keine ausreichenden Ersparnisse gebildet haben, finden sich in allen Einkommens- und Bildungsschichten.

Abstract:

In this study we investigate the future development of the so-called pension gap. First, we simulate the pension gap and the filling of this gap under different assumptions for the so-called "standard pensioner". Second, we examine the savings behavior of German households and the individual possibilities to close the pension gap. We use data from the SAVE panel, a representative longitudinal data set on households' financial behavior, and from SHARE-RV data, the German sub-sample of the Survey of Health Ageing and Retirement in Europe that has been developed in cooperation with the German Pension Fund (Gesetzliche Rentenversicherung). The projections for the "standard pensioner" as well as the calculations based on household data show that a funded supplementary pension can buffer the future reductions of the public pensions to some degree: On average households can fill the pension gap even if the interest rates remain on a low level. However, current low interest rates make it difficult for some households to completely close the gap. Households which cannot achieve this goal because of their low savings rates are present among all income and educational groups.

The development of the pension gap and German households' saving behavior*

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Abstract

In this study we investigate the future development of the so-called pension gap. First, we simulate the pension gap and the filling of this gap under different assumptions for the so-called "standard pensioner". Second, we examine the savings behavior of German households and the individual possibilities to close the pension gap. We use data from the SAVE panel, a representative longitudinal data set on households' financial behavior, and from SHARE-RV data, the German sub-sample of the Survey of Health Ageing and Retirement in Europe that has been developed in cooperation with the German Pension Fund (Gesetzliche Rentenversicherung). The projections for the "standard pensioner" as well as the calculations based on household data show that a funded supplementary pension can buffer the future reductions of the public pensions to some degree: On average households can fill the pension gap even if the interest rates remain on a low level. However, current low interest rates make it difficult for some households to completely close the gap. Households which cannot achieve this goal because of their low savings rates are present among all income and educational groups.

Kurzzusammenfassung (Deutsch)

Die MEA-Studie befasst sich mit der zukünftigen Entwicklung der sogenannten Rentenlücke. Zum einen werden am Beispiel des Standardrentners Simulationsrechnungen unter unterschiedlichen Annahmen durchgeführt. Zum anderen untersucht die MEA-Studie das Sparverhalten deutscher Haushalte und die individuellen Möglichkeiten, die Rentenlücke zu schließen, anhand der repräsentativen Datensätze SAVE (Sparen und AltersVorsorgE in Deutschland) und SHARE-RV, der in Zusammenarbeit mit der Gesetzlichen Rentenversicherung entwickelten deutschen Sub-Stichprobe des Surveys of Health Ageing and Retirement in Europe. Die Standardprognosen als auch die Berechnungen mit Haushaltsdaten zeigen deutlich, dass eine kapitalgedeckte Zusatzrente das Sinken der gesetzlichen Rente einigermaßen abfedern kann: Im Durchschnitt sind Haushalte so abgesichert, dass sie auch bei einem länger anhaltenden niedrigen Zinsniveau die Rentenlücke füllen können. Durch das derzeit niedrige Zinsniveau wird es jedoch für einige Haushalte schwieriger, die Lücke vollständig zu schließen. Haushalte, die dies nicht können, weil sie bislang keine ausreichenden Ersparnisse gebildet haben, finden sich in allen Einkommens- und Bildungsschichten.

1. Executive Summary (auf Deutsch)

Diese Studie hat zwei Hauptteile.

Der erste Teil der Studie (Abschnitte 2-4) umfasst eine Simulationsrechnung mit Hilfe des Rentensimulationsmodels MEA-PENSIM und gliedert sich in folgende Unterabschnitte:

- eine kurze Einleitung in das Thema und den Hintergrund dieser Studie,
- eine Definition des Begriffs Rentenlücke und dessen Quantifizierung unter Berücksichtigung der Rentenreformen in den Jahren 2001, 2004, 2007 und 2014,
- eine Untersuchung, inwieweit der Standardrentner die so definierte Rentenlücke durch eine kapitalgedeckte Zusatzrente (z.B. Riester) füllen kann, wenn er die gesetzlichen Regeln (z.B. Obergrenze der Förderung) und die begleitenden Empfehlungen einhält (z.B. früher Beginn und konsequentes Durchhalten der Einzahlungen für eine Zusatzrente),
- eine Sensitivitätsanalyse, in der wir die Möglichkeiten die Rentenlücke zu füllen in Abhängigkeit von der langfristigen Entwicklung der Zinsen (insbesondere der aktuellen Niedrigzinssituation) und Abweichungen des Standardrentners vom empfohlenen Sparverhalten untersuchen (spätere und unterbrochene Sparleistungen, Abweichung von der empfohlenen Sparhöhe etc.).

Der zweite Teil der Studie (ab Abschnitt 5) beinhaltet die empirische Untersuchung des tatsächlichen Sparverhaltens deutscher Haushalte auf der Basis des SAVE Surveys (Sparen und Altersvorsorge in Deutschland), einer repräsentativen Panelstudie deutscher Haushalte aller Altersstufen in den Jahren von 2001 bis 2013. Zur Plausibilitätskontrolle verwenden wir zudem SHARE-RV, die deutsche Sub-Stichprobe des Surveys of Health Ageing and Retirement in Europe, welche mit administrativen Daten der Deutschen Rentenversicherung verknüpft wurde. Hier sind lediglich Haushalte enthalten, bei denen die Bezugsperson 50 Jahre oder älter ist. Wir präsentieren Simulationsrechnungen, ob und inwieweit die Haushalte bei der Beibehaltung ihres aktuellen Spar- und Arbeitsmarktverhaltens ihre individuelle Rentenlücke füllen können.

Dieser Teil gliedert sich in folgende Unterabschnitte:

- die Beschreibung der beiden verwendeten Datensätze und ihrer jeweiligen Vor- und Nachteile,
- die Berechnung der individuellen Rentenlücken und der Nettovermögen zum erwarteten Rentenbeginn für alle Haushalte,
- die Umrechnung der Nettovermögen in Annuitäten unter Annahme unterschiedlicher Lebenserwartungen und eine Untersuchung, ob und inwieweit die Haushalte die Rentenlücke füllen können. Dabei ermitteln wir sowohl das durchschnittliche Ergebnis für alle Haushalte als auch die Verteilung in drei Gruppen: (1) Haushalte, die wahrscheinlich die Rentenlücke füllen können; (2) Haushalte, die bislang deutlich zu wenig gespart haben; (3) Haushalte, die bislang deutlich mehr gespart haben, als es zum Füllen der Lücke notwendig wäre,
- eine Sensitivitätsanalyse dazu, wie sich das Schließen der Rentenlücke bei unterschiedlichen Zinsentwicklungen verhält, unter besonderer Berücksichtigung des aktuellen Niedrigzinsniveaus,
- eine Untersuchung, wie sich die Rentenlücke und das Auffüllen derselben nach soziodemographischen Charakteristika (Vermögen zum Rentenbeginn, Einkommen, Alter, Bildung) unterscheiden.

Die wesentlichen Ergebnisse aus dem ersten Teil der Untersuchung sind:

- Mit dem Begriff der Rentenlücke wird gemeinhin der Rückgang des Rentenniveaus der gesetzlichen Rentenversicherung (GRV) bezeichnet, der sich in Zukunft aufgrund der 2001 und 2004 eingeführten Beitragssatz- und Nachhaltigkeitsfaktoren ergeben wird.

- Aufgrund dieser Faktoren und des demographischen Wandels wird die Rentenlücke bis 2060 graduell auf ca. 9,5% des Durchschnittsentgelts anwachsen.
- Ohne die Einführung der „Rente mit 67“ würde die Rentenlücke mit 10,5 % des Durchschnittsentgelts um ca. einen Prozentpunkt größer ausfallen.
- Berücksichtigt man zusätzliche Entgeltpunkte aufgrund einer um zwei Jahre längeren Erwerbstätigkeit, würde die Rentenlücke im Jahr 2060 nur 8% des Durchschnittsentgelts betragen.
- Die Rentenlücke wird sich durch die Rentenreform 2014 („Rentenpaket“ der Großen Koalition) in den Jahren 2015-2030 um durchschnittlich 31% (0,7 Prozentpunkte) vergrößern und wird im Jahr 2030 etwa 12% der Standardrente, die ohne die Reformen seit 2001 gegolten hätte, betragen. Dies entspricht 160 Euro pro Monat für Durchschnittsverdiener (in heutigen Werten).
- Durch eine kapitalgedeckte Zusatzrente mit einer nominalen Verzinsung von 4,5% kann die so vergrößerte Rentenlücke für Durchschnittsverdiener, die sich an den Regeln und Empfehlungen einer Riesterrente orientieren, geschlossen werden.
- Die Mindestverzinsung, die nötig ist, damit der Standardrentner seine Rentenlücke schließen kann, beträgt nominal 3,75%, wenn dieser allen Sparempfehlungen folgt.
- Sollte die Verzinsung jedoch darunter liegen oder die Regeln und Empfehlungen nicht eingehalten werden, wird das Schließen der Rentenlücke schwerer:
    - Bei einer nominalen Verzinsung von 2% verbleibt nach 2050 eine Rentenlücke von durchschnittlich 8% der Standardrente bzw. 117 Euro pro Monat (bei Orientierung an den Regeln und Empfehlungen einer Riesterrente).
    - Bei einer nominalen Verzinsung von 1,25% verbleibt nach 2050 eine Rentenlücke von durchschnittlich 10,7% der Standardrente bzw. 153 Euro pro Monat (bei Orientierung an den Regeln und Empfehlungen einer Riesterrente).
    - Werden die Einzahlungen 10 Jahre in der Mitte der Erwerbshistorie unterbrochen oder wird mit der Ersparnisbildung erst im Alter von 30 Jahren und nicht schon mit 20 begonnen, wird die Rentenlücke selbst bei einer Verzinsung von 4,5% im Jahr 2050 nur sehr knapp geschlossen. Sobald die Verzinsung etwas geringer ausfällt, kann die Rentenlücke nicht mehr geschlossen werden.
- Verlängert der Standardrentner seine Erwerbs- und Ansparzeit, indem er sein Rentenalter von 65 auf 67 verschiebt, reicht eine nominale Verzinsung von 3% aus um die Rentenlücke zu schließen.

Die wesentlichen Ergebnisse aus dem zweiten Hauptteil der Studie sind die folgenden:

- Wir betrachten Haushalte, die mindestens 40 Jahre alt und nicht in Rente sind. Im Durchschnitt sind Haushalte aus dem SAVE Datensatz 49 Jahre und SHARE-RV Haushalte 55 Jahre alt.
- Für diese Haushalte berechnen wir eine individuelle Rentenlücke basierend auf ihrem bisherigen und zukünftigen (prognostizierten) Erwerbs- und Einkommensverlauf. Diese Rentenlücke beträgt sowohl für SAVE als auch SHARE-RV Befragte etwa 4,2% des letzten Einkommens. Die Rentenlücke ist größer für jüngere Haushalte, da diese später in Rente gehen.
- Auf Basis des aktuellen Vermögens und bei konstantem Sparverhalten berechnen wir das erwartete Vermögen bei Renteneintritt. Dieses konvertieren wir dann in eine Leibrente, die wir mit der berechneten individuellen Rentenlücke vergleichen können.
- Wir legen unseren Berechnungen drei verschiedene Vermögenskonzepte zugrunde. Zunächst betrachten wir nur das Nettofinanzvermögen, das alle Bruttofinanzanlagen aufsummiert und von ihnen Konsumenten- und Familiendarlehen abzieht (net financial wealth, mit „NfinW“ bezeichnet). Zum zweitens beziehen wir auch das Immobilienvermögen ein und ziehen Hypotheken und Bauspardarlehen ab, so dass sich

das Nettogesamtvermögen ergibt (net total wealth, mit „NtotW“ bezeichnet). Drittens verwenden wir eine asymmetrische Definition, in der einerseits nur das Bruttofinanzvermögen berücksichtigt wird, andererseits aber sämtliche Schulden (Konsumenten- und Familienkredite plus Hypotheken und Bauspardarlehen) abgezogen werden (asymmetric net wealth, mit „AsymW“ bezeichnet). Letzteres beschreibt den „worst case“, in dem das Immobilienvermögen nicht zum Alterskonsum genutzt werden kann, die dementsprechenden Schulden aber dennoch vom Alterseinkommen bedient werden müssen.

- Haushalte schließen die Rentenlücke im Durchschnitt sehr deutlich: Betrachtet man nur das Nettofinanzvermögen (NfinW), ist dieses für die Haushalten in SAVE sieben Mal so hoch wie die Rentenlücke. Bei zusätzlicher Berücksichtigung des Immobilienvermögens (NtotW) ist das durchschnittliche Nettogesamtvermögen 20 Mal so groß wie die Rentenlücke. Selbst in der asymmetrischen Vermögensdefinition können die SAVE-Haushalte die Rentenlücke bei Zugrundelegung ihres Finanzvermögens und nach Abzug aller Schulden (auch der Immobilienschulden) im Durchschnitt die Rentenlücke zu mehr als 360% schließen. Das bedeutet, dass den Haushalten im Durchschnitt mehr als hinreichend Vermögen zur Verfügung steht, um die Rentenlücke zu schließen.
- Diese Durchschnittswerte sind allerdings insofern grob vereinfachend, als es reiche Haushalte gibt, die ihre Rentenlücke weit mehr als nur füllen können, und gleichzeitig arme Haushalte, die ihre Rentenlücke bei weitem nicht schließen können. Bei Berücksichtigung des Nettogesamtvermögens einschl. des Nettoimmobilienvermögens (NtotW) können knapp 78% der Haushalte die Rentenlücke vollständig schließen. Legt man nur das Finanzvermögen (NfinW) zugrunde, sind es 67%. Werden im pessimistischsten Fall nur das Finanzvermögen, nicht jedoch das Immobilienvermögen, aber alle Schulden berücksichtigt (AsymW), so schließen nur 53% der Haushalte ihre Rentenlücke vollständig. In diesem asymmetrischen Fall treten knapp 30% der Haushalte mit Schulden in Rente. In den beiden übrigen Vermögensdefinitionen (NtotW und NfinW) haben zwischen 8 und 11% der Haushalte eine so hohe Kreditbelastung, dass diese Haushalte nicht nur die Rentenlücke nicht schließen können, sondern zu Rentenbeginn noch verschuldet sind. Die übrigen Haushalte können die Lücke zumindest teilweise füllen.
- Diese Zahlen gelten unter der Annahme der von den Haushalten selbst angegebenen subjektiven Lebenserwartung. Allerdings zeigt sich, dass Haushalte ihre persönliche Lebenserwartung im Durchschnitt um vier bis sechs Jahre unterschätzen. Damit überschätzen die Haushalte auch ihre Möglichkeit, die Rentenlücke zu schließen, da das angesparte Kapital auf eine längere Rentenperiode verteilt werden muss.
- Nimmt man statt der subjektiven die vom Statistischen Bundesamt berechnete Kohorten-Lebenserwartung bei ansonsten identischen Annahmen, so sinkt die durchschnittliche Annuität beispielsweise von 418 auf 219 Euro in der pessimistischen Vermögensvariante (AsymW). Die Rentenlücke wird im Durchschnitt nur noch zu 230% geschlossen und der Anteil von Haushalten, der nicht in der Lage ist, genug Vermögen zum Schließen der Rentenlücke anzusparen, steigt je nach Vermögensdefinition um 2 bis 5 Prozentpunkte an. Die Unterschätzung der persönlichen Lebenserwartung impliziert also eine deutliche Überschätzung der Möglichkeit, die Rentenlücke zu schließen.
- Die Haushalte in SHARE-RV sind älter und haben daher am Ausgangspunkt unserer Berechnungen höhere Bruttovermögenswerte und niedrigere Schulden. Auf Basis der Kohorten-Lebenserwartung erhalten diese Haushalte bei einer zukünftigen Verzinsung von 2% eine Annuität von durchschnittlich 450 Euro und schließen ihre Rentenlücke durchschnittlich zu 560%. Wie in SAVE zeigt sich auch hier, dass es große Unterschiede zwischen armen und reichen Haushalten gibt. Insgesamt können selbst in der pessimistischen Vermögensvariante (AsymW) lediglich etwa 21% der Haushalte ihre Rentenlücke nicht füllen.

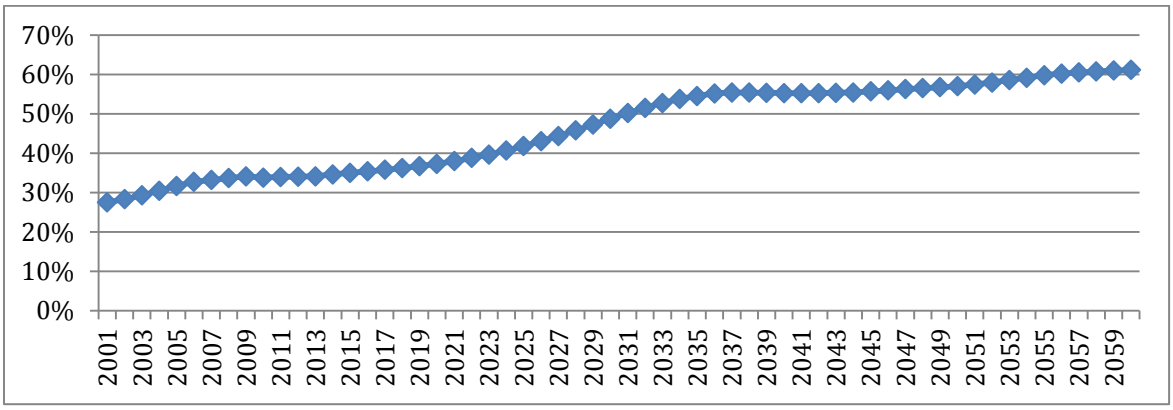
- Eine höhere Verzinsung treibt die Schere zwischen armen und reichen Haushalten weiter auseinander, denn höhere Zinsen machen es für Haushalte mit hohem Vermögen leichter und für verschuldete Haushalte schwerer, die Rentenlücke zu füllen. Für Haushalte mit keinem oder sehr geringem Vermögen hat ein hoher Zins kaum Auswirkungen. Bei einer nominalen Verzinsung von 4.5% im Vergleich zu 2% sinkt der Anteil der SAVE Haushalte, die die Rentenlücke nicht schließen können, von 47% auf 43% (AsymW).
- Die Hauptschwierigkeit beim Schließen der Rentenlücke ist demnach derzeit nicht primär die niedrige Verzinsung sondern die Tatsache, dass viele Haushalte (mehr als 40%) nicht sparen. Der Frage, warum so viele Haushalte nicht sparen, kommt daher große wirtschaftliche und sozialpolitische Bedeutung zu. Aufgrund früherer Studien schließen wir, dass dies nicht an einer zu geringen Förderung, sondern an erheblichen Informationsmängeln über die Förderberechtigung, die Akkumulationsgeschwindigkeit von Ersparnissen und die eigene Lebenserwartung liegt.
- Eine Betrachtung nach sozio-demographischen Charakteristika zeigt, dass insbesondere jüngere Haushalte, Haushalte mit geringem Einkommen und niedrigem Bildungsstand Schwierigkeiten beim Füllen der Rentenlücke haben. Allerdings gibt es auch unter Haushalten mit hohem Einkommen, und hoher Bildung sowie unter Haushalten, die kurz vor dem Renteneintritt stehen einen substantiellen Anteil, der nicht in der Lage ist die Rentenlücke bei Beibehaltung des derzeitigen Sparverhaltens zu füllen.
- Das Versäumnis zu sparen kann auch durch eine höhere Verzinsung nicht wettgemacht werden.

2. Introduction

The demographic change is putting increasing pressure on the German public pension system since a constantly increasing number of pensioners have to be financed by a decreasing number of contributors. In fact the old-age dependency ratio, i.e. the ratio of retirement-age individuals over working-age individuals, is projected to double by 2060 (see Figure 1). Consequently, it would be infeasible for the public pension system to guarantee both a stable pension level and a contribution rate acceptable to its contributors.

For this reason, major pension reforms began aiming at increasing the sustainability of the public pension system. In particular, one result of reforms in 2001 and 2004 is the reduction of public pension income in the following years. Subsequently, the pension level will decrease in a manner that would allow the contribution rate, of the system, to increase at a much lower rate compared to the pre-reform era. At the same time, however, a sufficient pension level would be guaranteed.

Figure 1 Old-age dependency ratio[1]



Source: 13th coordinated population forecast of the German Federal Statistics Office.

In consideration of these two opposing targets, thresholds were defined for which the contribution rate could not exceed and the net pension level before taxes[2] could not fall below. In the case of the net pension level before taxes the threshold is set to reach 46% by 2020 and 43% by 2030.[3] The contribution rate is set not to exceed 20% and 22% by the same dates. According to the last pension report (see BMAS, 2014), these thresholds will not be violated (see Figure 2 and Figure 3). On the other hand, as shown in Figure 3, the net pension level before taxes already decreased by 6 percentage points since the pension reform in 2001 and will decrease by another 3 percentage points by 2028 according to these predictions. Thus, compared to previous generations of German pensioners, future pensioners face a gap in their

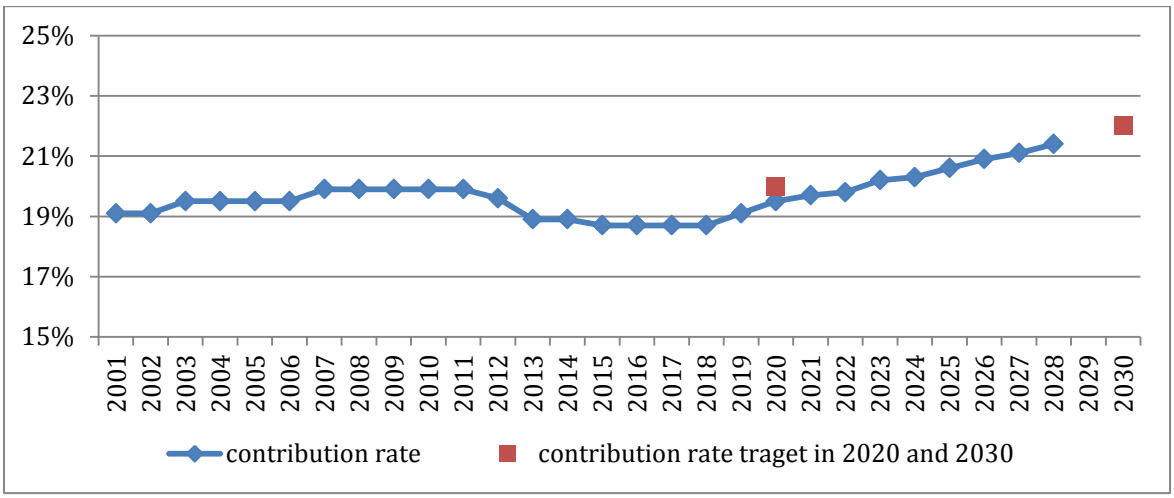
[1] The old-age dependency ratio is defined as the ratio between the individuals older than 64 and the individuals who are between 20 and 64 years old. The link of the data source is: "https://www.destatis.de/DE/Publikationen/Thematisch/Bevoelkerung/VorausberechnungBevoelkerung/BevoelkerungDeutschland2060.html".

[2] The net pension level before taxes is the ratio between the available standard pension and the available average income. The available standard pension is the old-age pension of an individual with 45 earnings points excluding his/her own contributions to the social insurances. The available average income is the average income excluding their own contributions to social insurances and the average expenses for the supplementary old age provision.

[3] See §154 SGB VI.

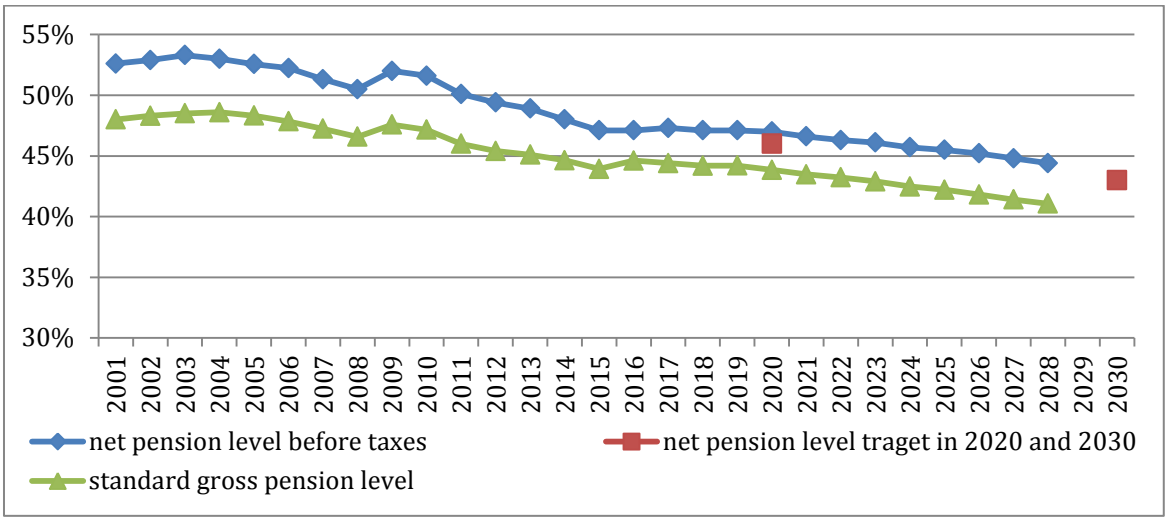
old-age income from the public system which they will need to fill with alternative income sources.

Figure 2 Projected contribution rate by the German pension system



Source: BMAS (2014).

Figure 3 Projected net pension level before taxes and projected gross standard pension level[4] by the German pension system



Source: BMAS (2014).

In order to ensure that households will fill this gap, the private voluntary but heavily subsidized Riester scheme was introduced (see Börsch-Supan et al., 2012b). The objective of the Riester scheme is to encourage households' contributions to private pension contracts by providing generous lump-sum subsidies and tax deductions depending on family status, number of children, and income. Full subsidies are only granted if a certain fraction of the gross income called the Riester contribution rate, which increased from 1% to 4% between 2001 and 2008, is saved. In addition to the Riester pension, reforms of the occupational pension system were implemented and the right to an occupational pension was introduced. As a consequence, the

[4] The gross standard pension level is given by the ratio between the standard pension and the average income. The standard pension is the old-age pension of an individual with 45 earnings points. The average income is, more or less, the average income of the insured population.

fraction of households without any pension income other than the public income decreased from roughly 70% of the population to less than 40% over the last decade (see Börsch-Supan et al., 2015a). However, there is a lot of heterogeneity among households' saving behavior: only around 25% of the German households report that they have planned how much they need to save for their retirement (see Bucher-Koenen and Lusardi, 2011). While households with high income, education and financial literacy are more likely to plan and save for their old-age, those with lower income, education and financial sophistication are less likely to do so.

In a stylized calculation Börsch-Supan and Gasche (2010) conclude that the Riester pension plans can close the pension gap under certain assumptions. They point out, that the success depends on the development of the aggregate variables such as wage growth and future interest rates as well as on individual decisions such as the savings period and savings rate. Another related study is by Börsch-Supan et al. (2005), which provides a micro-econometric analysis of actual savings behavior of German households using the SAVE survey. They estimate that given their saving behavior at the time, on average not more than 54% of individuals, depending on life expectancy assumptions, can close their pension gaps. However, they also show that the coverage of the pension gap depends largely on the households' characteristics. For example, married households have a higher level of wealth and, therefore, are more likely to close their pension gaps compared to unmarried households. Moreover, although the median pension coverage increases by income the non-coverage rate for the upper income third is still around 40%. Finally, they show that more educational training reduces the non-coverage rate.

The goal of this study is to check whether these results still hold or to what extent they might have changed. This is relevant and interesting for several reasons:

Firstly, individuals' awareness of the need for private old-age provision has increased over time which led to an increase in members with signed Riester contracts (see Coppola and Gasche, 2011). Hence, we expect that the number of individuals without private retirement savings to have decreased and the ratio of individuals who are able to close their pension gaps to have increased.

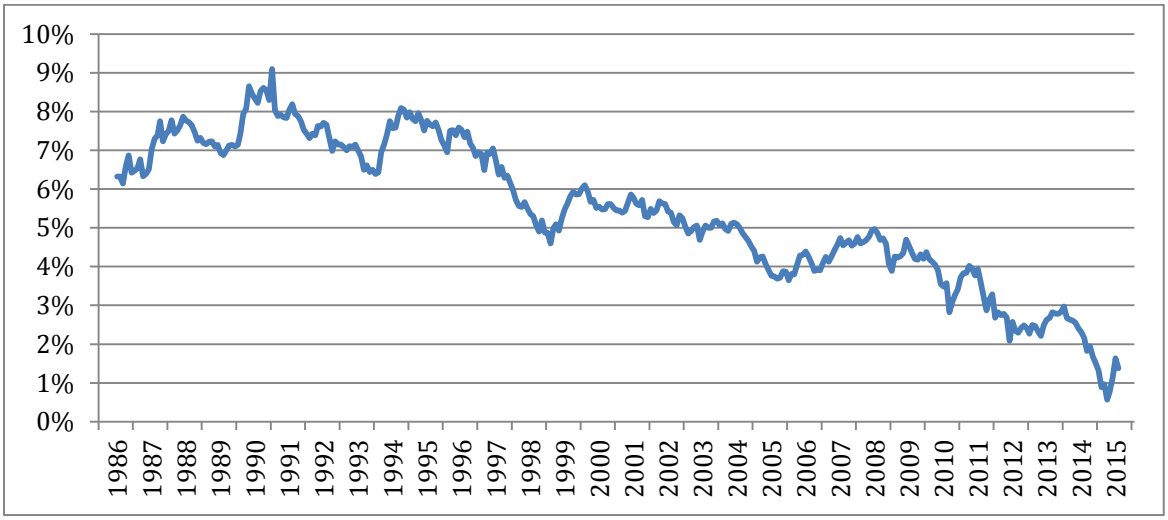
Secondly, two major pension reforms took place in 2007 and 2014 which influenced the development of the pension gap both positively and negatively. The 2007 reform is particularly relevant as it aims at increasing the actual retirement age by two years. If this aim is achieved then not only will the burden on the public pension system be reduced but also the savings period of a Riester contract will be extended.

Finally, and most importantly for this study, the low interest rate environment related to the recent financial crisis and the current debt crisis has a strong negative effect on the development of private wealth and possibly even on the amount of future private savings. In Germany, life insurance companies are not allowed to invest more than 7.5% of their funds in stocks.[5] Therefore, they have to invest in other financial instruments such as German Government Securities ("Bundeswertpapiere"). For example, in 2014 life insurance companies invested only 6.1% of total pension contributions in stocks and 30.2% in bonds and fixed-income securities (see GDV, 2014).[6] Even though the fixed-income securities are safer compared to stocks, their interest rates have followed a decreasing pattern over time, especially in the last decade, as shown in Figure 4. It is expected that the low interest rates would have a negative effect on the value of Riester pensions. Therefore, it is worth investigating how the current low interest rates will affect the extent to which the Riester pension can close the future pension gap.

[5] See „Verordnung über die Anlage des gebundenen Vermögens von Versicherungsunternehmen" (http://www.gesetze-im-internet.de/anlv/index.html).

[6] The other 60% are mainly invested in investment certificates, registered bonds, notes receivables and loans.

Figure 4 The development of the interest rate on listed German Federal Securities with a residual maturity of 20 years



Source: Deutsche Bundesbank.

This study is organized as follows: Section 3 defines and quantifies the pension gap. We will mainly focus on the effect the recent pension reforms had on the pension gap. For this purpose we will use the pension simulation model, MEA-Pensim, which provides a useful framework for calculating the arising pension gap before and after the introduction of the pension reforms in 2001 and 2004, and its development after the recent reforms in 2007 and 2014. Moreover, MEA-Pensim allows us to make different assumptions about how individuals' retirement behavior changes after the introduction of these reforms.

In Section 4, we will discuss whether the Riester pension can close the pension gap given that a standard pensioner follows all rules and recommendations. For this analysis, we will distinguish between two target definitions. In the first one, we consider whether the Riester pension can close the pension gap in the first year of retirement while in the second one we check whether the pension gap can be closed over the whole retirement period. We will calculate the Riester pension for an average person who follows the typical recommendations (e.g. starting Riester contract at a young age, save always the full Riester contribution rate, etc.). Afterwards, we will check the sensitivity of our results by changing the assumptions regarding the aggregate variables, such as the interest rates, or individuals' characteristics, such as the length of the savings period, retirement age and income profiles.

In Section 5, we analyze the actual savings behavior of German households based on two representative data sets SAVE and SHARE. We address the following questions: How high are the individual pension gaps of German households? Will they be able to close those pension gaps given their current wealth levels and savings behavior? How many households will not be able to cover their pension gap? Who are those households?

3. How large will the pension gap be?

3.1 Definition of the pension gap

The annual growth rate of pension payments is determined by the annual growth of the pension value which in turn develops according to the pension adjustment formula. Until 2001, this formula was mainly determined by the annual growth rate of wages and salaries.[7] Therefore, the pension adjustment formula provided a constant pension level at that time.[8] In the course of the pension reforms in 2001 and 2004, two additional factors were introduced into the pension adjustment formula: the contribution rate factor (CF_t) and the sustainability factor (SF_t). Since then, the annual adjustment ($1 + \theta_t$) of the current pension value is given by:

$$(1) \quad (1 + \theta_t) = (1 + \omega_t) \cdot CF_t \cdot SF_t \,,$$

where $(1 + \omega_t)$ represents the growth rate of the gross wages and salaries,[9] and the contribution rate factor is equal to:

$$(2) \quad CF_t = \frac{1 - AVA_{t-1} - \tau_{t-1}}{1 - AVA_{t-2} - \tau_{t-2}} \,,$$

where τ_t represents the contribution rate to the pension system in year t while AVA_t (which stands for "Altersvorsorgeanteil") represents the share a person should pay in his personal pension plan in year t.[10] Consequently, this value increases proportionally to the Riester-contribution rate.[11] The sustainability factor in equation (1) is given by:

$$(3) \quad SF_t = \left[\left(1 - \frac{PQ_{t-1}}{PQ_{t-2}}\right)\alpha + 1\right] \,,$$

where PQ_t represents the ratio between retirement expenditures and contributions.[12] The α-factor determines the influence the sustainability factor has on the pension adjustment formula and was set equal to 0.25 by the government in 2004.

From equation (1), it is clear that both the contribution rate factor and sustainability factor dampen the growth rate of the pension value if they become smaller than one. This is the case if the expenditures of the pension system grow faster than the contributions to the pension system which would occur if the number of pensioners grows faster than the number of workers.

Consequently, the pension payments will grow slower than wages, and salaries and the pension level will decrease compared to the situation in which these two factors had not been introduced. In other words, as a result of these reforms, the state pension income of future

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[7] Note that the pension adjustment formula has been changed several times in the past. See Gasche and Kluth (2011) for an overview of the changes made in the pension adjustment formula.

[8] More precisely, the pension adjustment formula took into account the growth of the net wages and salaries. Therefore, the formula guaranteed a constant net pension level described by the ratio of net pension to net income.

[9] Since 2004 the pension adjustment formula considers not only the growth rate of the gross wages and salaries but also the growth rate of the relevant income for pension contributions (see Holthausen et al., 2012).

[10] Because of this component, AVA_t, the contribution rate factor is also called Riester factor in some studies.

[11] However, the development of the two values was not always the same. While the Riester contribution rate increased from 0% to 4% between 2001 and 2008, the *AVA*-value reached 4% only in 2012 because it stayed constant during the financial crisis.

[12] Note that PQ_t is not identical to the old-age dependency ratio. For an explicit definition of the used pensioner/contributor ratio see Holthausen et al. (2012).

generations will be lower than that of current generations. The arising difference in pension income is the so-called "pension gap".

In this study, we will adopt the methodology of Börsch-Supan and Gasche (2010) and quantify the pension gap (PG) which expresses the pension gap as a percentage of the wage income. Hence, the pension gap in the year of retirement, Z, is the difference between the (gross) pension level of the reform year 2001 (PL_R) and the pension level of the retirement year, Z, after the reforms took place (PL_z):

$$(4) \qquad PG_Z = PL_R - PL_Z = PL_R \left[1 - \prod_{i=R+1}^{Z} CF_i \cdot SF_i \right].$$

The term in the brackets is the accumulated dampening effect of the contribution rate factor and the sustainability factor since their introduction.[13] In this context, however, it is important to note that the pension gap, by definition, shows the changes in the pension level only due to the dampening factors introduced in 2001 and 2004.

3.2 Changing the retirement age: the 2007 reform

Since the introduction of the contribution rate factor and the sustainability factor in 2001 and 2004, respectively, two important pension reforms took place.

The first reform in 2007 aimed to further improve the sustainability of the pension system. As life expectancy increases, the length of time spent in retirement increases as well. This creates a financial burden on the pension system since individuals receive retirement benefits for a longer period of time unless they postpone their retirement age. To address this issue, in 2007 the German government adopted a reform which aimed to gradually increase the normal retirement age from 65 to 67 years between 2012 and 2030.[14] Yet, the increase of the normal retirement age to 67 was not carried out entirely as it did not apply to all individuals in the pension system. For example, even after 2012 workers with 45 years of contributions can retire at age 65 without any deductions on their pension income (pension for persons with an exceptionally long insurance record). To become eligible for this pathway of retirement individuals must have contributed to the pension system for at least 45 years – the periods in which they were unemployed are not counted as contribution years.

Individuals without very long contribution history, under the hypothesis that they do not change their retirement behavior as a consequence of the reform, are instead subject to actuarial adjustments which reduce their pension by 0.3% per month of early retirement under the 2007 rules. The effect on the pension gap in this case is clear; as lower pensions imply lower expenditures of the pension system this in turn reduces the dampening effect of the sustainability and contribution rate factors. However, the question remains of whether this is enough to close the pension gap.

At the other extreme, if individuals did instead react to the new rules by postponing retirement to the new eligibility age, the effect on the pension gap would be ambiguous. On the one hand,

[13] Note that, for the sake of simplicity, this formula does not take into account some protection rules which could temporarily reduce the effect of the dampening factors. For instance, a pension guarantee exists which prevents a pension reduction in real terms or a protection rule for East Germany guarantees that the pensions in East Germany increase at least as much as the West Germans' pensions. Although the inclusion of the protection rules in the calculation of the pension value would slightly change our results in the short-run, their effects on the pension value would disappear over time.

[14] This reform also aimed to gradually increase the normal retirement age of the disability pension from 63 to 65.

individuals would receive pension benefits for a shorter period. At the same time they would be paying contributions for a longer period, which would reduce expenditures of the pension system. Both effects would contribute to a lower pension gap. On the other hand, a longer contribution period would lead to higher pension claims, thus increasing expenditures and potentially increasing the pension gap.

In Section 3.4, we will shed light on the effect of the 2007 reform under these different circumstances.

3.3 The 2014 grand coalition reform

While the 2007 reform and the previous reforms in 2001 and 2004 were similar in the sense that they all aimed at improving the sustainability of the pension system, the 2014 reform was different. The grand coalition government made an attempt to increase the generosity of the pension system through several adjustments:

"Mütterrente": Until 2014, mothers or fathers were receiving one earnings point for a child born before 1992 and three earnings points for a child born after 1992. The 2014 reform aimed at eliminating the unequal treatment of mothers and fathers with children born at different points in time. However, increasing the earnings points for children born before 1992 involves high costs, and therefore, creates a financial burden on the pension system. Because of this reason, the government decided to double the earnings points of mothers or fathers with a child born before 1992. Nonetheless, this adjustment is by far the most expensive component of the 2014 pension reform (see Bach et al., 2014).

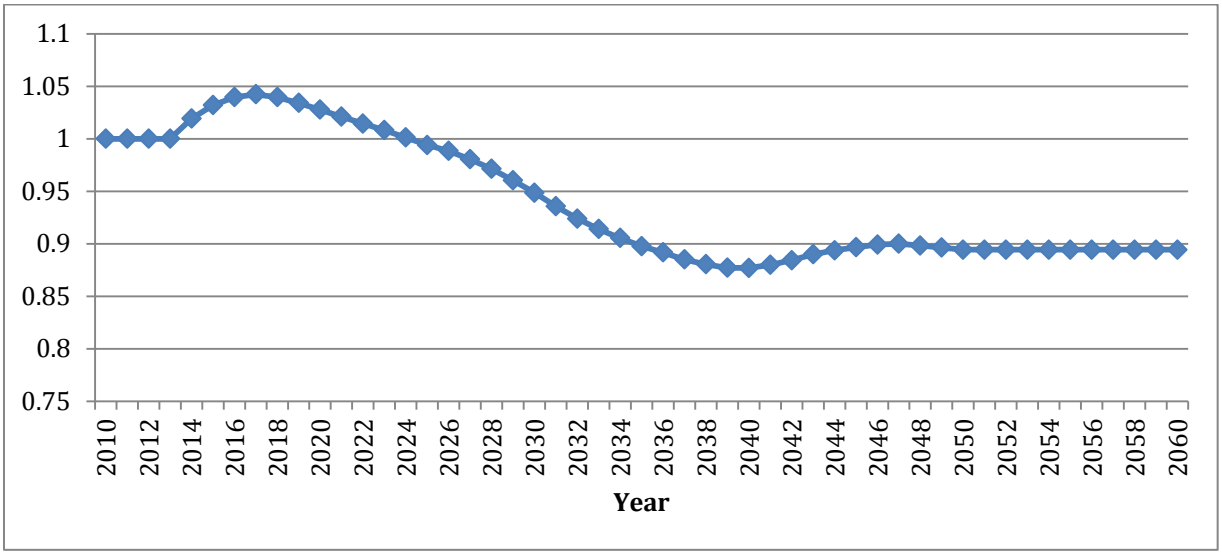
"Rente mit 63": The so-called "Rente mit 63" includes two components. First, from 2014 onwards the contribution period of 45 years includes the spells in which individuals received unemployment benefits. This consequently increases the number of people eligible for this pathway of retirement. Second, the retirement age for workers with very long contribution histories was reduced from 65 to 63. This means that individuals who have contributed to the pension system for at least 45 years can retire at age 63 without any deductions on their pension income. The reduction of the age limit is, however, temporary and will be phased out in parallel to the gradual shift in the normal retirement age. All in all, this component of the reform not only increases the expenditures of the pension system but also creates an incentive for a large group of individuals to retire earlier (see Börsch-Supan et al., 2015).

Disability pension: A person who becomes disabled before the age of 60 receives additional earnings points for each year until the age of 60 (known as "Zurechnungszeit"). Those additional earnings points depend on the average earnings points the disabled person had earned during his entire working life. With the 2014 reform there have been two changes in the calculation of the disabled persons' pension benefits. First, the calculation of the average earning points will not take into account the earnings points (or income) earned in the last years of employment if a person's average income by including the last years of employment is lower than that by excluding the last years of employment. This is mainly because disability could have a negative effect on the person's income earned in the last years of employment (e.g. part-time employment due to health conditions). Second, in parallel to the gradual shift in the normal retirement age of the disability pension, the reference year of the "Zurechnungszeit" will increase from 60 to 62 (see Börsch-Supan et al., 2012a).

"*Leistungen zur Teilhabe*": The last component of the 2014 reform was the inclusion of a demographic factor in the adjustment rule of the budget for participation benefits ("Leistungen zur Teilhabe"). This budget was created by the government with the aim of increasing the labor

force participation of older workers, and it is destined for rehabilitation and re-training.[15] Normally, this budget is annually adjusted according to the growth rate of gross wages. The number of people receiving these benefits is likely to increase in the next years but decrease afterwards since baby boomers are expected to retire between 2020 and 2030. To take this effect into account a demographic factor was introduced in the formula used to calculate the budget for participation benefits. As shown in Figure 5, this factor first increases the growth rate of the budget and dampens it afterwards. Altogether, this factor even decreases the budget by 10% in the long run (see Börsch-Supan et al., 2012a). It should be noticed, however, that the budget for participation benefits influences only the contribution rate factor directly as it increases or decreases the overall expenditures of the system and therefore the contribution rate. The sustainability factor is, in turn, only influenced indirectly due to the effect the contribution rate factor has on pension benefits.

Figure 5 Cumulative demographic factor



Source: § 287b Abs. 3 SGB VI.

3.4 Quantifying the pension gap

In this section we will quantify the arising pension gap similar to Börsch-Supan and Gasche (2010). To do this, we will calculate the pension gap according to equation (2) and use the gross standard pension level, which compares the standard pension with the average income.[16]

The standard pension is defined as the pension of the so-called "standard pensioner" who starts working at age 20, retires at age 65, and earns the average income in each year. Hence, the standard pensioner has 45 earnings points and satisfies the condition for the pension for persons with an exceptionally long insurance record.[17]

In the reform year of 2001, the gross standard pension level was at 48%. Compared to Börsch-Supan and Gasche (2010) we will additionally examine the sensitivity of the pension gap

[15] Currently, this budget makes up nearly 2% of the whole expenditures of the public pension system.

[16] Here, the average income means the average income of all insured persons.

[17] Therefore, the standard pensioner will not have to pay any actuarial adjustments on his pension if he does not increase his retirement age as a response to the 2007 reform.

with respect to the latest pension reforms described above. We will calculate the pension gap under four different scenarios which differ not only by the reforms but also by the assumptions regarding possible reactions to the reforms, as explained above.

For the calculation of the pension gap we need a simulation model which allows us to calculate the future expenditures and revenues of the German public pension system (GRV). In this study, we will calculate the pension gap by using a pension simulation model called MEA-Pensim (see Holthausen et al., 2012), which contains a very detailed implementation of the current statutory regulations of the GRV. This includes the exact definition of the pension adjustment formula as well as other most important regulations like: the adjustment rules for the government subsidies, protection clauses, and the correct adjustment of the contribution rate.

The future revenues and expenditures of the GRV are determined by the general development of the German population and the development of the labor market and wages. Therefore, we first have to specify our assumptions regarding the development of these three factors. In general, the pension reforms in 2007 and 2014 could influence the development of all three factors. However, in this study we will focus on the effect of these reforms on the development of the German labor market and assume that these pension reforms have no significant effects on the development of the population and wages.[18] Hence, in all scenarios, we make the same assumptions regarding the development of the population and wages. These can be summarized as follows:

i) Until 2060 the MEA-population forecast assumes:

- a constant fertility rate of 1.4,
- a constant net migration of 150,000 and
- a linear increase of the life expectancy at birth to 89.2 year for men and 92.3 years for women.

ii) The annual change in the wages and salaries will be based on the predictions of the Federal Ministry of Labour and Social Affairs available in the pension report of the year 2014 (see BMAS, 2014). According to these predictions, the annual growth rate of the wages and salaries will increase to 3% until 2020 and remain at this level afterwards.

Starting from 2013, MEA-Pensim forecasts the development of the labor market situation in Germany. Thereby, the labor force forecast in a specific year is based on the population forecast in that year and age-specific labor force participation rates which are taken from the German Microcensus in the base year of the forecast.[19] The number of pensioners depends on the decline of the ratio of employees and unemployed people relative to the whole population at each age and, therefore, it also depends on how labor force participation rates will evolve over time.

The development of the labor market changes if individuals adapt their behavior to the new incentives created by the pension system. This case could also hold for the labor force participation rate of younger cohorts. However, in this study we assume that the age-specific labor force participation rates of individuals younger than age 63 will not change as a response to the reforms.[20] Therefore, following the approach in Börsch-Supan et al. (2015b) we assume

[18] The underlying mechanisms through which the reforms affect the development of the population and wages are not straightforward. In addition, one needs to make stronger assumptions to incorporate these effects into the calculation of the pension gap.

[19] See Holtausen et al. (2012) and Börsch-Supan et al. (2015b) for a more specific explanation of the labor force forecast in MEA-Pensim.

[20] In MEA-Pensim, it is assumed that the earliest retirement age is 50. Furthermore, it is assumed that all people retiring before age 63 are disability pensioners.

that the labor force participation rates of this age group will remain at the same level as in 2013 in all scenarios described below. The labor force participation rates of individuals who are at least 63 years old, as will be discussed in detail below, are allowed to change in response to the pension reforms in 2007 and 2014.

Next, we will report our results regarding the calculation of the pension gap under four different scenarios. First, we briefly discuss how these scenarios are defined and how they differ from each other (see Börsch-Supan et al., 2015b and Bach et al., 2014 for a detailed description).

Scenario 2004: In this scenario we simulate the development of the GRV based on the institutional context after the pension reform in 2004 The normal retirement age is 65 years for all individuals, therefore the normal retirement age is assumed to be 65 years for the whole population in our simulation. Moreover, we assume that individuals do not change their retirement behavior as a response to the 2004 reform. As a result, the labor force participation rates of individuals older than age 63 remain at the same level as in 2013 in all simulated years.

Scenario 2007a (without reaction): In this scenario we simulate the development of the GRV based on the pension reform in 2007. The normal retirement age increases from age 65 to age 67 for all individuals except for those with very long contribution histories. Consequently, the pension benefits of all individuals who do not postpone their retirement will be reduced by 7.2% (3.6% per year). However, we assume that all individuals accept this amount of reduction in their pensions and do not change their retirement behavior as a response to the reform. Hence, similar to the first scenario, the labor force participation rates of those older than age 63 are kept constant over time.

Scenario 2007b (with reaction): This scenario is identical to the previous scenario, except that we assume that individuals affected by the 2007 reform will postpone their retirement by two years. Therefore, we, metaphorically speaking, shift the labor force participation rate of those individuals older than age 63 by two years. We do this in a linear manner until 2028. Individuals who contributed to the pension system for at least 45 years are assumed not to change their retirement age and retire at age 65.

Scenario 2014: In the final scenario, we consider the 2014 pension reform and make the following assumptions for the different components of the reform.

"Rente mit 63": In general, we assume that individuals affected by the 2007 reform retire at age 67 instead of 65. However, we also assume that all persons eligible for the "Rente mit 63" will change their retirement behavior and retire at earlier ages since they do not have to pay any actuarial adjustments on their pensions. Hence, according to their birth year they retire between the age of 63 and 65. This assumption is made to calculate a maximum increase in the pension gap as a result of the reform. Moreover, since the introduction of the reform the current official statistics on the number of people retiring at age 63 underpin this assumption.[21]

"Mütterrente": The additional earnings point for children born before 1992 is calculated differently for mothers who have already retired and for mothers who are still working. For the first group, we estimate the expenditures of the pension system using the historical fertility rates and the German Microcensus. Then, we annually adjust these expenditures using the pension adjustment formula and the life table survival probabilities for females. For the second group, we increase the earnings points of a "mothers' cohort" according to the fraction of their children born before 1992. This fraction is again estimated based on the historical fertility rates and the German Microcensus.

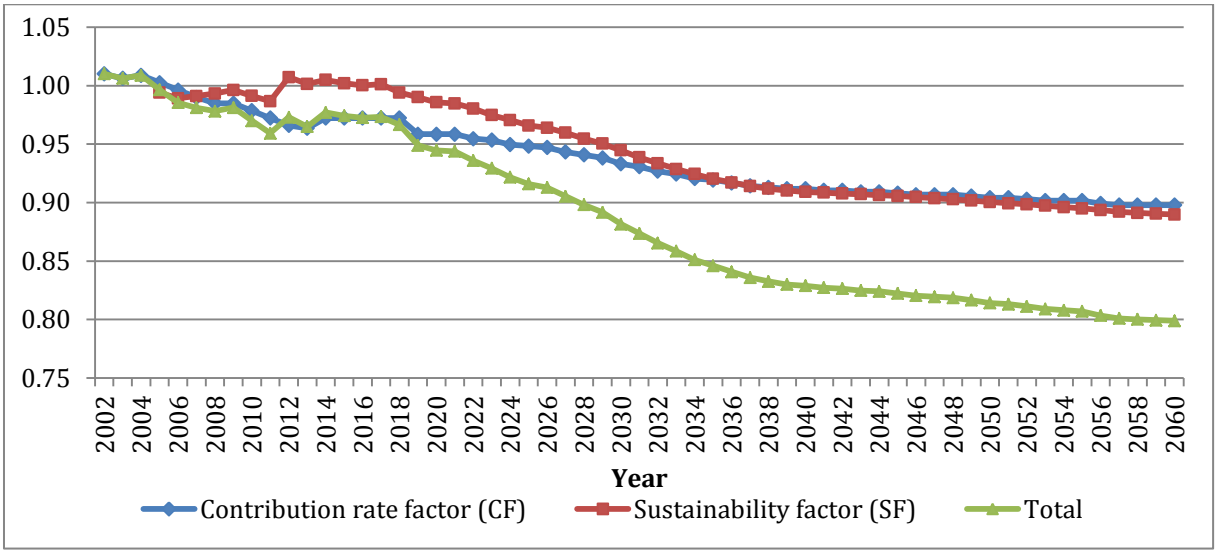
[21] See http://www.deutsche-rentenversicherung.de.

Disability pension: In this case we take into account only the increase of the reference age of the "Zurechnungszeit" from 60 to 62. In other words, we do not look at whether an individual's earnings points decrease in the last years of his employment because of the disability. This is due to the fact that we consider only the average person for each cohort.

"Leistungen zur Teilhabe": To include this component of the reform in our analysis we simply add the exogenously defined demographic factor to our pension simulation model (see Figure 5). Figure 6 shows the cumulative effect of the sustainability factor and contribution rate factor on the pension adjustment formula between 2002 and 2060 for the Scenario 2014.[22] According to this figure, each factor will reduce the growth rate of retirement benefits by more than 10% by 2060. The total effect of these two factors shows that retirement benefits of individuals who will retire in 2040 and 2060 will be, respectively, 17.1% and 20.1% lower compared to the benefits of someone who retired in 2002 when these factors were not yet introduced.

Compared to the previous study by Börsch-Supan and Gasche (2010), which finds a reduction of 15.9% in retirement benefits until 2040, our predictions for the same period suggest a slightly higher reduction in pension income. This difference might result from different assumptions regarding the development of the population and labor market or from the development of the German pension system since 2010.

Figure 6 Cumulative sustainability factor and cumulative contribution rate factor for the Scenario 2014

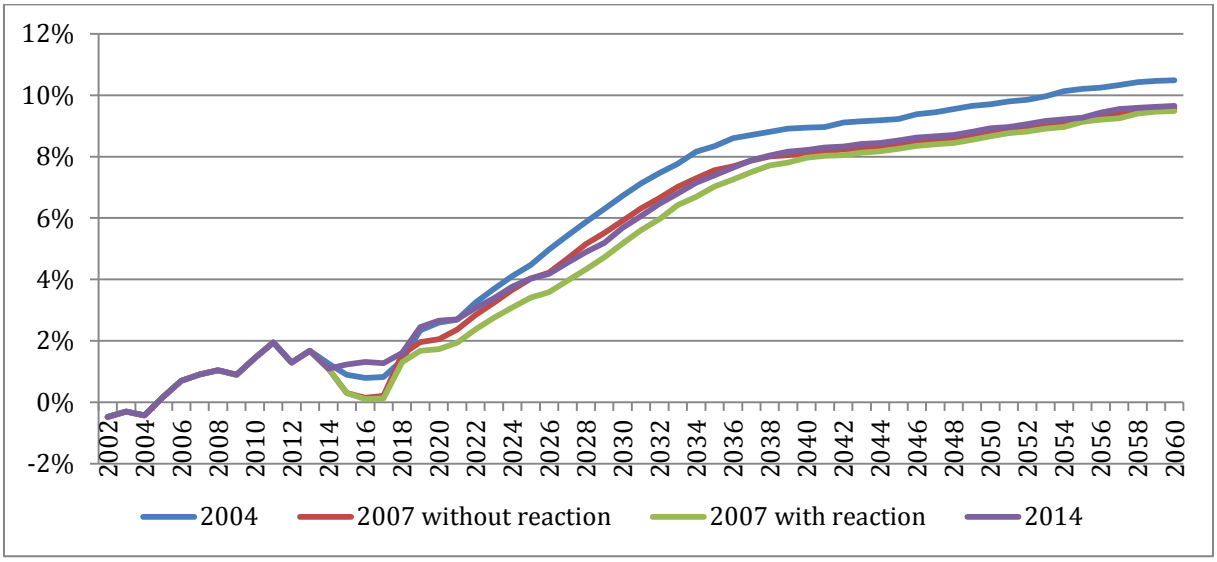


Source: Authors' own calculations.

Next, we will report our predictions for the pension gap as defined in Section 3.1. Figure 7 depicts the development of the pension gap between 2004 and 2060 for our four different scenarios. According to Figure 7, the general development of the pension gap over time is very similar across all scenarios.

[22] In fact, it is also possible to define the pension gap as one minus the cumulative effect of the sustainability rate factor and contribution rate factor. Hence, Figure 6 actually shows an alternative version of the pension gap which Börsch-Supan and Gasche (2010) called "relative pension gap". However, in this study we will focus on the pension gap definition of section 2, as this corresponds to the standard definition.

Figure 7 Pension gap after different pension reforms



Source: Authors' own calculations.

First, the pension gap increases rapidly until 2040 and then slows down. This pattern is due to the fact that most of the baby boomer generation will have retired by 2030, which will increase the expenditures of the pension system tremendously. The predictions based on scenario 2004 shows that the pension reforms between 2004 and 2007 lead to a pension gap of 8.9% in 2040 and a pension gap of 10.5% in 2060.

The pension reform in 2007 reduces the pension gap by approximately 0.9 percentage points when individuals do not change their retirement behavior at all (scenario 2007a) and by approximately 1 percentage point if they postpone their retirement (scenario 2007b).

The smaller pension gap in scenario 2007a is, as explained above (see chapter 3.2), a result of the higher deductions all individuals have to accept on their retirement benefits if they do not postpone their retirement by two years. All in all, the positive effect on the expenditures of the pension system leads to an approximately 1.5 percentage point smaller dampening effect of the sustainability factor and contribution rate factor on the growth rate of the pension payments (not shown graphically). However, in reality, the negative effect due to the increasing reductions in the pension benefits outweighs the positive effect due to the decreasing dampening factors and thus, the net effect would be negative. For example, in 2040 the monthly pension of a person retiring before the age of 65 is reduced by approximately 5.7% (7.2% reduction minus 1.5% less dampening factor).[23]

According to the predictions based on scenario 2007b, the future pension gap becomes lower in case all individuals postpone their retirement by two years as a response to the 2007 reform. In this scenario the expenditures of the pension system decrease as individuals claim their retirement benefits two years later; consequently, they receive pension payments for a shorter time period. Meanwhile, they contribute two more years to the pension system which, in turn, increases the system's revenues. This argument explains the smaller pension gap until 2040 in scenario 2007b compared to that in scenario 2007a (see Figure 7). Hence, in scenario 2007a, the financial burden on the pension system decreases due to lower expenditures whereas in scenario 2007b it decreases due to both lower expenditures and higher revenues.

[23] Note that in all scenarios the standard pensioner who has worked for 45 years is not subject to any reductions in his pension benefits.

However, additional contributions lead to higher pension claims in the long-run and, therefore, both scenarios predict almost the same pension gaps after 2040. The small differences (approximately 0.1 percentage points) can be explained by the fact that early-retirement adjustments in Germany are not actuarially fair (see Börsch-Supan, 2004; Werding, 2012 and Gasche, 2012).

As explained in Section 3.3, the grand coalition government increased the generosity of the pension system through several adjustments in 2014. Consequently, the expenditures of the pension system increased. This leads to a rising pattern of the pension gap from 2014 on, as shown in Figure 7. Nonetheless, the 2014 reform has a large effect on the expenditures of the pension system only in the short- and medium-run. In the long-run, especially after 2040, the negative effect on the pension gap becomes smaller. This is due to the fact that the major components of the 2014 reform cause a temporary increase in the expenditures of the pension system (see Bach et al., 2014 and Börsch-Supan et al., 2015b). For example, the "Mütterrente" increases the pension claims of mothers and fathers only with children born before 1992. This component of the reform will disappear over time. Similarly, the reduction of the retirement age for workers with very long contribution histories is temporary and will be phased out in parallel to the gradual shift in the normal retirement age.

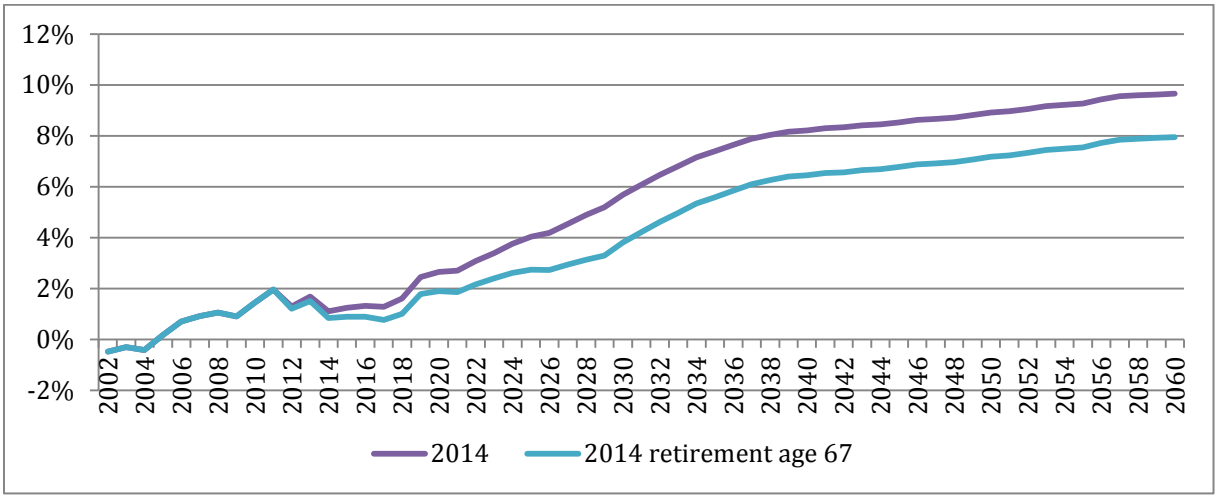
On average, we see that by 2040 the pension gap in scenario 2014 is 0.6 percentage points higher than that in scenario 2007b. After 2040 the pension gap is still on average 0.24 percentage points higher than that in scenario 2007b. It is also remarkable that the pension gap in scenario 2014 is higher than the pension gaps in all other scenarios until 2021.

However, it is important to note that the pension gap calculation gives us only the effect of the reforms on the contribution rate factor and sustainability factor and, therefore, the consequences for a standard pensioner only. In reality, there are those pensioners who benefit from the reform (e.g. mothers with children born before 1992) and those pensioners who do not benefit from the reform (e.g. people without any children or children born after 1992 only). The pension level of the former group increases and, consequently, their individual pension gap decreases. However, the pension level of the latter group is decreasing and, therefore, their individual pension gap increases. Individual pension gaps will be calculated in Section 5.

So far, we have analyzed the pension gap based on the gross standard pension level as described in equation (2). We have shown that the pension gap decreases after the 2007 reform regardless of individuals' reactions to the reform. However, the pension gap, by definition, shows the changes in the pension level due to the dampening factors introduced in 2001 and 2004. Additional earnings points and/or pension claims (e.g. due to postponed retirement) can therefore be interpreted as a tool to close or reduce the pension gap within the public pension system. For example, the contributions a person pays when retiring two years later can be interpreted as additional savings which lead to an additional pension. This pension then covers a certain amount of the pension gap. Therefore, as a last step, we calculate the amount of reduction in the pension gap for scenario 2014 by assuming that the standard pensioner postpones his retirement by two years as a response to the 2007 reform. Hence, the standard pensioner's earnings points increase from 45 to 47.[24]

[24] Note that we generally use the predictions of scenario 2014 and only change the calculation of the standard pension.

Figure 8 Pension gap for a modified standard pensioner with 47 earnings points for scenario 2014



Source: Authors' own calculations.

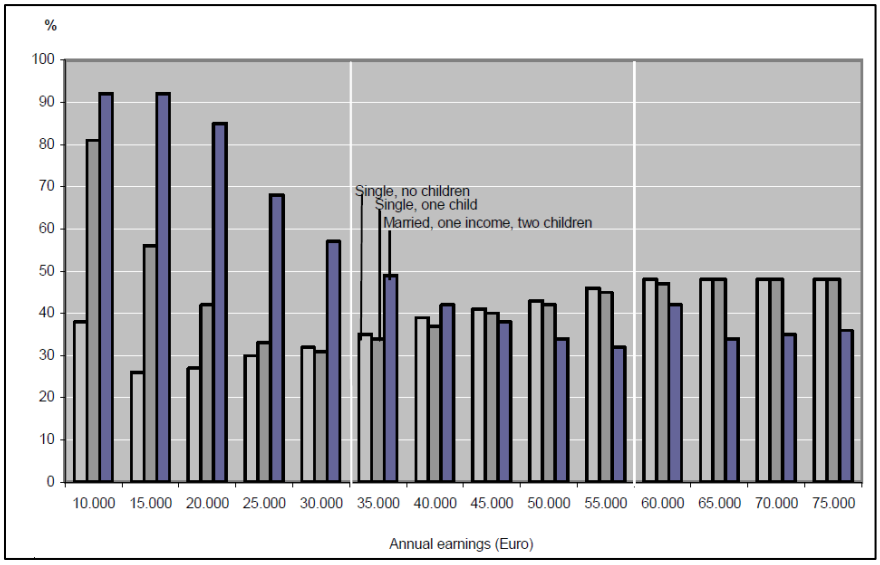
The predictions are shown in Figure 8. Obviously, the additional earnings points increase the gross pension level of the standard pensioner and, therefore, the pension gap decreases by more than 1.7 percentage points in the long-run. Nonetheless, it should be noted that the reduction in the pension gap is only possible if the standard pensioner gives up two years of his retirement benefits and contributes to the pension system for two more years.

4. Closing the pension gap under current rules and recommendations

In this section, we analyze whether a standard pensioner who follows all the recommendations can close the arising public pension gap by the state-subsidized private saving scheme called the Riester pension. Therefore, we will consider several scenarios which differ, among other things, with respect to the interest rate and the contribution rate (see Sections 4.3 to 4.7).

The Riester scheme was introduced in 2001 and the objective was to encourage households' contributions to private pension contracts by providing generous lump-sum subsidies and tax deductions depending on family status, number of children, and income. The participation is voluntary and the subsidies are bound to eligibility criteria. Basically, everyone who is affected by decreasing public pensions is eligible to receive these subsidies (for more specific eligibility rules, see Börsch-Supan et al., 2012b). On average, subsidies amount to about 45% of contributions, depending on income and number of children (see Figure 9). Subsidies are particularly high for low-income earners and families with children.

Figure 9 Subsidy as percentage of total (own plus government) contribution



Source: Deutsche Bundesbank (2002).

The question of whether the Riester pension can close the pension gap can be formulated based on two definitions. According to the simple target definition, the pension gap has to be closed in the first year of retirement (Z). So far, we have performed our simulations based on the simple target definition.[25] The strict target definition requires the pension gap to be closed in each year of retirement. This definition is in line with the logic of the Riester pension, which was supposed to replace part of the public old-age provision. However, it could be too strict since consumption expenditures typically decrease at older ages due to deteriorating health conditions (Börsch-Supan and Stahl, 1991). In this section we will present our simulation results under both definitions.[26]

We will start our analysis by calculating hypothetical savings profiles. Based on different assumptions about savings behavior and the development of the interest rates, we will check if the pension gap can be closed in the beginning as well as over the entire retirement period. We

[25] This definition was adopted by the previous studies as well, i.e. Börsch-Supan et al. (2008a).

[26] Note that the strict target definition cannot be satisfied if the simple target definition is not fulfilled.

will estimate the sensitivity of the calculations with respect to different income and savings profiles on the one hand and with respect to the underlying interest rate assumptions on the other hand.

The interest rates are particularly interesting because of the recent financial crisis and especially the Euro crisis which induced very low interest rates that might make filling the gap harder. In the light of an increase in the retirement age to 67, we will also check the sensitivity of the Riester pension with respect to the savings period. We will generally consider the Riester pension level, which is defined as the ratio between the Riester pension and the average income, and compare it with the pension gap. The Riester pension can close the pension gap if the Riester pension level is at least equal to the pension gap.

4.1 Calculation of the Riester Pension

Similar to Börsch-Supan and Gasche (2010) the Riester pension is constructed like a pension scheme, which yields an annuity for the insured person during the retirement period. The whole amount of capital saved is, therefore, distributed to an annuity period which starts from a specified age E (age of retirement) and ends with the death of that person. The basic purpose is to provide a steady annuity income in old age.[27]

For the hypothetical calculation of the Riester pension we assume that a person starts saving at a certain age *A'* after the introduction of the Riester pension in 2001. He saves an amount of S_i in each year, yielding an annual interest of η_j, until the age before retirement denoted by *E-1*. The entire saving period is, therefore, given by *E-1-A'*. This person retires and, simultaneously, starts to draw his Riester pension benefits in year *Z=E+c*, where c stands for the birth year of the person. Consequently, the year when the person starts saving can be denoted by *A=A'+c*.

Under these assumptions, the Riester-capital W_{Z-1} which has been saved for the time of retirement can be characterized by the following equation:

$$(5) \quad W_{Z-1} = \sum_{i=A}^{Z-1} \left[S_i \prod_{j=i}^{Z-1} (1+\eta_j) \right]$$

In general, an individual can freely decide how much to contribute to his Riester plan. However, to qualify for the full government subsidy, he must save a certain percentage of his gross income y. We call this percentage the "Riester-contribution rate" and denote it by b_i in year i. The gross income y grows with the rate ω_j, as introduced in Section 3. Based on these definitions, equation (5) can be rewritten as:

$$(6) \quad W_{Z-1} = \sum_{i=A}^{Z-1} \left[b_i \cdot y_A \prod_{j=i}^{Z-1} (1+\omega_j)(1+\eta_j) \right], \text{ with } \omega_A = 0$$

The accumulated capital W_{z-1} is converted into annual pension payments which will be received in the expected annuity period *T-Z*, depending on the cohorts' remaining life expectancy at the time of retirement. The annual pension payments are calculated dynamically with a rate of δ, e.g. to account for inflation. The pension payment in the first year of retirement is denoted by p_z. The present value of the pension payment at time *Z-1* corresponds to the amount of saved capital W_{Z-1}:

[27] According to the current legislation 70% of the accumulated wealth has to be converted into an annuity at retirement, 30% could be taken as a lump sum.

$$(7) \quad W_{Z-1} = p_z \sum_{i=Z}^{T} \frac{\prod_{j=Z}^{i}(1+\delta_j)}{\prod_{j=Z}^{i}(1+\eta_j)}$$

Hence, considering equation (6) the Riester Pension in the first year of retirement Z is given by the following equation:

$$(8) \quad p_Z = \frac{\sum_{i=A}^{Z-1}\left[b_i\, y_A \prod_{j=i}^{Z-1}(1+\omega_j)(1+\eta_j)\right]}{\sum_{i=Z}^{T}\prod_{j=Z}^{i}\frac{(1+\delta_j)}{(1+\eta_j)}}$$

According to equation (8), the substantial determinants of the Riester pension are:

- The interest rate η_j: the higher the interest rate, the larger is the Riester pension, ceteris paribus. This suggests that the low current interest rates would negatively affect the Riester pension and might make filling the pension gap harder. Therefore, in this study we will look at the sensitivity of Riester pension with respect to different interest rates (see Section 4.3).
- The dynamization rate δ_j: the larger the dynamization during the time of retirement, the smaller the Riester pension is in the first year of retirement. On the other hand, pension payments in the later years of retirement become larger. Therefore, the right choice of the dynamization rate plays a crucial role for the satisfaction of the strict target definition.
- The remaining life expectancy at the time of retirement in the year *T-Z*: the higher the remaining life expectancy, i.e. the duration of retirement, the smaller is the Riester pension. The assumed life expectancies of the life insurance companies are often criticized by the public. People argue that the assumed life expectancies are too high and therefore pensions are too small. However, Bucher-Koenen and Kluth (2012) show that individuals are rather pessimistic about their life span compared to the official life tables. Hence, much of the criticism may stem from the fact that people underestimate their own life expectancy.
- The saving period *Z-1-A*: the longer the saving period, the higher the amount of saved capital, i.e. the Riester pension.
- The Riester contribution rate b_i: the higher the contribution rate, the larger the Riester pension.
- The income y_A and the growth rate ω_j: the larger the income in the first year and the higher its growth rate, the larger the Riester pension.

4.2 Simulation results

In this section we present our simulation results. When answering the question whether the Riester pension can close the pension gap, we take into account the effect of the recent pension reforms on the pension gap and the sensitivity of the Riester pension with respect to some of its determinants such as interest rate, saving period, level of income, and contribution rate.[28]

Whether the Riester pension can close the pension gap depends crucially on the assumptions made regarding the level of the aforementioned determinants. Therefore, we calculate the Riester pension in a first scenario, using a plausible combination of assumptions. In a second

[28] The sensitivity of the Riester pension with respect to its other determinants (i.e. dynamization rate, growth rate of income, etc.) will not be analyzed in this paper. See Börsch-Supan and Gasche (2010) for the effect of those determinants on the Riester pension.

step, we conduct sensitivity analysis which shows the changes in the results if we change a single determinant. Our first scenario is calculated based on the following assumptions:

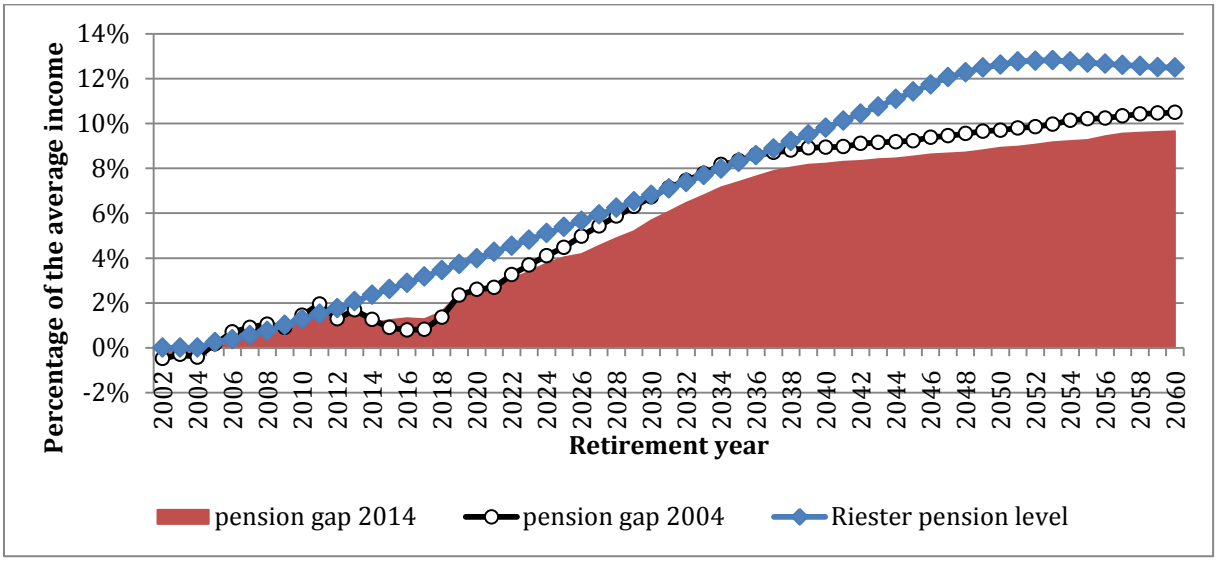
- We assume a standard pensioner, who earns the average income every year and pays contributions for 45 years, i.e. has obtained 45 earning points. Furthermore, we assume that this person starts his Riester contract at age 20 and retires at age 65. Hence, the individual is identical to the standard pensioner of the public pension system. This assumption is important as the pension gap can be compared with the Riester pension level only if we look at identical individuals.
- Each year the contribution rate that is necessary for the maximum government subsidy is being paid, starting off with 1% of the gross income in 2002 and progressing to 4% in 2008 making steps of 1% every two years. As of 2008 the Riester contribution rate remains constant at 4%.
- The remaining life expectancy at retirement is calculated under the assumptions of the MEA population forecast. According to this forecast, the remaining life expectancy of a 65 year old person is 19.2 years in 2012, 22.6 years in 2040 and 26 years in 2060.
- The dynamization rate of the pension is assumed to be 1.5% per year, which can be interpreted as inflation adjustment.
- The costs of the Riester contract amount to 10% of the savings rate each year.[29] We further assume that there are no costs during the payoff period (the retirement period).
- We used the observed nominal interest rates from 2002 to 2015, with an average of 4%, which are taken from a study by Assekurata (2013). Following Börsch-Supan and Gasche (2010), we assume that the Riester capital pays a nominal interest of 4.5% p.a. from 2013 until 2060, at an approximate inflation rate of 1.5% this corresponds to a real interest rate of about 3%. However, given the current period of low interest rates, we will also calculate the Riester pension level under assuming alternative interest rates in the future in Section 4.3.
- The hypothetical reference level of the public pension without reforms is 48.0%, i.e. the gross pension level of the reform year of 2001.
- Similar to the pension gap, the Riester pension level expresses the Riester pension of a standard pensioner as a percentage of the average wage income. Equation (9) shows the Riester pension level ($RPL_{Z,t}$) of a pensioner who retired in year Z and has been retired for t years is given by:

$$RPL_{Z,t} = RPL_{Z,t-1} \cdot \frac{1 + \delta_{Z+t-1}}{1 + \omega_{Z+t-1}} \quad (9)$$

Figure 10 shows the development of the Riester pension level under the assumptions given above together with the development of the pension gap calculated based on the assumptions of the scenario 2004 and 2014 (see Section 3.4).

[29] Note that Gasche et al. (2013) show that the costs vary considerably across different contracts. For example, they find that out of all Riester contracts they analyzed the costs of the most expensive one amount to approximately 24% of the savings rate.

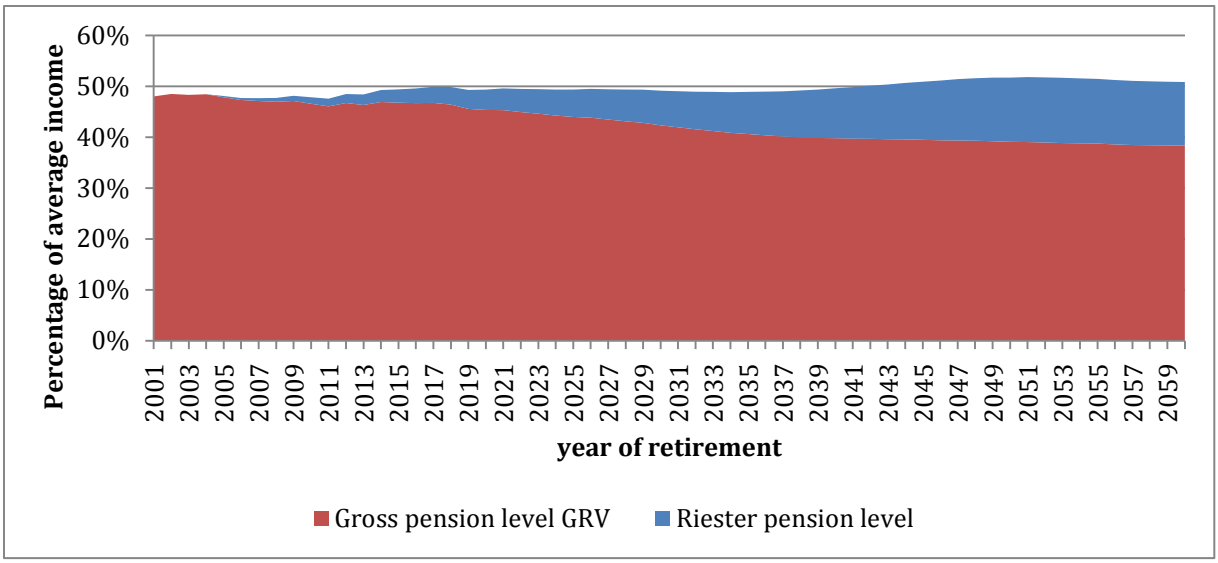
Figure 10 Pension gap and Riester pension level



Source: Authors' own calculations.

Under the simple target definition the pension gap is closed in the first year of retirement if the Riester pension level is larger than the pension gap. Our findings suggest that the Riester pension will close the pension gap which is left after the pension reforms until 2014 in all years except between 2004 and 2012. This is mainly because individuals retired shortly after the introduction of the Riester contracts were only able to save for a relatively short period of time. According to Figure 11, until 2050 the Riester pension level amounts to 12% such that the Riester pension as the third pillar of old age provision accounts for about a fourth of the future pensioners' retirement income. Therefore, one can note that the Riester pension is quite efficient in closing the gap in the first year of retirement by taking into account the positive effect of the 2007 pension reform on the pension gap. In fact, this finding does not entirely hold when we compare the Riester pension level with the pension gap in scenario 2004 (see Figure 10). In this case, the Riester pension could not close the pension gap entirely for the cohorts retiring between 2028 and 2038. Nonetheless, the Riester pension would still close more than 94% of the pension gap in those years.

Figure 11 Pension level out of the public pension and private (Riester) pension



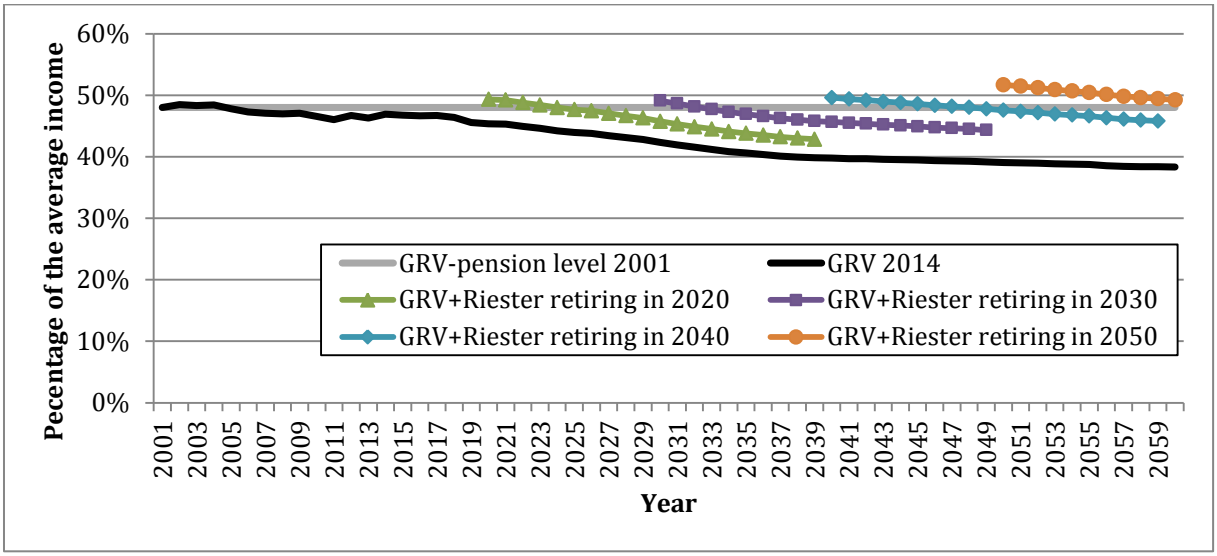
Source: Authors' own calculations.

It is worth noting that the Riester pension of people retiring after 2040 seems to increase the total pension level by more than 2 percentage points. However, in this context we should keep in mind that we do not assume an increase in cohort life expectancy after 2060. Therefore, we might underestimate the remaining lifetime of the cohorts and overestimate their Riester pensions.

If we formulate the question whether the Riester pension can close the pension gap under the strict target definition, i.e. over the entire retirement period, things look different. In this case, the total pension level consisting of public pension and Riester pension is supposed to reach at least the pension level of the year prior to the reforms (i.e. the gross pension level of 48%) in each single year of the retirement period. The grey line in Figure 12 presents the target pension level of 48%, whereas the black line shows the development of the standard gross pension level of the public pension system without the Riester pension level (this also corresponds to the pension level of everyone who retired before 2002). The remaining colored lines show the development of the total pension level over 20 years in retirement for four different cohorts of pensioners who differ by their initial year of retirement (2020, 2030, 2040, and 2050, respectively).

According to Figure 12, a person who participated in the Riester plan can reach a higher pension level during the entire retirement period, compared to a person who retired before 2002 without the availability of the Riester savings. The pension level is higher the later the first year of retirement. On the other hand, the total pension level decreases over time, which can be explained as follows: the development of the total pension level during the time of retirement depends on the growth rate of the public pension and of the Riester pension in comparison to the development of the average income. As shown in equation (7), the Riester pension level of a retired individual decreases over time if the dynamization rate of the Riester pension is smaller than the growth rate of the average gross income. The Riester pension level follows a decreasing trend after retirement since we assume an annual dynamization rate of 1.5% and an income growth rate of 3%. At the same time, the public pension benefits of a pensioner grow slower than the gross income due to the damping factors in the pension benefit adjustment formula (as discussed in Section 3.1). Consequently, as shown in Figure 12, the total pension level of the pensioner decreases over time in all cases. It also reveals that in all considered cases the total pension level drops below the reference level of 48% during the first 20 years of retirement. Hence, the Riester pension is not able to close the pension gap if one demands the strict target definition. However, this result crucially hinges on the assumed growth rate of wages. Here wages are assumed to grow by 3% p.a. If one assumes a smaller growth rate of wages, the Riester pension level would increase. In fact, Börsch-Supan and Gasche (2010) show that assuming 1.5% wage growth, the strict target definition is satisfied at least for individuals who retire after 2030.

Figure 12 Total pension level during the retirement period for different retirement years



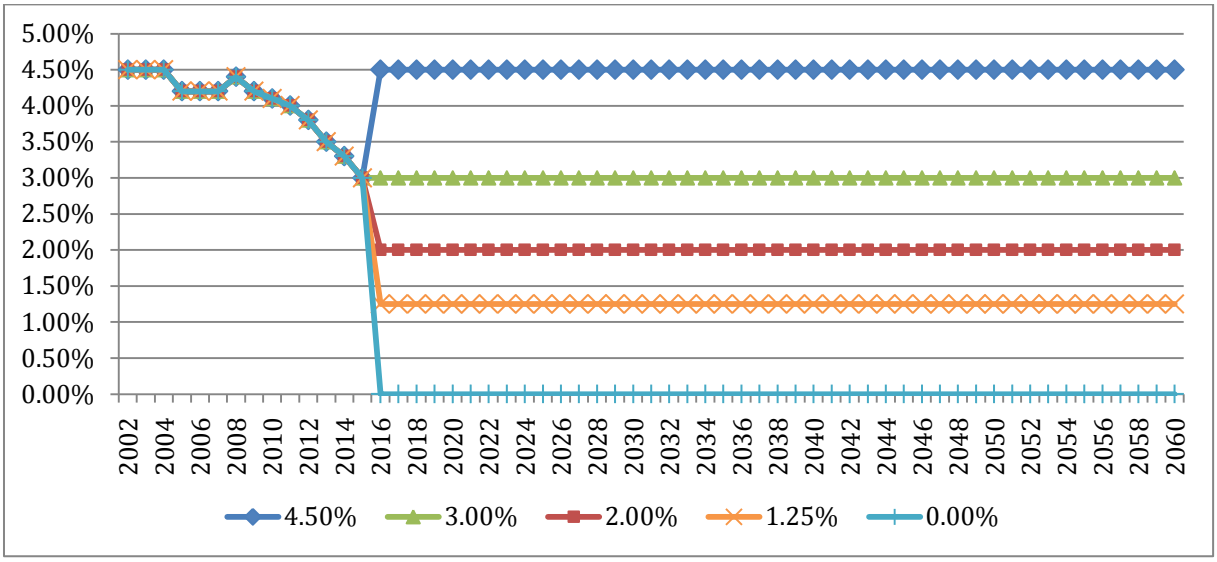
Source: Authors' own calculations.

4.3 Dependency on the interest rate

During the design phase of the Riester pension the standard assumption for actuarial computations has been an interest rate of 4% or even higher. In retrospect, Figure 4 shows that 20-year German government bonds had an average nominal return well above 5% between the mid-1980s and the beginning of the 2000s. However, considering the recent financial crisis, and especially the Euro crisis, these interest rate assumptions appear to be very optimistic. Therefore, we now turn our attention to analyzing the sensitivity of our results with respect to differing interest rate assumptions.

We calculated a multitude of alternative scenarios. We present five scenarios with fixed interest rates in Figure 13 and Figure 14. Two scenarios with variable interest rates are presented in Figure 15 and Figure 16. As before, in all scenarios we use the observed nominal interest rates from 2002 to 2015. From 2015 on, we assume constant nominal interest rates of 4.5%, 3%, 2%, 1.25% and 0% p.a. (see Figure 13). At an annual inflation of around 1.5% this corresponds to real interest rates of 3%, 1.5%, 0.5%, -0.25% and -1.5% p.a., respectively.

Figure 13 Alternative nominal interest rates of the Riester capital

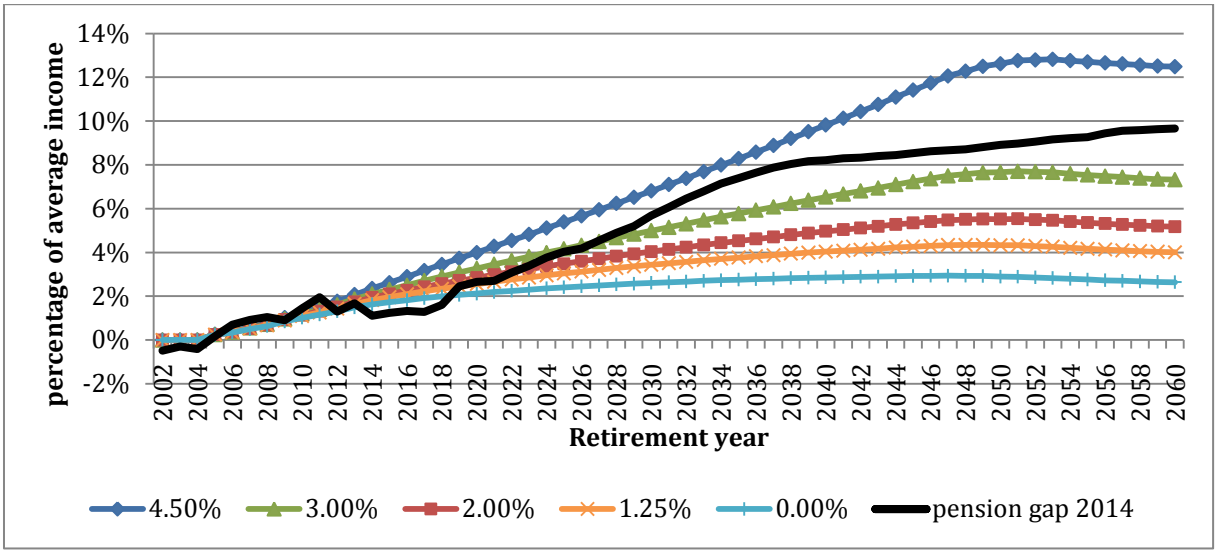


Source: Authors' own calculations.

Figure 14 shows the development of the pension gap considering all reforms until 2014 (black solid line) together with the development of the Riester pension level under five different interest rate scenarios. The lower the interest rate, the lower is the Riester pension and, consequently, the smaller is the Riester pension level. In the scenarios considered here, the pension gap according to the simple target definition can only be filled at an annual interest rate of 4.5%. If the interest rate is only 3%, pensioners retiring after 2023 can no longer fill their pension gap.

An additional calculation suggests that the pension gap can be filled more or less completely in the first year of retirement if the Riester savings yield an interest of at least 3.75%. For smaller interest rates the gap cannot be closed. In the case of an interest of 3% per annum (p.a.) only up to 82% of the total pension gap can be filled. In case the interest rate drops to 1.25% p.a., the resulting Riester pension can close the pension gap only up to 50%.

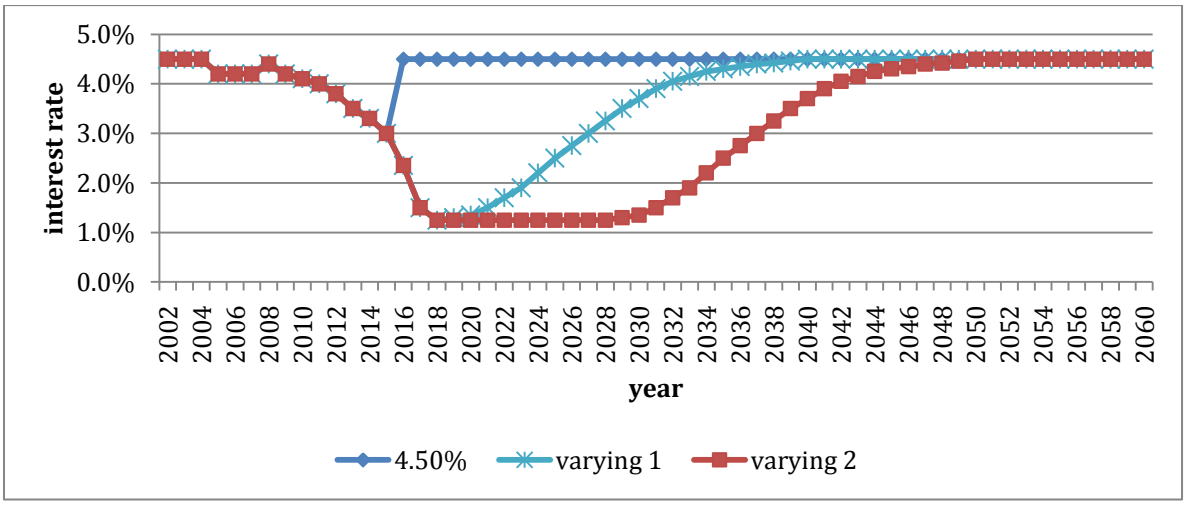
Figure 14 Pension gap and Riester pension level based on different interest rates



Source: Authors' own calculations.

As an alternative to the constant interest rate scenarios we also calculated the Riester pension using time varying interest rates (see Figure 15). We assume that the nominal interest rate first decreases to 1.25% until 2018. Afterwards, in the first scenario ("varying 1") the interest rate increases gradually to 4.5% until 2040. In the second scenario ("varying 2") the interest rate remains at 1.25% for ten years before increasing in the same way as in the first scenario. Hence, in the second case the interest rate reaches 4.5% in 2050.

Figure 15 Alternative nominal interest rates of the Riester capital – part 2

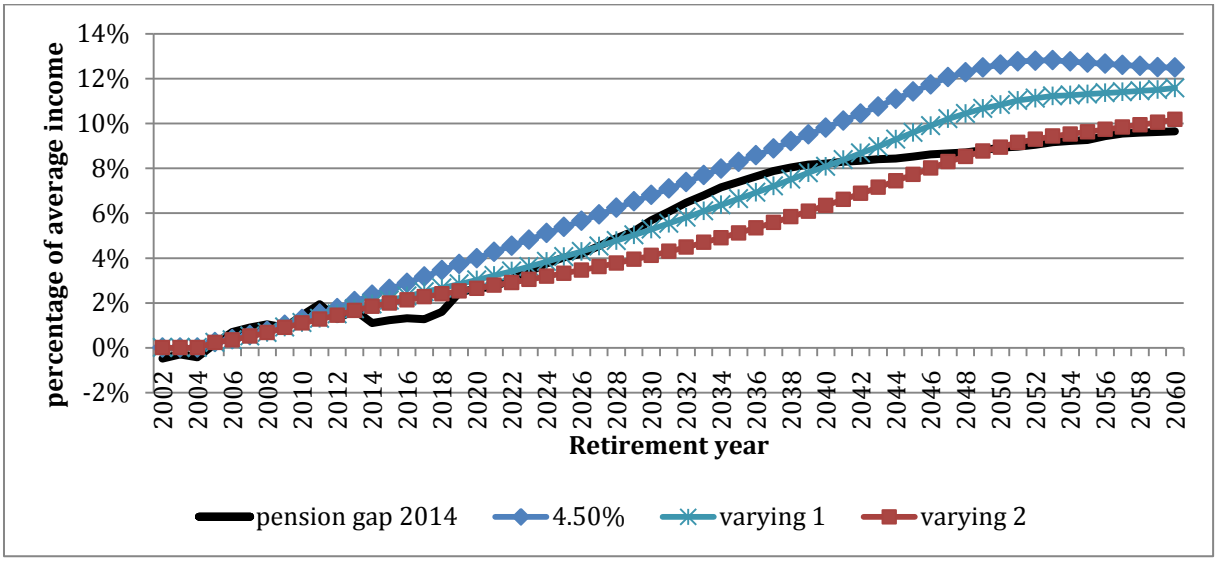


Source: Authors' own calculations.

If we assume only a temporary rather than permanent decrease of the interest rate things look a bit different. Figure 16 shows that the length of the low interest rate period strongly affects whether or not the pension gap can be closed. The longer the interest rates remain at a low level, the more unlikely it is that the Riester pension can close the pension gap. In fact, we see that the pension gap cannot be closed for all years when the interest rate takes 23 year to recover from a drop to 1.25% (line varying 1). However, at least the individuals retiring before 2027 and after 2040 can close the pension gap according to the simple target definition. In the remaining years up to 93% of the pension gap can be closed.

An even longer low-interest period results in even smaller Riester pensions. Consequently, the period by which the pension gap can be closed decreases in the case that the interest rate remains at 1.25% for 10 years (line varying 2). In fact, in this scenario the pension gap cannot be closed between 2020 and 2050 and, in the worst case, only 68% of the pension gap can be closed by the Riester pension. Nonetheless, it is noteworthy that the high interest rates in the future could at least compensate the small interest rates assumed in the near future as long as the simple target definition is satisfied by the cohorts retiring after 2050.

Figure 16 Pension gap and Riester pension level based on different interest rates – part 2

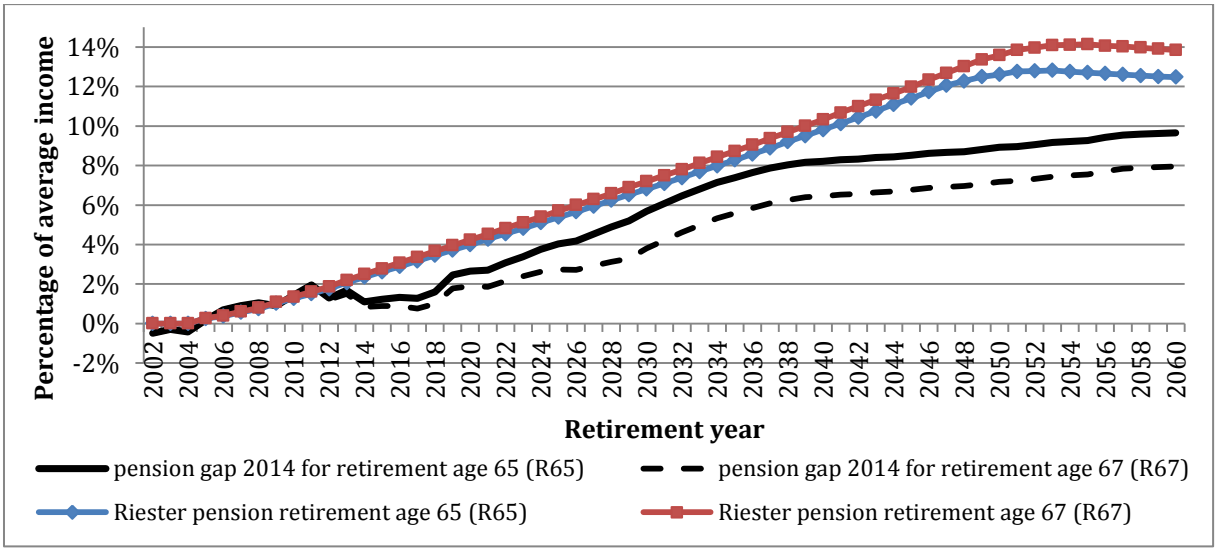


Source: Authors' own calculations.

4.4 Dependency on the retirement age

As discussed in Section 3.2, the 2007 reform might change individuals' retirement behavior in the sense that they might postpone their retirement by two years hence drawing their pension benefits two years later. If this is the case, their savings period would be longer; consequently, the amount of the accumulated savings would become larger. Concurrently, postponing retirement by two years would cause the length of time spent in retirement to decrease and, therefore, individuals would receive a higher level of the Riester pension in each year of retirement. To measure the effect of increasing the retirement age on the Riester pension level we calculate an alternative scenario by assuming that our standard pensioner delays his retirement as a response to the reform and retires at age 67. Figure 17 shows the development of the Riester pension level for retirement at 65 and 67, respectively. The Riester pension level increases for nearly all cohorts if individuals postpone their retirement by two years.

Figure 17 Pension gap and Riester pension level based on different retirement ages

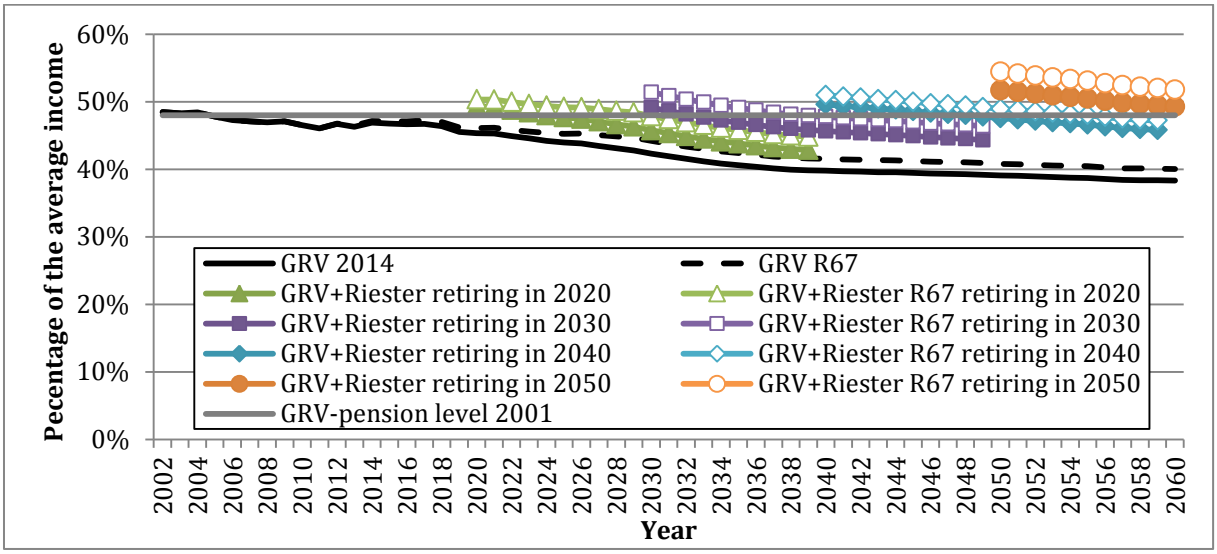


Source: Authors' own calculations.

To check if the Riester pension can close the pension gap in this case, we should take into account the fact that a standard pensioner who retires two years later will obtain two additional earning points and, as a result, closes a certain amount of his pension gap within the public pension system (see Section 3). Therefore, in Figure 17 we also present the reduced pension gap of a standard pensioner who postpones his retirement by two years (shown by a dashed black line).[30] According to this comparison, on average, the Riester pension exceeds the necessary level to close the gap by more than 99% in the first year of retirement.

Figure 18 shows the simulation results based on the strict target definition. According to these predictions, the strict target definition cannot be satisfied even if individuals postpone their retirement by two years. Especially older cohorts who will retire in the next years (i.e. in 2020 and 2030) would not be able to build up enough savings to compensate the reduction in their public pension benefits. Nonetheless, it seems that for younger cohorts who will retire in 20 years from now it may be possible to provide Riester pensions which close the pension gap in each year of their retirement.

Figure 18 Pension level during the retirement period for different initial retirement years, retirement age 65 vs retirement age 67

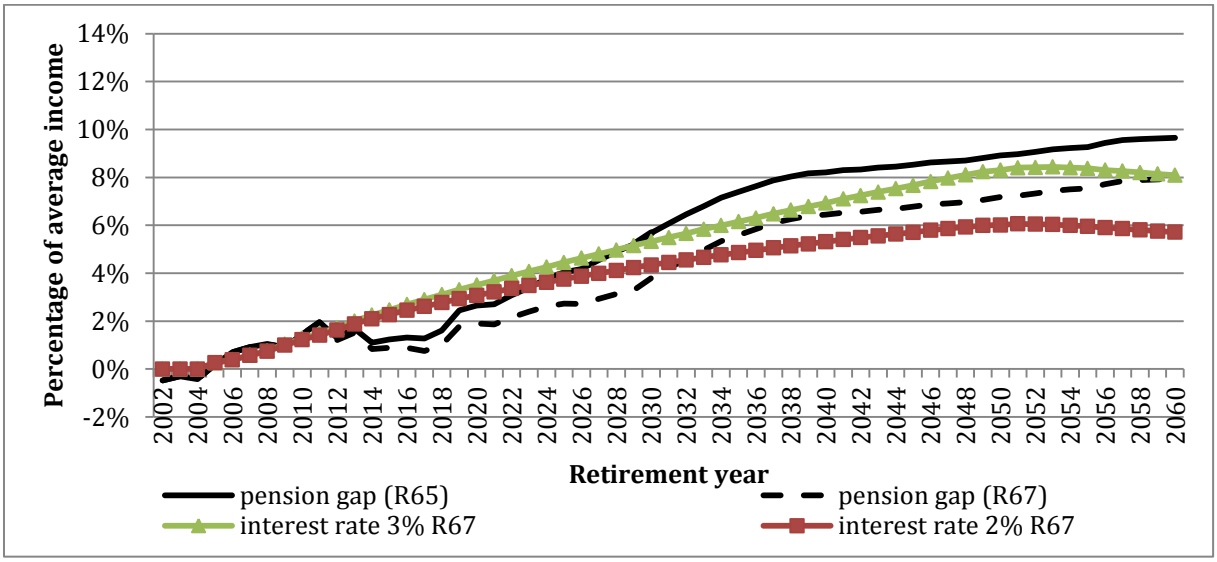


Source: Authors' own calculations.

As an additional analysis, we check if the Riester savings can close the pension gap if the standard pensioner delays his retirement by two years even if the interest rate is lower than 4.5%. Hence, we look at a combination of the first two sensitivity analyses. In Figure 19 we show the Riester pension level with retirement at age 67 and for 3% and 2% interest rates, respectively. Compared to the predictions in Figure 14, we see that the Riester pension can now close the pension gap if the interest rate is 3% p.a. However, for this to be achieved, an individual must delay the claim on his retirement benefits and contribute to the pension system for two more years. At a nominal interest rate of 2% the pension gap at retirement age 67 can only be closed by pensioners retiring before 2030. Younger cohorts will not be able to close their pension gap at such low interest rates even if they work and save for two more years.

[30] This part of the figure is identical to the Figure 8 in Section 3.4.

Figure 19 Pension gap at retirement ages 65 and 67 and Riester pension level at age 67 with 3% and 2% interest rate



Source: Authors' own calculations.

Until now, the sensitivity analyses have mainly considered the determinants influenced by the recent pension reforms or the development of the financial markets. In the next section, we will look at how individuals' savings decisions or socio-economic status affect the extent to which the Riester pension can close the pension gap. The findings of the next section will be useful especially when we interpret the findings in the last part of this study, where we provide a micro-econometric analysis of the actual savings behavior of German households.

4.5 Dependency on the income profile

The Riester pension not only depends on the individuals' income today but also on the development of their income over time. This is because the annual saving amount of an individual is determined by the income related "Riester contribution rate". Up until now we assumed that the standard pensioner earns the average gross income in each year. In other words, the income profile given by the earnings points[31] is constant over time. In reality, however, individuals' income increases with age. This means that, relative to the average income, a person's income is lower when he is young and higher when he is old. This in turn has consequences for the accumulation of pension rights and capital over the life time of an individual.

Therefore, we now calculate the Riester pension levels based on different income profiles. In order to guarantee that we observe only the effect of the different income profiles on the Riester pension level, the number of the accumulated earnings points must be identical in all scenarios. Hence, we consider only the income profiles which lead to 45 earnings points at the retirement age of 65.

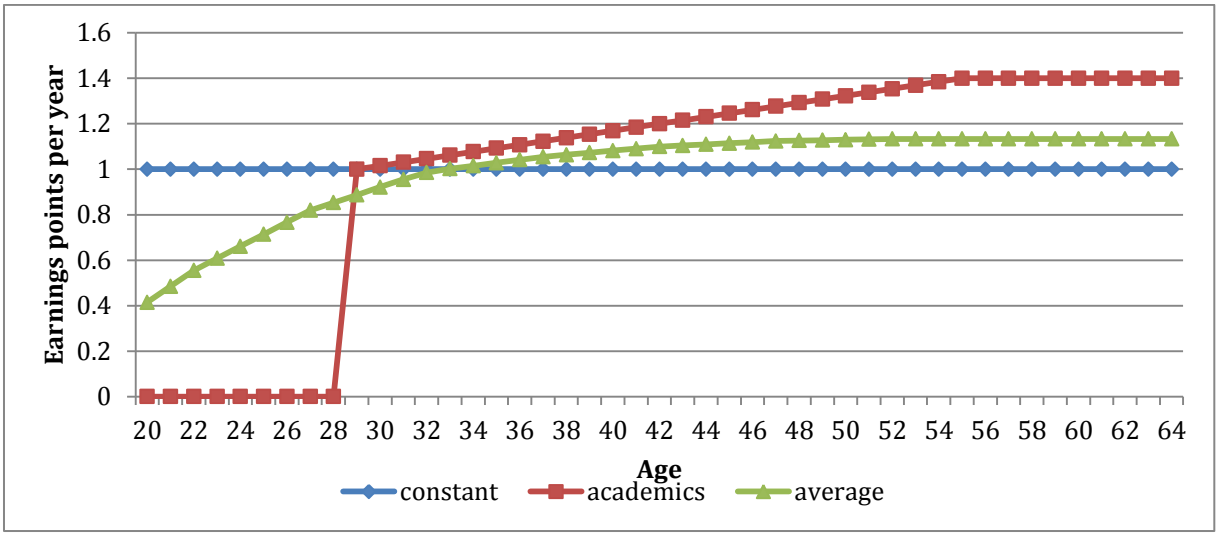
[31] The earnings points represent a value of the public pension system which describes the earnings history of an individual. Each year an individual's gross income is compared in relation to the average income (of all insured individuals). If the individual's income coincides with the average income, he receives one earnings point. If the income is less than the average, he receives less earnings points, and vice versa. The development of the earnings points, therefore, represents the income profile of an individual.

Generally, the introduction of income profiles which increase with age can lead to larger or smaller Riester pensions compared to the constant scenario. This is because the increasing income profile has both a negative and a positive effect on the saving amount. A negative effect occurs due to the fact that in this scenario the savings at younger ages, on which the compound interest has the greatest effect, are lower than in the constant scenario. A positive effect comes from the higher income or savings at older ages.

The question becomes whether the higher income at older ages can compensate for the losses due to the lower income at younger ages. This depends on the growth rate of the Riester capital (which is the interest rate) or the growth rate of the individual's income (which depends on the growth rate of the wages and the change in the individuals' income profiles with age).

As shown in Figure 20 we will analyze two alternative income profiles. The first one is the average income profile of those employees, who are insured in the public pension system, and the second one is a stylized profile which resembles the income profile of academics. More specifically, for the average income profile we simply use the age-specific average income of the insured employees in 2012. For the academics' income profile we follow the assumptions of Börsch-Supan and Gasche (2010) and construct the income profile as follows: an academic person earns no income until age 28 since he spends a long time in education. Afterwards, the income exceeds the average income of the other employees and increases strongly until age 55.

Figure 20 Alternative income profiles



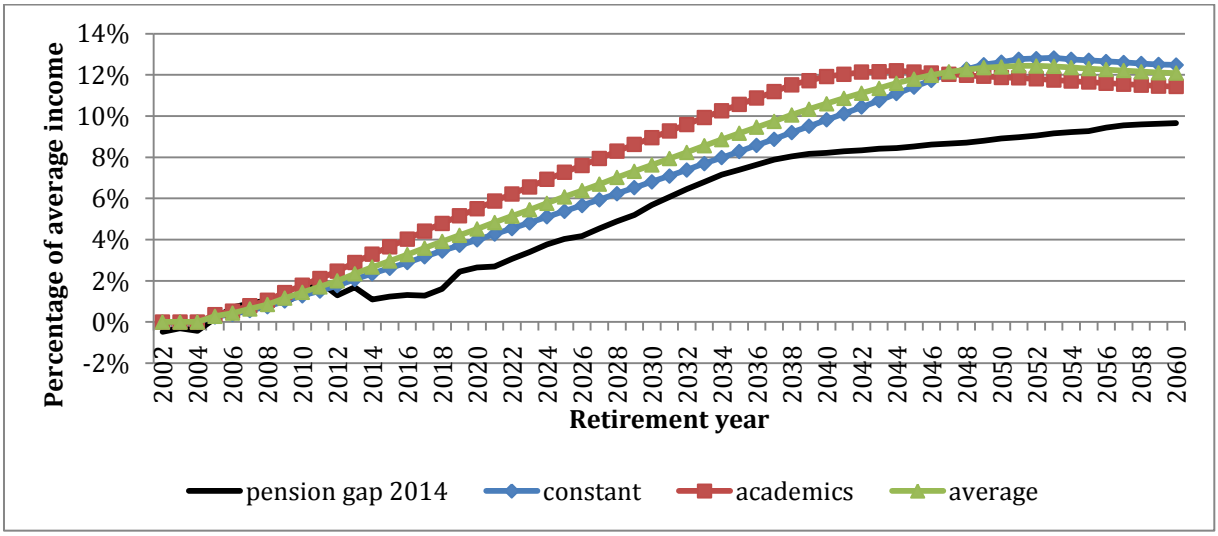
Source: Authors' own calculations.

The corresponding predictions regarding the Riester pension level are presented in Figure 21. Note that a comparison of the Riester pension levels with respect to different income profiles is possible (or meaningful) only for complete labor market histories. Under our assumptions this is the case only for individuals retiring after 2046. The cohorts retiring before 2047 start their Riester contract at ages older than 20, and therefore, the lower income or lack of income at younger ages does not have any effect on their Riester pension. Hence, the Riester pension of these cohorts increases continuously since only the positive effect of the higher income at older ages is present.

Consequently, we observe a higher Riester pension level until 2046 under both the income profile of academics and the average income profile of employees. However, after 2046 the Riester pension level calculated based on the alternative income profiles are smaller compared to the Riester pension level of the scenario with constant average income. Obviously, the higher income at older ages cannot compensate for the losses due to the lower income at younger ages. This is especially the case for the income profile of academics. Nonetheless, the simple target

definition is satisfied in all cases at an interest rate of 4.5% p.a. The picture would greatly change if we assumed lower interest rates.

Figure 21 Pension gap and Riester pension level based on different income profiles



Source: Authors' own calculation.

4.6 Dependency on starting age of saving and career interruptions

So far we assumed that each individual enters into a Riester contract at age 20 after the introduction of the Riester pension. Furthermore, we assumed that individuals retire at age 65, which implies a maximum savings period of 45 years. Now, we want to analyze the effect of a shorter savings period on the Riester pension level. We will distinguish between two cases: first, a reduction due to a later starting age of the Riester contract and second, a reduction due to an interruption of the Riester contract.[32]

We will now consider three alternative scenarios which all include a reduction of the savings period by 10 years. In the first scenario we assume that a person does not start a Riester contract before reaching the age of 30 (scenario starting age 30). In the second and third scenarios we assume that a person interrupts saving in the Riester contract. We let the person interrupt the savings period between ages 30 and 40 (scenario interruption 30-40) and alternatively between ages 35 and 45 (scenario interruption 35-45).

The simulation results are presented in Figure 22. Until 2038 the Riester pension level is identical for both the scenario with starting age 20 and 30, respectively. This is because people who retire before 2038 were older than 29 in 2002. Hence, the savings periods of those pensioners are identical in both scenarios. The figure also shows that when starting the Riester savings at age 30 the Riester pension level does not increase anymore after 2040 whereas it does increase by another 4 percentage points if the individual starts to save at age 20. Nonetheless, it seems that persons who do not start saving before the age of 30 can achieve a Riester pension which is sufficient to close the pension gap. Only for younger cohorts retiring

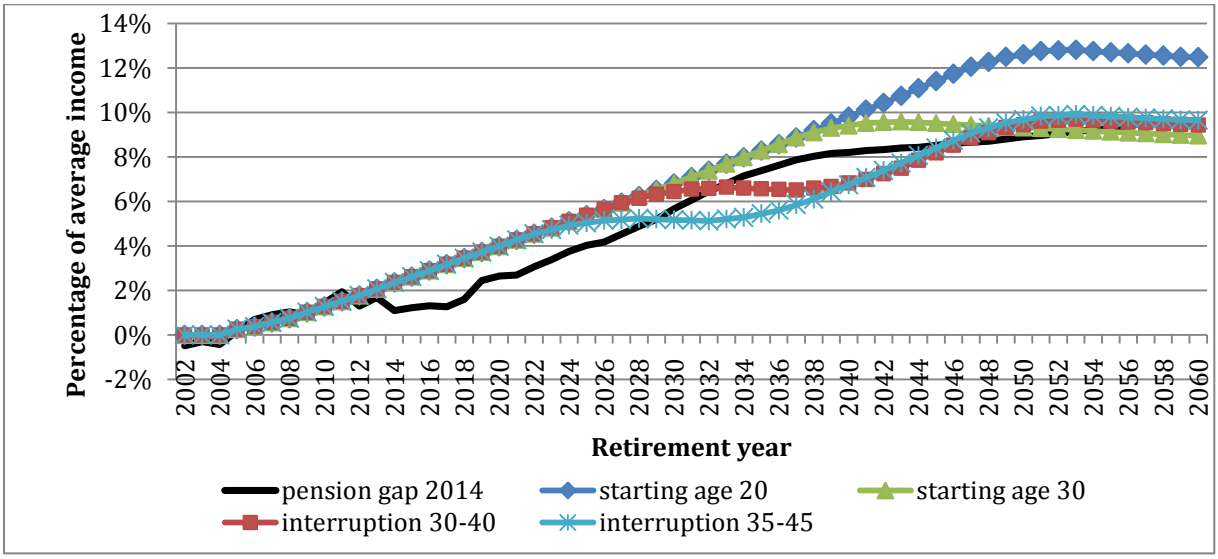
[32] In fact, there is also the possibility to extend the savings period by postponing retirement age (as discussed in section 3.4).

after 2060 the pension gap is not closed completely although the coverage rate is still higher than 95%.[33]

However, if we assume that a person interrupts the savings period the situation changes. First, we see that individuals retiring around 2030 and 2040 cannot close the pension gap. This is the case because now those who were younger than 40 (45) at the time of the introduction of the Riester pension, reduce the length of their active savings period due to career interruptions.

The most prominent effect can be observed after 2050. Even though the length of the active savings period is the same in all three scenarios[34], the Riester pension differs in the long run. The later the interruption, the higher the final Riester pension becomes. This is due to the same reason as for the differences between various income profiles. If the compound interest rate exceeds the wage's growth rate, an interruption at younger ages has a more negative effect on the Riester pension than an interruption at older ages. However, again this observation depends strongly on the assumed interest rates and the growth rate of wages and salaries. Different assumptions could lead to different results.

Figure 22 Pension gap and Riester pension level based on different saving periods



Source: Authors' own calculations.

4.7 Dependency on the Riester contribution rate

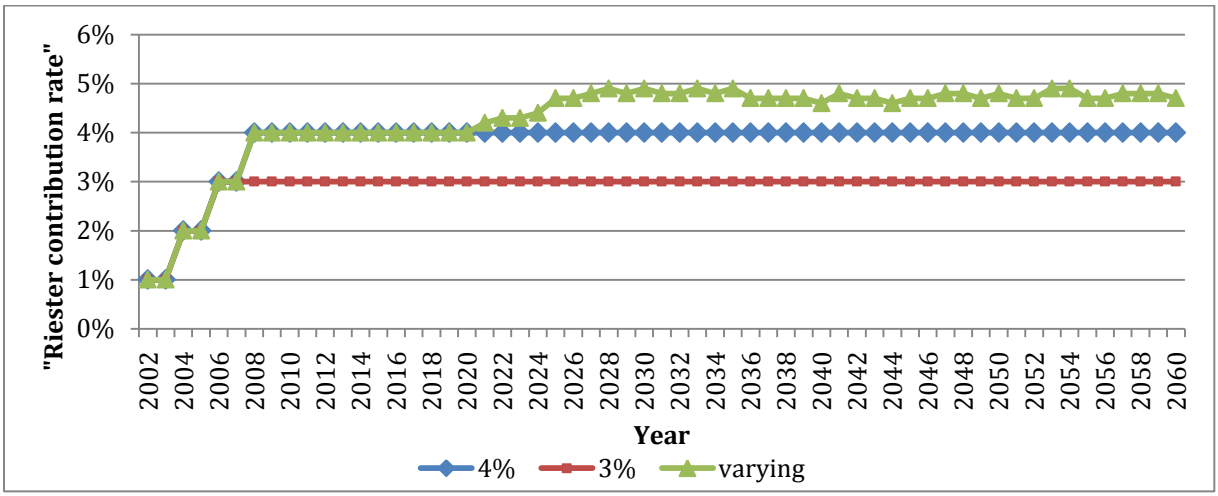
So far the Riester pension level has been calculated under the assumption that the 4% Riester contribution rate, which is required to obtain the maximum government subsidy, has always been paid. In reality, not all people with Riester contracts pay this amount. Moreover, people can also save more or less than 4% of their gross income in each year. Therefore, in this section we calculate two alternative scenarios to analyze the effect of different contribution rates on the Riester pension level.

[33] Obviously, the pension gap would not be closed if the maximum savings period would be further reduced (see also Börsch-Supan and Gasche, 2010).

[34] Actually, the case a person begins a Riester contract at the age of 30 can also be considered as an interruption of the Riester contract between the age of 20 and 30.

In the first scenario an individual saves 3% of his gross income in each year. In the second scenario it is assumed that the individual pays the normal rate of 4% plus the amount of reduction in the contribution rate of the public pension system due to the positive effect of the recent pension reforms. For example, until 2030 the contribution rate of the public pension system increases to 23.1% in scenario 2004, but only to 22.2% in scenario 2014. In this case, the amount of reduction due to the recent pension reforms is 0.9%. Hence, we assume that the individual saves 4.9% (instead of 4%) of his gross income in 2030, as shown in Figure 23.

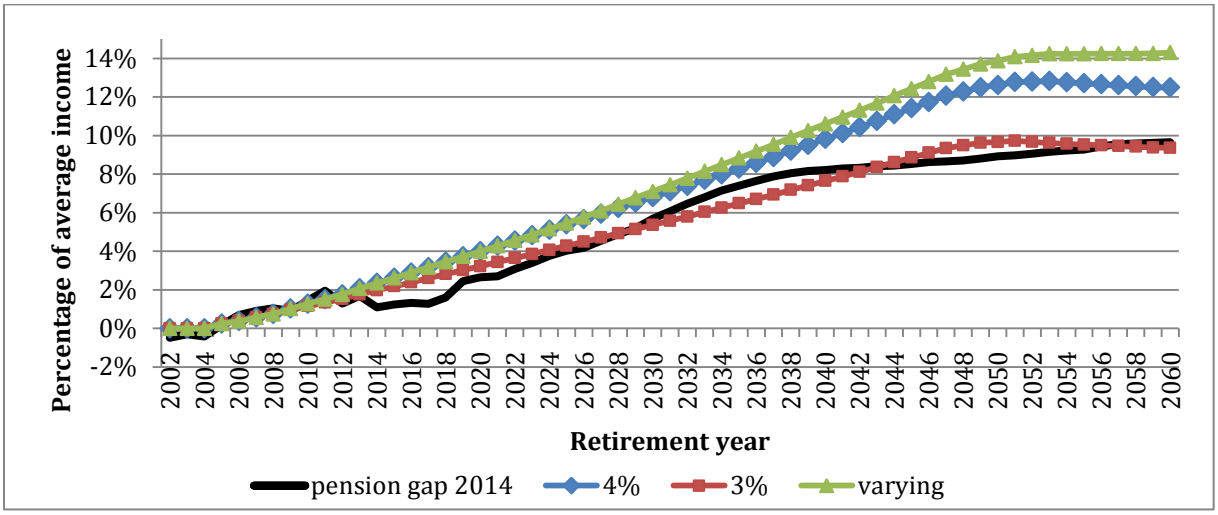
Figure 23 Alternative "Riester contribution rates"



Source: Authors' own calculations.

We present the corresponding Riester pension level calculations in Figure 24. According to these findings, the Riester contribution rate of 4% closes the pension gap under the simple target definition. Especially the older cohorts have to save this amount to close their pension gap. A contribution rate of only 3% would not suffice to close the pension gap of people retiring between 2028 and 2044. The contribution rate of 4% plus the amount of reduction in contribution rate of the public pension due to the recent pension reforms have only a small effect on the Riester pension level compared to the baseline scenario (at least in the short and middle run). However, if one assumes a much higher Riester contribution rate (e.g. 6%), the Riester pension would close the pension gap even under the strict target definition (see Börsch-Supan and Gasche, 2010).

Figure 24 Pension gap and Riester pension level based on different contribution rates



Source: Authors' own calculations.

Thus, overall, our calculations show that there is a substantial pension gap arising over the next decades. The gap is lightly lower following the 2007 pension reform that legislated an increase in the statutory retirement age from 65 to 67 even if individuals continue to retire at 65. Our simulations of the Riester pension level show, that the pension gap can be closed as long as interest rates are above 3.75% p.a. If interest rates are lower for an extended period of time part of the pension gap remains uncovered. If in turn individuals extend their working lives by 2 years and retire at 67 only, the pension gap would be covered even if interest rates are around 3% p.a. Starting the savings contract later, career interruptions and low contribution rates all influence the possibility to close the gap. After these stylized calculations we will now turn to a microeconometric analysis of the German households' saving behavior. We would like to know if households on average can close their individual pension gaps given their savings behavior today.

5. The saving behavior of German households

5.1 Introduction

In this section we provide a micro-econometric analysis of actual savings behavior of German households. Consequently, this section provides a follow-up to the previous sections where we calculated the pension gap based on hypothetical savings and income profiles for the standard pensioner. Our central question is, "Do German households save enough to fill the arising pension gap if they keep their current saving behavior?"

In theory, rational and forward looking individuals should react to reductions in public pension benefits by increasing their private savings in order to smooth their consumption over the life cycle (see Modigliani and Brumberg, 1954; Friedman, 1957). The reality, however, might look different. Thus, in this section we will work mainly with a representative sample of German households in the SAVE survey (Sparen und Altersvorsorge in Deutschland). We will also provide robustness checks based on the SHARE-RV survey, the German subsample of the Survey of Health Aging and Retirement (SHARE) which is linked to administrative records of the German public pension system. We will calculate pension gaps for those persons based on their labor market and earnings histories, and expected age of retirement. Moreover, we will look at the actual distribution of their wealth levels and savings behavior. These analyses will reveal, on the one hand, whether the savings of German households are on average sufficient to fill the arising pension gap. On the other hand, as we are able to identify the most vulnerable groups such as households with low income, or low education, we can check if they will be able to close their individual pension gaps. We will also investigate how the ability to fill the pension gap hinges on current and future interest rates and how it might be influenced by expectations about the length of one's life.

There are many reasons why households might have difficulties in closing the pension gap. One of the reasons could be related to financial literacy. The evidence from the SAVE survey shows that a large fraction of the German population is not well-informed about the financial incentives provided by the Riester scheme and that especially low income households are not aware of their eligibility for subsidies under the Riester scheme (see Coppola and Gasche, 2011). The lack of financial literacy might explain, for example, why individuals may fail to plan and save for retirement (see Bucher-Koenen and Lusardi, 2011; Börsch-Supan et al., 2015a).

Secondly, incorrect expectations about the future pension might be another reason for under-saving for retirement. If people are not well informed about the institutional context for receiving public pensions, they may form incorrect expectations on which they base their savings decisions. In fact, Honekamp and Schwarze (2010) show that people have problems with predicting their future replacement rates. Using the SAVE survey they find that women, people with low educational background and low wages are less likely to predict their future income-replacement rates. Those people may fail to increase their private savings as a response to reductions in their public pensions. Further evidence is provided by Lamla and Gasche (2014). They find that 38% of the households expect to rely on "Grundsicherung im Alter", i.e. means-tested social assistance, when they retire. For them it could seem rational not to save for retirement, because all wealth will be considered when applying the means test. At the same time the authors show that more than half of the households have already accumulated enough public pension rights to place them above the threshold of the means test. Thus, these households misjudge their future eligibility for social assistance and might consequently be mistaken in their assessment of their savings needs.

Thirdly, individuals' incorrect beliefs about their life expectancy might play a role in their savings decisions. Individuals have to form expectations about their future health and life

expectancy taking future developments in longevity into account. Bucher-Koenen and Kluth (2012) find that German men and women underestimate their life expectancy by 6.5 and 7 years, respectively, compared to official cohort life tables. This might have severe consequences for private savings, since individuals might not save adequately for the extra years they might live. As a result, it might be harder for those individuals to close the pension gap.

Finally, the financial planning horizon might have a crucial role when making savings decisions. One of the innovations brought in the profession by Behavioral Economics is the concept of bounded self-control (see Thaler, 1981) and hyperbolic discounting (see Thaler and Shefrin, 1981; Laibson, 1997; Laibson et al. 1998). According to this view, short-sighted individuals tend to overvalue the present and place a lower value on future benefits, therefore failing to save adequately to sustain a desirable consumption level in the future. The US evidence from the Health and Retirement Study shows that individuals with a longer planning horizon accumulated larger amounts of retirement savings (see Lusardi, 1999). Another US study by DeVaney and Chiremba (2005) finds that households with a financial planning horizon of 5 years or more are more likely to hold an individual retirement account. Having a longer financial horizon is also positively associated with being a male, married, and having high education (see Rodriguez de Rubio, 2015).

We will proceed in the following way: We will take a sample of non-retired German households. Based on their labor market histories we will calculate their individual pension gaps making use of the pension values calculated in the previous section and individuals' expectations about their retirement age. Based on their current wealth levels and saving behavior we will project their future wealth levels. Considering individual life expectancies we can convert the wealth into annuities and then compare the annuities to the pension gap to check to which extent individuals can cover the pension gap.

In addition to these considerations we will also provide the following robustness checks. In the previous section 4.3 we conducted some sensitivity analyses to show how results for the standard pensioner depend on different assumptions regarding the development of the interest rates. As assumptions on future investment returns may be an important factor driving our results when studying the actual behavior of German households, we will again experiment with different interest rates in order to see if and how our conclusions change depending on the assumed returns. Moreover, we will check the impact of different life expectancies and retirement age expectations. Since previous research has shown that individuals are rather pessimistic about the duration of their lives, it might be important to analyze the sensitivity of their ability to close the pension gap depending on life expectancy.

In the next section we will describe our main data set, before we present some details of the calculations in sections 5.3 and 5.4. In section 5.5 we will present our main results about the coverage of the pension gap. Robustness checks will follow in sections 5.6 to 5.9.

5.2 Data and sample selection

Our main analyses are based on the 2010 wave of the German SAVE panel collected by the Munich Center for the Economics of Aging.[35] The SAVE study is a representative longitudinal study of German households' financial behaviors with a specific focus on old age provisions. SAVE provides data at the level of the individual respondent and the respondent's spouse (referred to in the following as household). In 2010 the total sample size was about 2,000 households whose members are aged 16 and over. To calculate the pension gap for each

[35] For the details on the data set see Börsch-Supan et al. (2008b).

household we restrict our sample to households whose main earner is at least 40 years old, not yet retired and subject to social security contributions. This choice is necessary since we have to predict the pathway of income, savings and wealth, which is more difficult the longer the time period until retirement. Younger households are typically exposed to higher uncertainty than older households, for instance regarding choice of profession, their income profile and their saving behavior. Therefore, we will not consider households with a respondent that is younger than 40. Our main sample includes 608 households (N). For our analysis we use information regarding income and labor market history, total wealth (financial wealth, housing wealth, consumer debt and mortgages), the saving rate, individual life expectancy, and expectations about the year of retirement, as well as background characteristics, such as education, age, and gender. More details about these variables are provided below (see Table 1).[36] All statistics are weighted based on the income and age distribution of the German Microcensus. On average, the respondents in our sample are roughly 50 years old, 36% are female and the majority (72%) has a medium education level.

Table 1 Descriptive statistics

Variables	Mean	Median	Standard error
Age	49.9	50.0	0.2
Expected Retirement Age	64.5	65.0	0.1
Statutory Retirement Age	66.3	66.3	0.0
Total Household Income (in Euros)	31493	29994	796
Gross Financial Wealth (in Euros)	41779	20829	2733
Consumer and Family Credit (in Euros)	6816	0	710
Housing Wealth (in Euros)	168708	100000	15676
Mortgages and Other Housing Debt (in Euros)	33836	0	2578
Net Financial Wealth (in Euros)	34963	14426	2730
Net Housing Wealth (in Euros)	134872	50000	15108
Savings Rate	0.07	0.04	0.01
Individual Life Expectancy	78.7	79	0.3
Cohort Life Expectancy	83.0	81.5	0.1
Female	0.4	0.0	0.0
Low Education	0.1	0.0	0.0
Medium Education	0.7	1.0	0.0
High Education	0.2	0.0	0.0
N	608		

Source: Authors' own calculations based on SAVE 2010. Notes: Variables which are not measured at the household level are reported for the main earner of the household. We are using five imputed data sets.

[36] Missing data regarding income and assets are completed using a multiple imputation technique. Using regression methods the available correlations of the data structure are determined. Then the missing data is replaced in auxiliary regressions. A detailed description can be found in Schunk (2008). Standard errors are calculated based on the average of five imputed data sets in the SAVE survey.

5.3 Calculating pension claims and the individual pension gap

In this section we calculate the pension gap for the main earner of the household in the SAVE sample. The calculation is done in three steps: first, the individuals' earnings points at their expected retirement age are determined; secondly, the earning points are adjusted according to the expected retirement age (the adjustment factor for an early or a late retirement age), and lastly, the adjusted earning points are multiplied with the current pension values as calculated in the previous section. Pensions are calculated in two different ways: once according to the law in force before the Riester-reform in 2001, and once according to current regulatory framework (scenario 2014 in the previous section). The difference between the calculations according to old and new law will yield the individual pension gap at retirement.[37]

5.3.1 Calculation of future pension claims

The SAVE survey does not include much retrospective information on the labor market and earnings history of an individual. Therefore, we are making some assumptions in order to calculate the public pension claims which an individual has earned in the past.

Insurance years: The number of insurance years is defined as the difference between the expected age at retirement and the age when entering the labor market. The age of entering the labor market is assumed according to the education degrees: age 16 for Haupt- or Realschule, age 20 for Abitur, and age 25 for people with a university degree. Additionally, the number of insurance years is reduced by one year if the data on the working history indicate that the head of the household has been unemployed for more than six months.[38]

Annual labor income/earnings points: In the SAVE survey the average monthly income of households in the year prior to the survey is asked. In order to calculate the accrued pension entitlements of a household at the end of the working period, one requires knowledge about the entire working career – from entering the labor market until retirement. Thus, we assume that the income in the year prior to the survey is representative for the household's relative income position and that the pathway of lifetime income corresponds to the pathway of lifetime income of the average employee with the same qualifications and gender. The calculation also assumes that the relative income position of the household towards peers does not change during the course of employment. The individual income position is the relation between the household's income in the year prior to the survey and the average income of the regular same-age employees with the same level of qualifications.

The general pathway of lifetime income is calculated based on the "Versichertenkontenstichprobe" (VSKT) of 2011.[39] In order to determine the future expected pathway of the income, the corresponding income profile is chosen for each household according to the following criteria: no completed apprenticeship, completed apprenticeship, university degree, men and women in East and West Germany. It is then multiplied with the

[37] Moreover, we assume that the ex-post taxation has no influence on the pension gap, i.e. that the taxes saved during the contribution phase equal the taxes paid during the pension phase. This leads to a minor overestimation of the percentage pension gap for those households who used tax savings rigorously for their old-age provision and an underestimation of the percentage pension gap in those cases in which households have used tax savings for consumption.

[38] This is a simplification of the law since employment agencies pay the contributions for unemployed individuals receiving unemployment benefits.

[39] The VSKT is a data source provided by the German Pension Fund (FDZ-RV) which contains, among other things, the detailed earning and insurance histories of the individuals in the German sub-sample of SHARE. See Appendix I for further details.

personal income position. The level of pension entitlements of a household arises from the sum of all earning points that the head and second earner of the household was able to collect during their working lives.

Expected retirement age: Table 2 shows the expected age at the time of retirement which was provided by the main earner of the households in the SAVE survey. According to this data men (women) expect to retire at 64.7 (64.2) years on average. The median age of retirement is 65 for both, men and women. However, since we are considering the expected retirement of individuals not yet retired, some upward adjustment can be expected given the increase in the statutory retirement in the coming years (see description of the reform in 2007 in Section 3.2). Coppola and Wilke (2014) show that individuals indeed adjusted their retirement expectations according to the new legislation. As an alternative to the expected retirement age one could also use the statutory retirement age that individuals are eligible for based on cohort and gender. We will make the calculations based on this alternative retirement age as a sensitivity check in Section 5.8.

Table 2 Expected retirement age

	Men	**Women**
Mean	64.7	64.2
Median	65	65
Standard error	0.14	0.19
N	385	223

Source: Authors' own calculation based on SAVE 2010, all data are weighted.

In case of retirement before or after the statutory retirement age a reduction or a supplement accrues which reduces or increases the sum of earning points by the individual age factor (the adjustment factor). Apart from a special regulation in case of a reduction of earning capacity, the earliest possible retirement age is currently 63 years (for cohorts born before 1952, there is an additional possibility to retire at age 60).[40] As the SAVE survey does not contain information regarding an individual's actual insurance history, we do not take into account the adjustment free retirement possibility due to "the pension with 63" in our calculations.

5.3.2 The level of the pension gap

Table 3 shows the average pension claims according to the old and the new law as well as the resulting pension gap for the households in the SAVE sample. The results are expressed in Euros of 2011's relative purchasing power[41] and in percent of the estimated final individual income according to the projection explained prior. In correspondence to our calculations in the previous section, we are reporting the pension gap according to the simple target definition, i.e. at the beginning of the retirement period.

The results show that the pension reforms have lowered the pension level of the average regular employee in our sample by 4.2 percentage points in the first year of retirement. Adjusted by purchasing power parity this implies a decrease by about 144 Euros per month. This average

[40] More specifically, we allow individuals to stop working before age 63 (or before age 60) but not to claim pensions before this age.

[41] Euro amounts are corrected for inflation and wage growth according to the corresponding indexation rule of the governmental pension scheme.

spreads over all age groups. Although not reported in Table 3, we find that younger cohorts (age group 40-49 years) face a significantly higher pension gap of 200 Euros per month, since they retire later when the reforms have a stronger impact. Households in the age group of 50-59 years face an initial pension gap of 101 Euros per month, and households close to retirement (60 years and older) have a pension gap of 36 Euros only.

Table 3 Monthly pensions before and after the pension reforms and pension gap in Euros

	monthly public pension **Before the reforms** (in Euro)	monthly public pension **After the reforms** (in Euro)	**Pension gap** in Euro per month at retirement	**Pension gap** in % of pension before reform
Mean	1593	1449	144	4.2
Median	1533	1388	121	3.9
Std Error	32.3	29.4	4.3	0.1

Source: Authors' own calculation based on SAVE 2010, all data are weighted. N=608

5.4 Current wealth and future savings

5.4.1 Current wealth

After the calculation of the pension gap we now turn to the question of whether German households are able to fill the arising pension gap if they continue their current saving behavior. In order to do this, we have to project wealth levels at the time of retirement and convert them into annuities. To calculate the projected wealth at the time of retirement, we start from the current wealth levels. We then add annual saving each year until retirement. Annual saving is computed by multiplying the current individual household's saving rate with the projected annual household income. At the end of each year, interest at the current interest rate is added to the balance. Finally, we convert the resulting wealth at retirement into a real annuity. This annuity is then compared to the pension gap.

We distinguish four saving and wealth components:

- Gross financial wealth
- Gross housing wealth
- Consumer debt and family loans
- Mortgages and building society loans

Mean, median and standard deviation of these components at the time of the interview are shown in Table 1. Gross financial wealth includes all private savings including the value of private pension contracts and occupational pensions. On average SAVE households own around 42,000 Euros in financial wealth. However, the median of the distribution is substantially lower, at 21,000 Euros. Additionally SAVE households own 170,000 Euros in housing wealth (median 100,000). The average consumer debt is about 6,800 Euros, with a median debt of 0. Mortgages and other housing related debt is on average 34,000 Euros (median 0). The net financial wealth (financial wealth minus consumer debt) is about 35,000 Euros. The average net housing wealth is around 135,000 Euros.

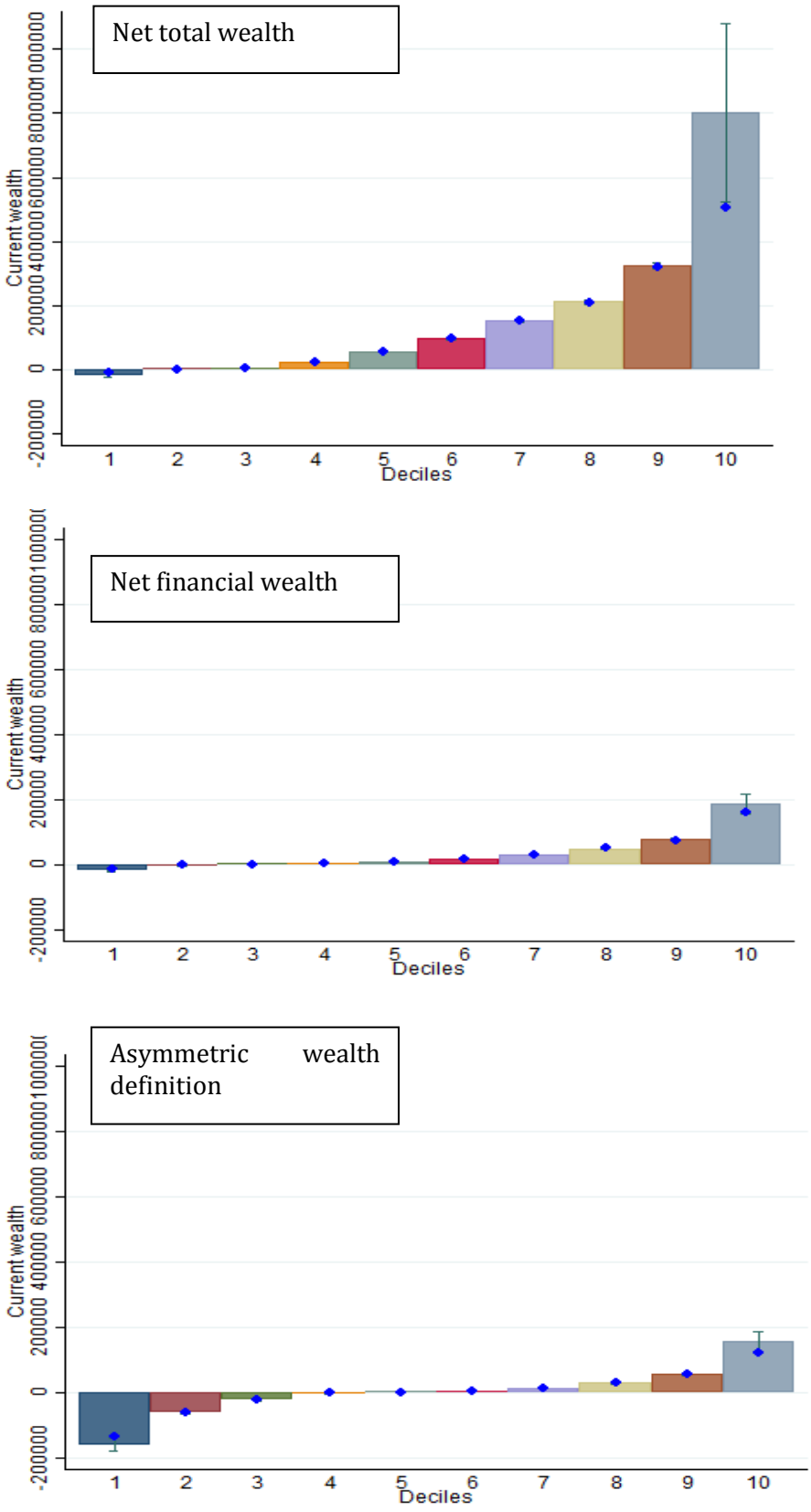
Using these four wealth components, we define three different wealth concepts:

- **Net financial wealth (NfinW)** is defined as gross financial wealth minus consumer debt and family loans

- **Net total wealth (NtotW)** is defined as gross total wealth (gross financial and housing wealth) minus all debts (consumer debt, family loans, mortgages, and building society loans)
- **Asymmetric wealth (AsymW)** excludes gross housing wealth from net total wealth, i.e., on the positive side, only gross financial wealth is included, but all debts, including mortgages and building society loans are subtracted. This "pessimistic" variant is used as a worst case scenario in which the value of any housing owned cannot be used for consumption in old age, but all debts have to be served from old-age income.

Figure 25 shows the distribution of these three wealth concepts among the SAVE households. As is well known, the wealth distribution is very skewed. Households in the lowest wealth decile have negative wealth according to all three definitions. The wealthiest decile has about 200,000 Euro in net financial wealth plus about 600,000 Euro in housing wealth, totaling a net worth of 800,000 Euro. Using the asymmetric wealth definition, wealth is negative for the first three deciles of the wealth distribution, and quite close to zero in the fourth, fifth and sixth wealth deciles.

Figure 25 Initial distribution of wealth among SAVE households



Source: Authors' own calculation based on SAVE 2010, all data are weighted.

5.4.2 Projected wealth at retirement

Current wealth will increase until the time of retirement for most households for two reasons. First, they will be subject to interest and compound interest. Given the low interest rate and also low inflation in recent times, we use a nominal interest rate of 2%. At 1.5% inflation, this corresponds to a 0.5% real interest rate. Since the interest rate is a crucial element of the calculations especially since many households have a long savings period ahead of them, we will also explore the sensitivity of our results with respect to the interest rate assumptions. Results are shown in section 5.6.

The second reason why wealth would grow until retirement is due to ongoing savings which add to the current wealth – provided that the household saves. In the previous section we assumed a constant savings rate of 4% according to the Riester regulations. In the SAVE survey we have information on actual savings behavior, since households report their total savings of the previous year. The average savings rate of all households in the SAVE sample was 7% in 2009 (median 4.2%). For our calculations we assume that the savings rates of our households will remain constant until the time of retirement. This is a fictional assumption that corresponds to our research question: How well can households close the pension gap given they *do not* adapt their current behavior? Thus, the total wealth of households when entering retirement is comprised of the compound wealth as of today (minus possible debts) and the compound stream of savings until the time of retirement.

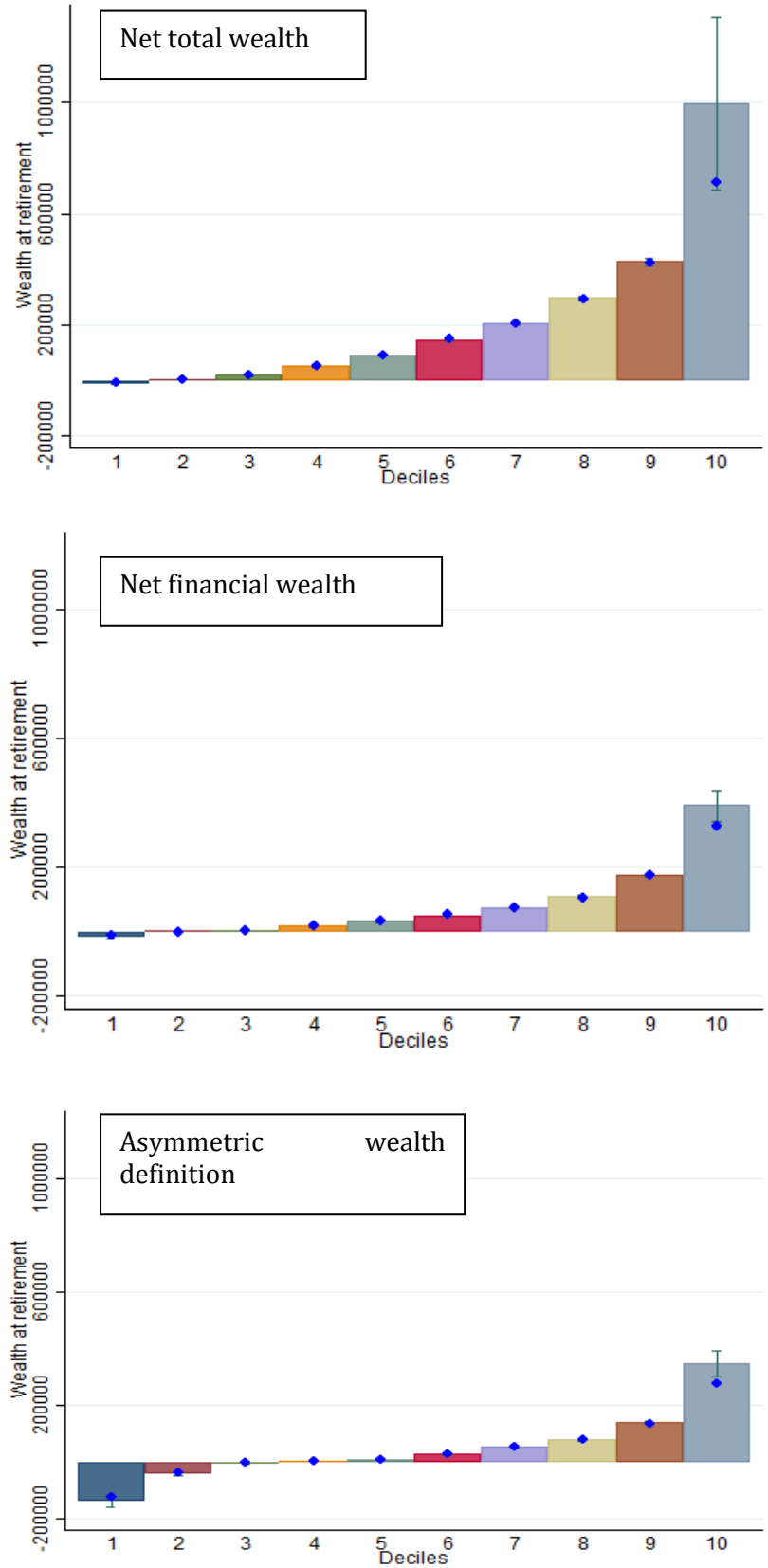
Table 4 displays the corresponding asset components. On average, households will add savings of more than 45,000 Euros to their initial wealth. Together with interest at a nominal (real) rate of 2% (0.5%) this yields a final net total wealth at the time of retirement of about 226,000 Euro. Net financial wealth at retirement is about 82,000 Euro. If we count all debt, but omit housing wealth (asymmetric wealth definition), the average SAVE household owns about 46,000 Euro. Medians are about half of this. This reflects the fact that households on the right side of the wealth distribution have much more wealth than households on the left of the distribution. This can be seen when looking at the wealth distribution in Figure 26. In all three definitions, households in the lowest deciles have no or negative wealth, while the richest households accumulate substantial amounts of net wealth until they reach retirement age.

Table 4 Projected wealth at retirement (in Euros)

	Mean	Median	Standard Error
Gross Financial Wealth	44603	22812	2617
Consumer and Family Credit	6816	0	709
Housing Wealth	180688	104965	15829
Mortgages and Other Housing Debt	33836	0	2626
Future Savings	45164	14122	3594
Net Total Wealth	226513	118342	17424
Net Financial Wealth	82392	40678	5066
Asymmetric Wealth Definition	45825	18611	5317

Source: Authors' own calculation based on SAVE 2010, all data are weighted.

Figure 26 Distribution of projected net wealth at the time of retirement for SAVE



Source: Authors' own calculation based on SAVE 2010, all data are weighted.

5.4.3 Converting assets into a life annuity

Using these projected assets households can partially cover their expenses during the retirement period, i.e. individual life expectancy minus retirement age. However, there is no standing rule on how households distribute their wealth over the time of retirement. The household could, for instance, spend the whole amount during the first year of retirement or save everything as an inheritance. To answer our research question, we convert net wealth at retirement into an even and constant payment stream. This constant payment stream will then be compared to the pension gap.

One way to obtain a constant payment stream is simply to divide total wealth by the number of years in retirement. However, in this case the wealth lasts for exactly this time period and the individual has to live on his public pension after this time period ends. Alternatively, the total wealth can be transformed into a life annuity. This has the same effect: a lifelong constant annual payment which does not end if the lifetime is longer than expected. We chose the second alternative which provides a possibility to compare the annual pension payments with the accumulated wealth. This approach would also correspond to the Riester pensions. One of the features of Riester pensions is that 70% of the accumulated wealth has to be converted into an annuity at retirement a maximum of 30% can be obtained as a lump sum.

When calculating the duration of retirement one has to have information about the individual life expectancy. In SAVE we have information on subjective life expectancies which were declared by the households themselves. We are using these life expectancies to calculate the annuities. On average, SAVE respondents expect to become around 79 years old (men 77.3, women 80.9 years, see detailed statistics on subjective and cohort life expectancies in Appendix II). Compared to cohort life tables, however, respondents in the SAVE survey can expect to live substantially longer. The Statistische Bundesamt publishes life tables according to two different calculations (see Appendix II for details). According to those life tables men (women) in the SAVE sample can expect to live until age 81.4 (85.9). This significant underestimation has potentially large consequences for retirement savings. Thus, we are providing additional analyses based on cohort life expectancies as a comparison (Subsection 5.8).

When calculating the life annuity we assume a constant real annuity.[42] Wealth at retirement is converted into a life annuity according to the following formula:

$$LA_{HH,t} = FV\left(TW_{HH,R}\right) \cdot \frac{(1+r)^{(LE-1)} \cdot r}{(1+r)^{LE} - 1}$$

where $FV(TW_{HH,R})$ denotes household HH's wealth at the time of retirement (that is, the future value FV at the date of retirement R of current wealth TW), r is the real interest rate and LE is the remaining life expectancy (that is, life expectancy minus age at the date of retirement).

Table 5 shows the results of life annuity calculations using the individual life expectancy. All values are given in Euro, adjusted for expected price and wage increases until retirement. Based on net total wealth, the annuity is about 1,800 Euro per month. Based on financial wealth only, the annuity is about 720 Euro per month. This compares favorably to the average monthly public pension payment of about 1,000 Euro. Based on the asymmetric wealth definition, the annuity is some 420 Euro per month. However, as discussed before, looking at the mean values can be misleading. Given the uneven distribution of wealth, the average value of assets is not

[42] We also calculated an annually increasing life annuity, growing by 1% per year, so that not only inflation is taken into account, but also the fact that the pension payments increase with wage growth. However, results do not significantly differ.

representative for the household in the middle of the wealth distribution. The median household receives a real annuity of about 800 Euro if net total wealth is annuitized. This is only half of the average. The distribution is even more skewed for the other two wealth definitions: based on net financial wealth, the median annuity is less than 40% of the mean, while the median is less than 30% of the mean in the asymmetric wealth definition.

Table 5 Monthly annuities (in Euros)

	Mean	Median	Standard Error
Based on net total wealth	1853	807	168
Based on net financial wealth only	716	282	58
Based on asymmetric wealth definition	419	123	58

Source: Authors' own calculation based on SAVE 2010, all data are weighted.
Annuity calculations are based on individual life expectancy.

5.5 To what extent can the pension gap be filled?

This sub-section presents the main findings of this study on the coverage of the pension gap by private savings. The results are summarized in Table 6 for a real interest rate of 0.5%. We compare the size of the pension gap in Table 3 with the amount of the real annuity in Table 5. "Absolute coverage" is defined as the Euro difference between annuity and pension gap. Positive values indicate over-coverage and negative values indicate under-coverage. Table 6 also presents the fraction of the pension gap covered by private savings ("coverage rate"). A coverage rate of more than 100% implies that the life annuity which the household could obtain from private wealth would be more than sufficient to close the pension gap. Finally, the last panel of Table 6 depicts the percentage of households who are not able to close the pension gap under each of the three wealth definitions.

Our main result is at the bottom of Table 6: The majority of German households will be able to cover the pension gap. If all wealth is considered, about 78% of households have sufficient initial wealth and/or save sufficiently to cover the emerging pension gap. If we ignore housing wealth and corresponding debt, this percentage is still about 67%. Under the pessimistic asymmetric wealth definition which includes housing debt but excludes gross housing wealth, 53% of households are able to cover their pension gap.

The average coverage rate is very large: annuitized net total wealth is about 20 times larger than the pension gap; annuitized net financial wealth 7 times larger. Median coverage rates are much lower due to the skewed wealth distribution shown earlier but they are still large: the median household has a 660% coverage rate out of total wealth and 244% out of financial wealth. Even for the asymmetric wealth definition the median coverage rate exceeds 100%.

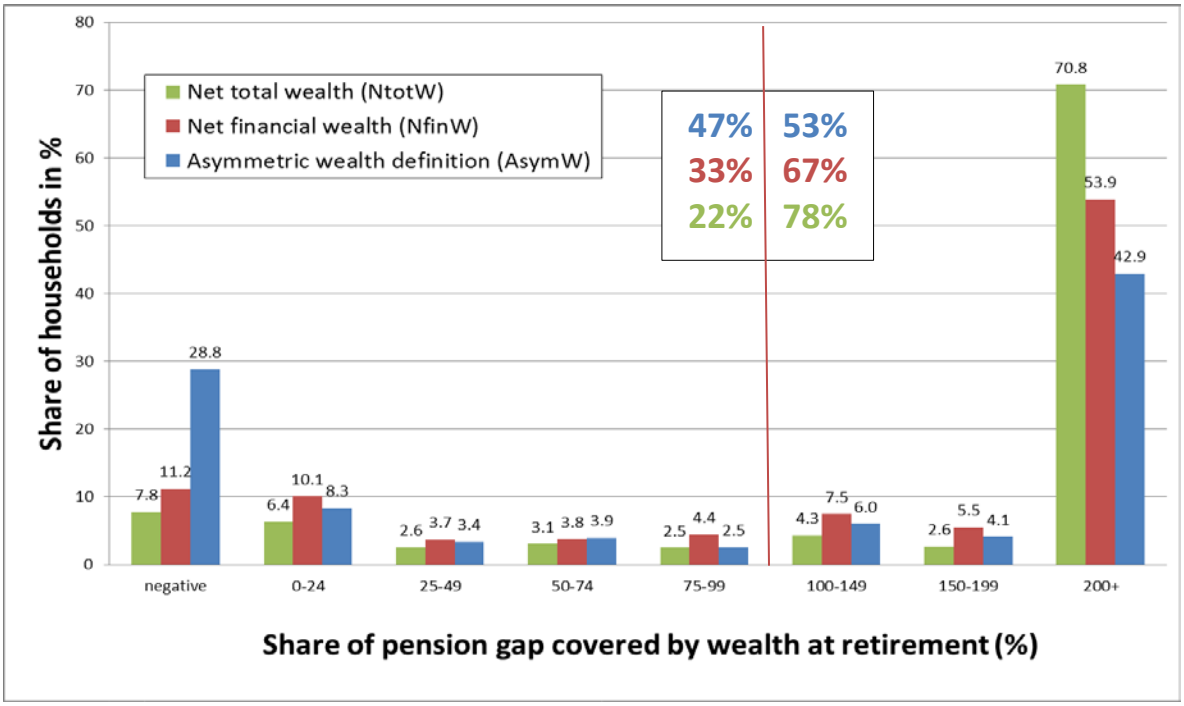
While all this sounds very positive, the skewness of the distribution leaves many households uncovered at various degrees. Figure 27 provides a more detailed picture of the distribution of coverage rates.

Table 6 Coverage of the pension gap

	Mean	Median	Standard Error
	Absolute coverage in Euros		
Based on net total wealth	1709	669	168
Based on net financial wealth only	571	152	57
Based on asymmetric wealth definition	274	20	57
	Coverage rate (%)		
Based on net total wealth	2053	660	232
Based on net financial wealth only	698	244	91
Based on asymmetric wealth definition	363	114	116
	Fraction of households with		
	covered pension gap (%)	**non-covered pension gap (%)**	
Based on net total wealth	77.8	22.2	
Based on net financial wealth only	66.8	33.2	
Based on asymmetric wealth definition	53.1	46.9	

Source: Authors' own calculation based on SAVE 2010, all data are weighted. Notes: Annuity calculations are based on individual life expectancy.

Figure 27 Distribution of the share of households by the fraction of the pension gap that is covered at retirement for SAVE



Source: Authors' own calculation based on SAVE 2010, all data are weighted.

Based on net total wealth including housing wealth and related debt (green bars in Figure 27), more than 70% of households have sufficient wealth to fill their pension gap at least twice (bar to the very right). In turn, however, almost 8% will enter retirement indebted, and another 6.4% will not be able to fill at least one quarter of the pension gap. If only financial wealth is considered (red bars in Figure 27), about 54% of households have sufficient wealth to fill their pension gap at least twice while more than 11% will enter retirement indebted and another 10% will not be able to fill at least one quarter of the pension gap. The most pessimistic view is given by the blue bars where we count all debt but do not consider housing wealth. Then the percentage of households who are indebted at begin of retirement jumps to almost 29% and only 43% will cover their pension gap at least twice.

5.6 How does the pension gap coverage depend on interest rates

As shown in Section 4.3 the prediction of the private pension crucially depends on the assumptions made about the interest rates. So far in this section we have assumed a nominal interest rate of 2%; at an inflation rate of 1.5% this would be a real interest rate of 0.5%. In view of the current situation of the capital markets this seems reasonable. However, in this sub-section we use combinations of significantly higher and significantly lower returns to see how this changes our main results. The assumptions follow those made in Section 4.3, i.e. we present results based on nominal scenarios of 4.5%, 3% and 0%. These correspond to real interest rates of 3%, 1.5% and -1.5%, respectively. As expected, a higher interest rate helps closing the pension gap on average, while the opposite holds true for lower interest rates. Furthermore, the fraction of individuals who do not manage to close the gap decreases between 4 and 6 percentage points depending on the wealth definition. The conclusion is that a higher interest rate does not help households who fail to save.

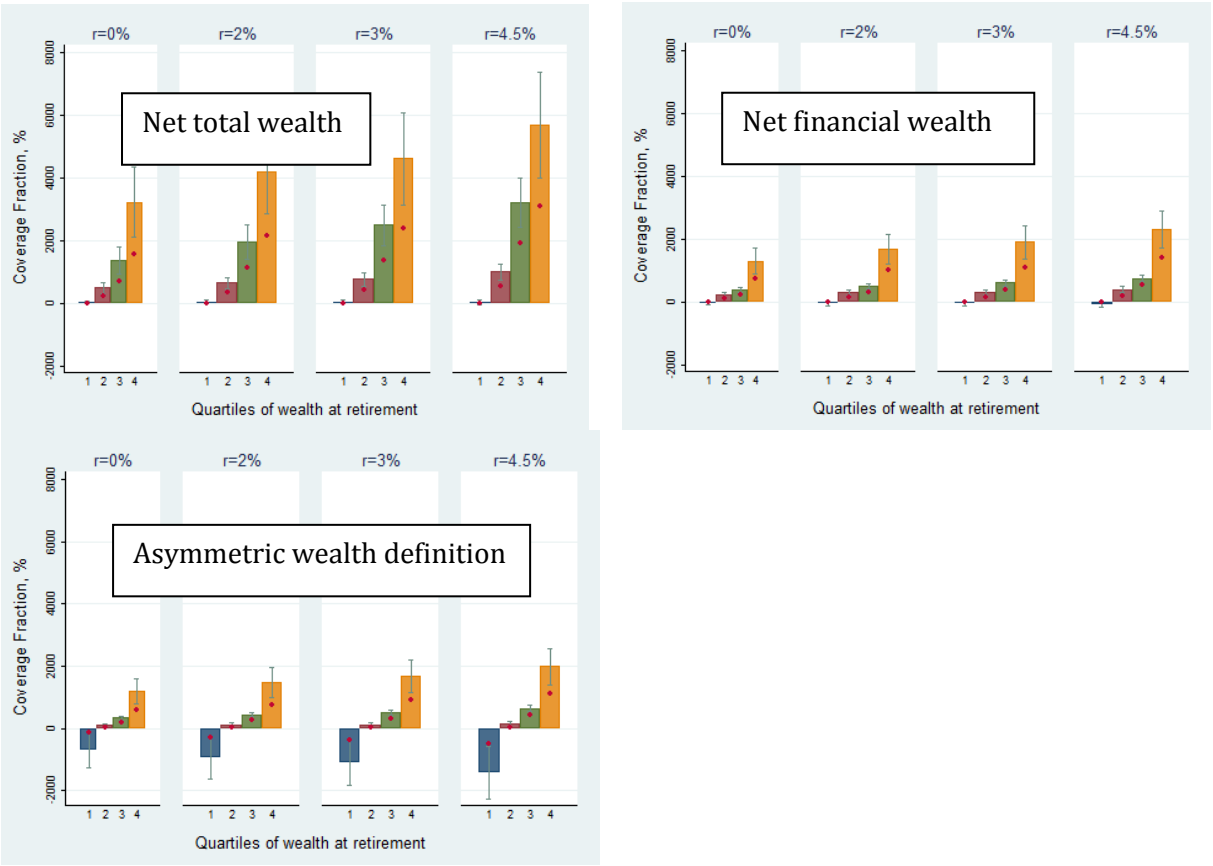
In Figure 28 we show the coverage rate as a function of the prevailing interest rates, stratified by quartiles of the wealth distribution. It becomes clear, that a higher interest rate would make it easier for the richest households to cover the gap, while it would make it harder for the poorest households (with debt) to cover the gap. For households with zero wealth nothing changes. The fraction of households with an uncovered pension gap is close to 100% at the bottom of the wealth distribution irrespective of the interest rate, while it is close to 0 among the 25% of the richest households. Among the middle of the wealth distribution there are some households for which it becomes easier to close the gap at higher interest rates. Thus, the fraction of households who are not able to cover the pension gap is decreasing in the second and third wealth quartiles.

While interest rate assumptions affect our main result, the sensitivity is astoundingly small. Our main results do not hinge qualitatively on the assumptions about the development of future returns on investment. It seems that on average a higher return helps closing the pension gap while a lower return makes it more difficult. But variations in the return between 0% and 4.5% do not change our general conclusion. The main reason is that households in the upper part of the wealth distribution anyway fill the pension gap by a large margin such that low interest rates do not particularly hurt them. On the other side of the wealth distribution, households are indebted. Higher interest rates make it even harder for them to pay back their debt.

We conclude that the primary risk of private provision does not lie in low returns, but in not making sufficient and/or early enough provisions. Even a relatively high return cannot offset the limited savings for many households. Previous research has shown, that there are many reasons that might contribute to the fact that households fail to plan and save for retirement. They range from behavioral mistakes such as bounded self-control and short sightedness (see e.g. Thaler, 1981 and Laibson, 1997) to fundamental lack of information such as low financial literacy (see e.g. Lusardi and Mitchell, 2007) or misguided expectations (see e.g. Bucher-Koenen and Kluth, 2012). Earlier results for Germany show that households are not well informed about the Riester subsidies (Coppola and Gasche, 2011) and they know little about basic concepts

related to saving and investing (see Bucher-Koenen and Lusardi, 2011). Moreover, households are not well informed about their public pension claims (see e.g. Honekamp and Schwarze, 2010 and Lamla and Gasche, 2014), and underestimate their individual life expectancy substantially (see Bucher-Koenen and Kluth, 2012). Thus, many households might not assess their savings needs correctly.

Figure 28 Distribution of the coverage fraction



Source: Authors' own calculation based on SAVE 2010, all data are weighted.

5.7 How does the pension gap coverage depend on household characteristics?

So far we have only looked into the ability to cover the pension gap by the level of net wealth at retirement. In this section we take a closer look at the probability to close the gap by socio-demographic characteristics such as income, age, and education. All comparisons are based on the asymmetric wealth definition; results for the more conventional definitions are qualitatively very similar.

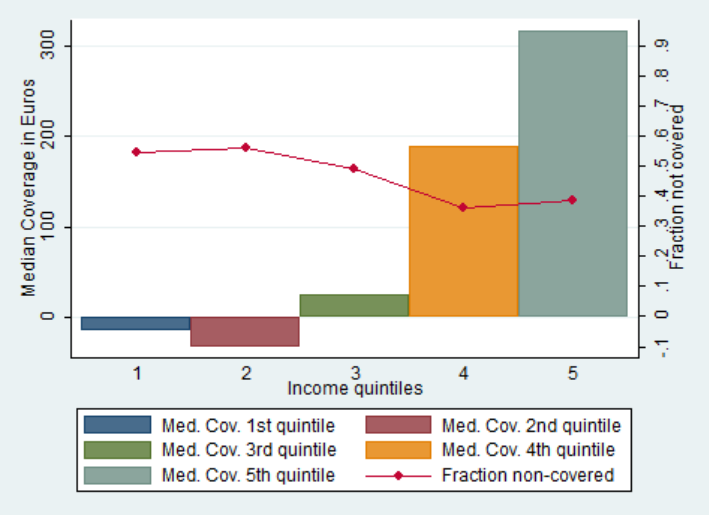
5.7.1 Pension gap coverage by income

The ability to save crucially hinges on the availability of income from which households can save. Thus, it is interesting to see how the ability to cover the pension gap depends on household income. In Figure 29 we show the median amount of coverage and the percentage of non-covered households by income quintiles. As expected, the coverage of the pension gap is increasing with income. In the bottom first and second income quintile the median household is 15 and 32 Euros short each month of covering the pension gap. In the middle of the income distribution households have about 26 Euros left after filling their pension gap. At the fourth and fifth income quintile these number are much higher at 189 and 317 Euros, respectively. The

fraction of households not covering their personal pension gaps is declining by income. While around 54% of the poorest households do not cover the gap, in the top quintile 38% are unable to fill the pension gap.

While Figure 29 shows some sensitivity to household income, this sensitivity is rather small. Even among the highest-income households a large fraction is not able to cover their pension gap. Even in case of a 4.5% interest rate more than one third of the households at the top quintile of the income distribution would still not be able to cover the pension gap.

Figure 29 Median coverage and fraction of households not covering the pension gap by income quintile, SAVE respondents



Source: Authors' own calculation based on SAVE 2010, all data are weighted.

This shows once more that households' savings behavior is the most crucial element for filling the pension gap. If we dig a little bit deeper into this we realize that a large share, almost 40%, of the households in SAVE reports no savings at all. Figure 30 shows the distribution of the fraction of households who are not saving by income. This fraction is decreasing with income, but even in the top quintile more than 20% of the households are not saving at all. The percentage reaches more than 50% in the lowest quintile. A similar heterogeneity across household income quintiles can be observed when looking at Riester ownership. According to Figure 30, more than half of the households in the top quintile own a Riester pension contract, while in the bottom quintile only around 26% own such a product. As already noticed by Börsch-Supan et al. (2015a), the relatively low uptake of Riester pensions among low income earners is puzzling given the generosity of government subsidies for these households. This lets us conclude that most likely not the size of the subsidies is hindering private retirement savings but other factors such as failure to plan for the future or lack or information and misguided expectations.

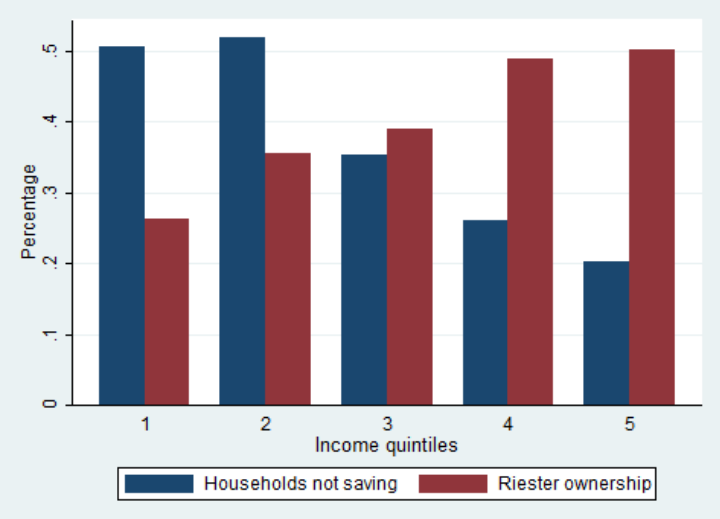
Box 1 – Differential mortality by income

An important issue, but that we can address only marginally, is how actual and individual life expectancies differ by socio-economic status. Von Gaudecker and Scholz (2007) estimate mortality rates by a measure of socio-economic status in a sample of male Germans aged 65 or older, and show that period life expectancy at age 65, which is calculated based on observed mortality rates, between the lowest and the highest socio-economic groups differ by 6 years.

If high-income individuals have a longer LE - and low-income individuals a shorter LE - with respect to the population (average) LE we used in our calculations, the pension gap non-coverage problem would become relatively more serious for high-income individuals, and relatively less serious for low-income individuals. As individuals' behavior, however, depends on their expectations rather than on the actual LE, it is interesting to look at the heterogeneity of households' life expectancy at different socio-economic categories. Besides, it is interesting to see who makes the biggest mistake regarding LE: in fact, if low-income individuals make a larger mistake than high-income ones, this could offset the "positive" effect on pension gap-coverage of having a shorter LE.

If we restrict our analysis to the male components of the SAVE sample (in order to compare our figures to those found by von Gaudecker and Scholz (2007), we calculate that households at the bottom decile of the income distribution expect to live for another 6.86 years at age 65, while those at the top decile expect to live another 12.94 years at the same age. Thus, the difference between top and bottom decile is slightly larger than that found using period LE. It also seems that those at the bottom decile make a larger mistake when evaluating their LE. This leads us to conclude that the relative gain due to the shorter LE that low-income individuals have with respect to high-income individuals when comparing the pension coverage calculated using individual LE or actual LE, could be offset by the relatively bigger mistake that low-income individuals make when evaluating their LE.

Figure 30 Percentage of households not saving and Riester ownership by income quintile, SAVE respondents



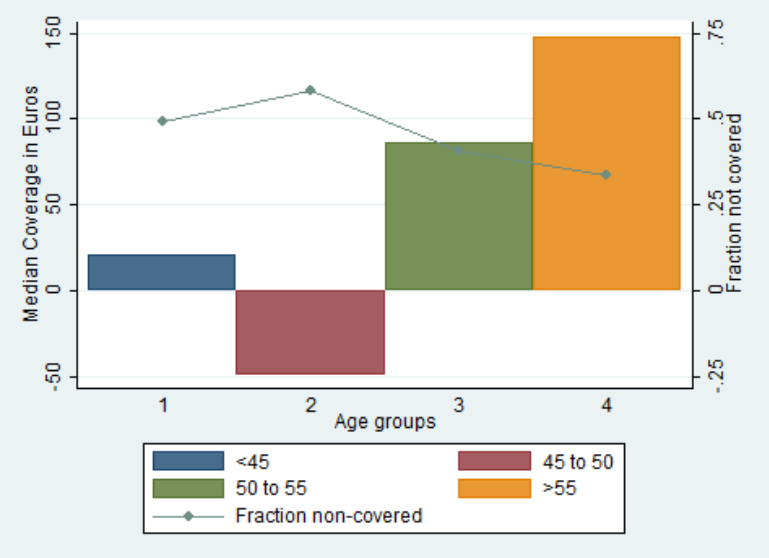
Source: Authors' own calculation based on SAVE 2010, all data are weighted.

5.7.2 Pension gap coverage by age

As explained above, pension reforms will affect relatively younger cohorts more severely. Thus, in Figure 31 we present the median coverage and the fraction of uncovered households by age. The graph shows that households older than 50 have a substantially larger median coverage.

An analysis of the effect of income and age simultaneously shows that in particular households whose main-earner is older than 55 show a far larger coverage fraction than younger households, irrespective of income. Households aged 50-55 have 85 Euros and those older than 55 148 Euros, respectively, each month after filling the pension gap. The fraction of households unable to fill the pension gap is highest among the households age 45-50, almost half of them are not able to fill the arising pension gap. Among the households shortly before retirement still about one third are not covering the gap. This is particularly worrying since these households only have few years left before retiring which makes it particularly difficult to fill the pension gap.

Figure 31 Median coverage and fraction of households not covering the pension gap by age, SAVE respondents

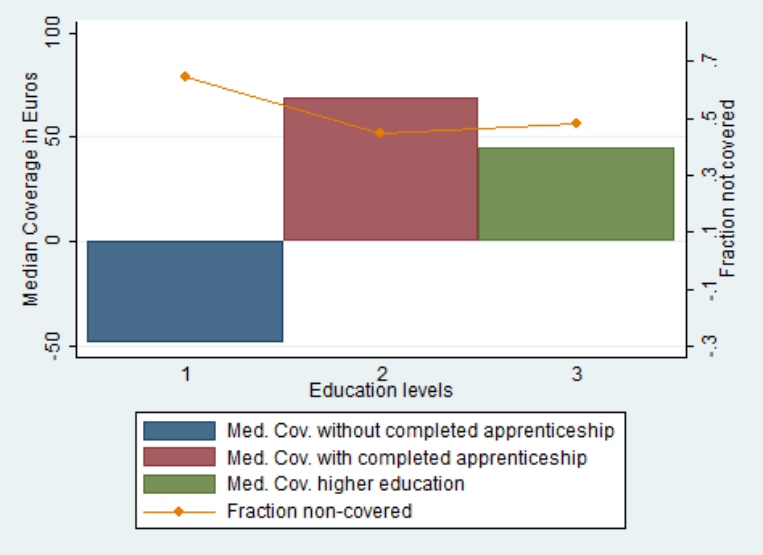


Source: Authors' own calculation based on SAVE 2010, all data are weighted.

5.7.3 Pension gap coverage by education

Finally, we would like to consider households' education level. On the one hand households with higher education on average have higher income and own greater wealth, on the other hand they also have higher levels of financial education, which has been shown to be a crucial factor when planning for retirement (see e.g. Bucher-Koenen and Lusardi, 2011). Figure 32 shows the median coverage and the fraction of households not covering the pension gap by education level. It seems that holding a degree of full secondary education (a completed apprenticeship) helps households in covering the pension gap. In particular those household without a completed degree have difficulties saving enough for retirement, among these 64% are unable to fill the pension gap. While the median coverage is a bit lower among those with a higher education compared to those with an apprenticeship, the fraction of households unable to fill the gap is very similar between the upper two education categories (44% and 48%, respectively). This relatively high fraction of households unable to save enough for retirement even among the top education groups is rather surprising.

Figure 32 Median coverage and fraction of households not covering the pension gap by level of education, SAVE respondents



Source: Authors' own calculation based on SAVE 2010, all data are weighted.

We conclude from this analysis that in particular households with low income, the younger cohorts, and those with low education have difficulties covering the pension gap that will arise in the next couple of years under their current savings behavior. However, the problem of insufficient savings is common to all the categories we considered: even among the high income earners, households close to retirement, and those with high education levels a substantial fraction will not be able to fill the pension gap at current behavior. What is more, the analyses here show that even high interest rates would not help covering the gap, since the primary problem is that a large fraction of households is not saving at all.

5.8 How does the pension gap depend on life expectancy and expected retirement age?

In this section we are slightly moving away from our assumption about individuals not adjusting their behavior. In section 4.4 we presented the behavior of the standard pensioner and also a calculation where we assumed that the standard pensioner would work for two more years. This corresponds to the fact that we can assume that people will adjust the duration of their working life according to the new statutory retirement ages which will increase from 65 to 67 until 2031. So far we have used the expected retirement age that individuals report in the SAVE survey. However, the median retirement age that individuals report is 65. Given the new legislation this will increase by about two years. Thus, in this section we present a calculation of the pension gap and the coverage of this pension gap if the individuals in SAVE would retire at the statutory retirement age and not before. The question is: will more households be able to fill their pension gaps if they work longer?

Our calculations show that the average pension gap for households will slightly increase from 144 to 154 Euros if they work longer. This is surprising at first glance since individuals receive more earnings points when they continue to work. However, the pension gap is increasing over time. Thus, households who work longer retire later and have to fill a larger gap when entering retirement. At the same time they are also able to save more. Columns 1 and 2 of Table 7 show that these two effects pretty much offset each other, such that our main results are essentially unaffected by the retirement age assumption.

Our calculations so far were based on the subjective life expectancy reported by the respondents. Since individuals substantially underestimate their life expectancy we also calculate the annuities based on the cohort life expectancy provided by the Statistische Bundesamt (see Appendix II). The value of the annuity decreases substantially when using the cohort instead of the subjective life expectancy. This has consequences for the ability of the households to cover their pension gap. Because of the underestimation of their life expectancy, many households save too little to cover their pension gap. The percentage of households with a pension gap that is not fully covered increases between 3 and 5 percentage points when using cohort instead of individual life expectancy as can e.g. be seen by comparing Columns 3 and 1 in Table 7.

Table 7 Fraction of households not fully covering the pension gap depending on expected retirement age and life expectancy

	Individual life expectancy		Cohort life expectancy	
	Expected retirement age	Statutory retirement age	Expected retirement age	Statutory retirement age
Based on net total wealth	22.2%	22.1%	25.5%	25.9%
Based on net financial wealth only	33.2%	33.1%	38.2%	37.8%
Based on asymmetric wealth definition	46.9%	46.7%	51.5%	51.2%

Source: Authors' own calculation based on SAVE 2010, all data are weighted.

5.9 Filling the pension gap among the older households of the SHARE-RV survey

Our final robustness check involves a completely different data set. This second dataset, SHARE-RV, stands for the linkage of the survey data from the German subsample of SHARE with administrative records of the German public pension system (RV). Upon respondents' consent, the data of the German subsample of SHARE are linked to the RV data using the respondents' Social Security Number (SSN) as a unique identifier. The advantage of SHARE-RV lies in the combination of RV administrative data containing past contribution and income histories with the SHARE survey data containing socio-economic household characteristics. SHARE-RV also permits identifying administrative data of persons living in the same household.[43] Hence, the pension gap can be more reliably computed than in the SAVE data set. The disadvantage of using SHARE-RV for this paper lies in the limited age range. SHARE respondents are of age 50 and older, retire earlier than the average SAVE respondent and thus are less affected by the recent pension reforms. Moreover, SHARE has much less information on saving behavior than SAVE.

The SHARE German subsample collected in the fifth wave (year 2013) comprises 5,690 individuals; for 3,485 of these individuals we have access to linked information in the administrative file. After excluding households whose main earner is younger than 40, observations with missing data or with insufficient information on last income and individuals

[43] For details see "SHARE Release Guide 2.6.0 Waves 1 & 2" (2013), available at http://www.share-project.org/fileadmin/pdf_documentation/SHARE_guide_release_2-6-0.pdf. As spouses of the 50+ individuals selected into the sample are interviewed as well, the sample actually includes also individuals younger than 50. For details on the record linkage see Czaplicki and Korbmacher (2015).

who are already retired, we obtain a sample consisting of 611 observations. Data are weighted and missing data regarding income and assets are replaced by imputed data (see De Luca et al., 2015). The SHARE respondents are on average about 55 years old, which is considerably older than the average respondent in the SAVE sample. About half of them are female and 57% have a medium level of education (see Table A.3 in Appendix III).

In contrast to the SAVE survey, the SHARE-RV survey contains all necessary information regarding the contribution and income histories of an individual. Since the SHARE-RV respondents are aged 50 and above, we assume that they remain working at the same relative income level (with the same earnings points) until their expected retirement age. In SHARE we do not have information about the current level of savings. We impute age-specific savings rates using the SAVE data for similar households in SHARE. Due to the lack of subjective life expectancy data in SHARE-RV, we calculate the annuities using the cohort life tables.

While SAVE encompasses households of all ages, SHARE is restricted to 50+. Due to the different age range, net assets at retirement are higher in the SHARE sample than in SAVE, at around 94,000 Euro (median 66,000 Euro). SHARE households also retire earlier. Hence, the effects of the pension reforms are smaller and the resulting pension gap is smaller.

Based on the most pessimistic asymmetric wealth definition, SHARE households can expect to receive a real annuity of 365 Euros out of current wealth plus interest and 217 Euros out of future saving including interest on that saving. The amount from future savings is lower since the sample is older and thus has a shorter time span to accumulate additional assets. These numbers are slightly higher compared to the SAVE sample because of the much lower debt levels of SHARE respondents. The median SHARE respondent receives a total real annuity of roughly 296 Euros per month.

The analysis of the SHARE respondents reveals that households closer to retirement are on average better prepared to fill the gap. On the one hand, those households have smaller pension gaps of only 114 Euros on average as shown before. On the other hand, they also have higher levels of net wealth at retirement to cover the gap. The average SHARE household has a coverage rate of more than 560%, the amount left each month is 336 Euros. The median household covers the gap by 346% and has more than 200 Euros left each month. The fraction of households unable to fill the gap is 21%. Note that this is substantially lower compared to the SAVE respondents for the same asymmetric wealth definition.

6. Conclusions

In the first part of this study we examined the development of the pension gap which was created by the 2001 and 2004 pension reforms. The pension gap is defined as the difference between the pension benefit level in 2001 (pre-reform) and the future pension benefit level. This gap has changed due to the recent pension reforms which took place in 2007 and 2014. These reforms influenced the development of the pension gap both positively and negatively. The 2007 reform is particularly relevant as it aims at increasing the actual retirement age by two years. If this aim is achieved, not only the burden on the public pension system will be reduced but also the savings period of a Riester contract will be extended. The introduction of the increasing retirement age from 65 to 67 lowers the pension gap in 2060 by about 1 percentage point from 10.5% to 9.5% if individuals do not change their current retirement behavior. If in turn individuals postpone their retirement by 2 years on average as envisaged by the 2007 reform, then the pension gap will only be 8% in 2060. On the other hand, the pension reform in 2014 with its introduction of a new early retirement pathway for age 63 will widen the pension gap again by about 31% (0.7 percentage points), especially in the short and medium term (2015 to 2030).

This study first calculates the accumulation of private savings according to a stylized savings profile of a standard pensioner. A household which follows the rules and regulations of the Riester plan, will be able to close the pension gap when the nominal interest rate is at least 3.75%. However, the current low interest rate environment related to the recent financial crisis and the current debt crisis has a strong negative effect on the development of private wealth. Our calculations show that lower interest rates make it substantially more difficult to fill the pension gap, even when households follow the Riester recommendations. In this case, additional old-age saving provisions will be necessary to save sufficiently for retirement. If the nominal interest rates will remain around 2% (which corresponds to a 0.5% real interest rate) private savings will be too low to fill the pension gap. The household of a standard pensioner will lack around 117 Euros each month or 8% of the standard pension.

In the second part of this study, we study the actual distribution of German households based on two surveys. The aim is an analysis of the actual savings behaviour of German households, in order to investigate the extent to which they would be able to fill the arising pension gap under the assumption that they keep their current saving behaviour. We make use of two different datasets, SAVE and SHARE-RV, which offer complementary advantages and disadvantages in terms of households' information necessary for our calculations.

We find that the average pension gap in our samples amounts to 144 Euros and 113 Euro per month using SAVE and SHARE, respectively. This difference is due to the fact that the reform will have a stronger impact on younger generations, and the SAVE sample is relatively younger compared to the SHARE sample. Expressed as percentage of the pension before the reforms, the pension gap is close to 4.2% in both samples.

On average, households are well able to close their pension gap. Annuitized net financial wealth at retirement is about 7 times as large as the pension gap, and annuitized net total wealth even 20 times. Even under an asymmetric wealth definition which includes mortgages but excludes the value of housing assets, annuitized wealth is 360% of the pension gap. Hence, households have on average sufficient wealth and save sufficiently to close the pension gap. This also holds for the median household in all three wealth definitions.

Averages and even medians, however, mask the large skewness of the wealth distribution. There are many households, whose annuitized wealth is much larger than their pension gap, but also a considerable percentage of households, who are indebted or have so little wealth that none or only a small fraction of the gap can be closed. Considering net total wealth, 78% of households can close their pension gap. Considering only net financial wealth, these are 67%. Using the

pessimistic asymmetric wealth definition, this percentage shrinks to 53% of SAVE households (21% of the older SHARE households).

A second important result of our analysis is that individuals strongly underestimate their life expectancy by 4 to 6 years. This individual life expectancy, together with the age at which individuals expect to retire, determines an unrealistically short retirement period (11.5 years for men and 16 years for women). This has severe consequences on households' capability to close the pension gap: the underestimation of individual life expectancy compared to cohort life expectancy increases the proportion of those who are not able to cover the pension gap by around 6 percentage points.

We finally calculate net wealth at retirement using different interest rates. While the first part of this study has shown that higher interest rates will help the standard pensioner who follows all rules and recommendations regarding the Riester pension, this result does not hold as strongly when looking at the actual distribution of households. This is due to the many households who save relatively little. Hence, higher interest rates do not help the average German household to close the pension gap as compared to the synthetic figure of the standard pensioner. We find that the primary effect of higher interest rates is to widen the gap between relatively rich households and households with debt. Thus, the overall conclusion is that while higher interest rates would help some households to close the pension gap, the primary risk of private provision does not lie in fluctuations of returns, but in not making sufficient and/or early enough provisions. In fact, 40% of the households report no savings at all. These households are thus insensitive to interest fluctuations. While households with low income and low education will find it particularly difficult to close the pension gap, a surprising finding of this study is that insufficient savings are common even among high income earners and those with high levels of education.

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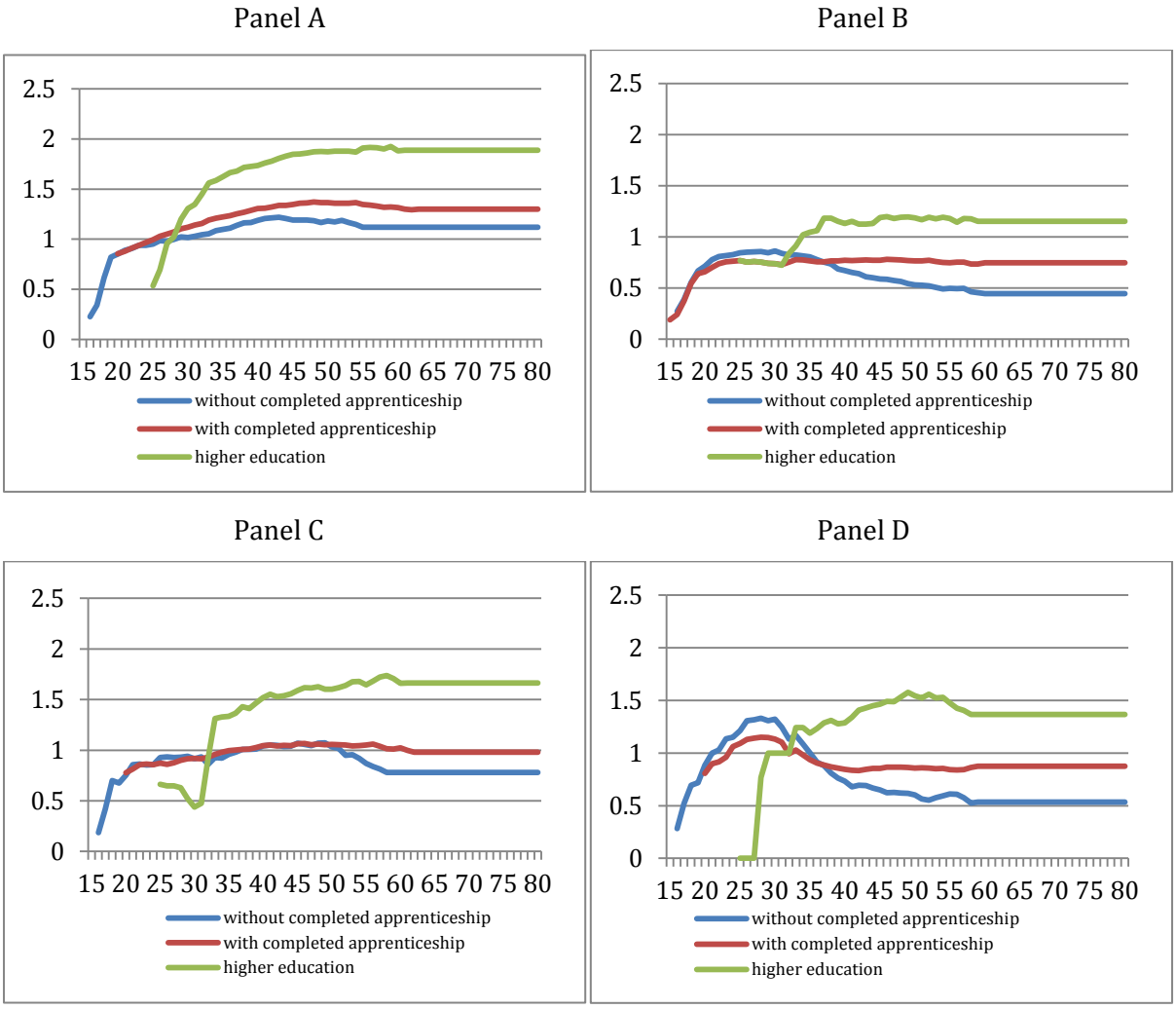
Appendix

I. Calculation of income profiles from the VSKT 2011 for SAVE respondents

The VSKT (Versichertenkonten Stichprobe of the German pension provider) data set has information on individuals' earning points so that it allows us to calculate income profiles differentiated by age, gender, the level of education, and whether an individual lives in West or East Germany. Individuals receive one earning point if they earn the average income. If they earn less than the average income, they receive fewer earning points. For a higher than average income they earn more earning points. The development of the earning points, therefore, represents the income profile of an individual. This calculation takes also into account the earnings points for non-labor work (e.g. earning points for the upbringing children).

The predicted income profiles are shown in Figure A.1. The y-axis shows the earnings points and the x-axis the age. As expected, income profiles are higher for men than for women and for those with higher education.

Figure A.1 Income profiles for Men in West Germany (Panel A), Women in West Germany (Panel B), Men in East Germany (Panel C) and Women in East Germany (Panel D)



Source: Authors' own calculations based on SUF-VSKT 2011.

II. Life expectancy

We use two different measures for life expectancy. First, we use subjective life expectancy elicited from SAVE respondents. In the SAVE survey subjective life expectancy was elicited in two steps. This procedure was chosen because it does avoid a straightforward question in the sense of "at what age do you think you are going to die?" First, participants are asked to state their belief about average life expectancy of their cohort. Second, they are asked whether their life will be longer, as long as or shorter compared to their cohort, and then they are asked to predict their relative life expectancy in years. The exact wording of the questions is as follows:

- What do you think, which age will women of your age reach on average? (answer expressed in years)
- What do you think, which age will men of your age reach on average? (answer expressed in years)
- If you think about your own situation and health status, what do you think, how long you will live compared to the average person of your age and gender. Shorter, by [ ] years; About as long as the average; Longer, by [ ] years.

We calculate the individual life expectancy by adding respondents' gender specific subjective cohort life expectancy based on the first two questions, and their relative life expectancy based on the third question. The advantage of measuring subjective life expectancy is that this method does not neglect that there are huge differences in the individual life expectancy depending on health status, socio economic characteristics, optimism and many other factors. These differences are reflected in individuals' predictions about their own life expectancy and might change the individual behavior and decision making.

Second, we use two versions of cohort life expectancies issued in 2011 by the federal statistical office. This calculation is based on two underlying trend scenarios named Version one (V1) and Version two (V2). V1 looks at the long-term development of mortality since 1871. V2 also uses this long-term development, yet combines it with the short-term development since 1970. The idea is to capture the non-linear increase of life expectancy in recent decades due to the advances in medical supply. Since mortality rates experienced a stronger decline in the short run, life expectancies are always higher in V2 compared to V1.

Table A.1 shows the average subjective and cohort life expectancies for both men and women in the SAVE sample. According to Table A.1, both genders (heavily) underestimate their life expectancy by four to six years depending on which measure the individual life expectancy is being compared with.

Table A.1 Average life expectancy for men and women

	Men	**Women**
SLE	77.31	80.96
Cohort LE (V1)	81.37	85.92
Cohort LE (V2)	82.68	86.97
Number of obs.	385	223

Source: Authors' own calculation based on SAVE 2010, all data are weighted.

Table A.2 shows the average subjective and cohort life expectancies by gender and age. These results suggest that there is a considerable underestimation of the subjective life expectancy at all age groups.

Table A.2 Average life expectancy for men and women by age

	40-49	50-59	60+
	Men		
SLE	76.88	77.70	77.82
Cohort LE (V1)	81.17	81.45	82.31
Cohort LE (V2)	82.70	82.60	83.10
Number of obs.	169	182	34
	Women		
SLE	80.73	81.21	80.92
Cohort LE (V1)	85.87	85.90	86.30
Cohort LE (V2)	87.07	86.85	86.98
Number of obs.	94	102	27

Source: Authors' own calculation based on SAVE 2010, all data are weighted.

Combining the expected retirement age and individual life expectancy yields the expected retirement period in years. It is 11.5 years for men and 16 years for women. Both are unrealistically short. The retirement period increases, however, when we replace individual life expectancy with cohort life expectancy in the calculation. For V1 the retirement period increases to 16.5 years for men and 21.5 years for women. V2 yields a retirement period of 18 years for men and 22.5 years for women.

III. Results from the SHARE-RV Survey

Table A.3 Descriptive statistics SHARE-RV

Variables	Mean	Median	Standard error
Age	55.23	55	0.172
Expected Retirement Age	64.88	65	0.077
Statutory Retirement Age	66.09	66	0.0192
Total Household Income	47347.34	41202.09	1140.18
Gross Financial Wealth	73462.38	44760.31	3739.34
Total Debt	28108.32	600	1888.58
Cohort Life Expectancy (V1)	83.98	83.07	0.085
Female	0.49	0	0.02
Low Education	0.05	0	0.01
Medium Education	0.57	1	0.02
High Education	0.38	0	0.02
N	611		

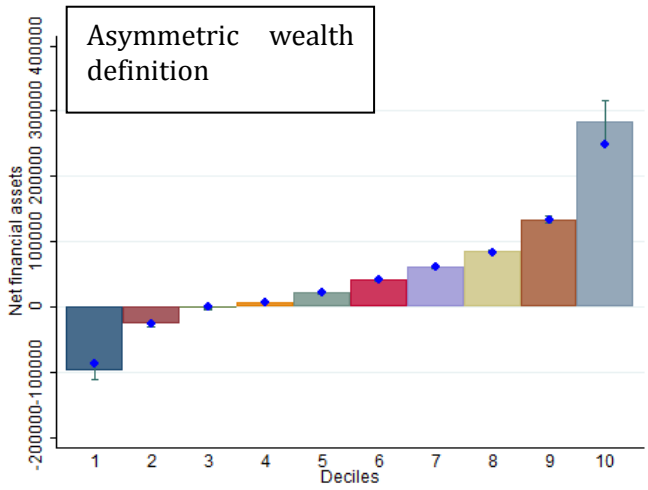
Source: Authors' own calculations based on FDZ-RV – SHARE-RV 3-0-0, all data are weighted. Notes: Variables which are not measured at the household level are reported for the main earner of the household.

Table A.4 Pension level before and after the pension reforms SHARE-RV

	monthly public pension **Before the reforms** (in Euro)	monthly public pension **After the reforms** (in Euro)	**Pension gap** in Euro per month at retirement	**Pension gap** in % of pension before reform
Mean	1525	1411	114	4.2
Median	1381	1276	93	3.4
Std Error	31.8	28.8	3.6	0.2

Source: Authors' own calculation based on FDZ-RV – SHARE-RV 3-0-0, all data are weighted. N=611

Figure A.2 Distribution of net assets among SHARE respondents



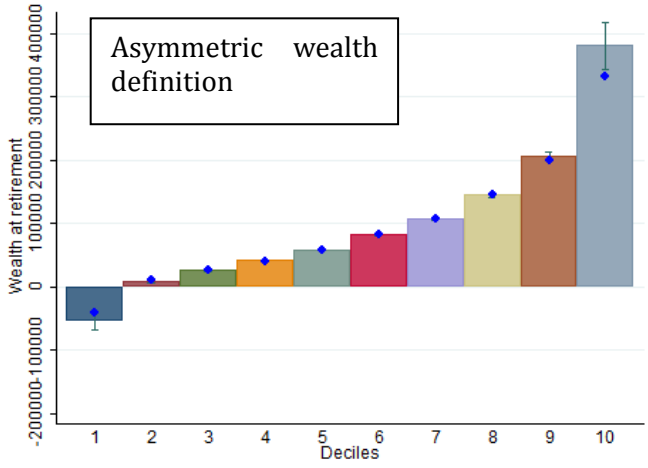
Source: Authors' own calculation based on FDZ-RV – SHARE-RV 3-0-0, all data are weighted.

Table A.5 Projected wealth at retirement (in Euros)

	Mean	**Median**	**Standard Error**
Gross Financial Wealth	77163	47116	3937
Consumer and Family Credit, Mortgages and Other Housing Debt	26487	565	1780
Future Savings	44980	33205	1639
Asymmetric Wealth Definition	94148	65550	4784

Source: Authors' own calculation based on SAVE 2010, all data are weighted. N=611

Figure A.3 Distribution of projected net wealth at the time of retirement for SHARE respondents



Source: Authors' own calculation based on FDZ-RV – SHARE-RV 3-0-0, all data are weighted.

Table A.6 Monthly annuity and coverage of the pension gap in SHARE (asymmetric wealth definition)

	Mean	**Median**	**Standard Error**
Monthly annuity (in Euro)	450	296	23.6
Amount of coverage (in Euro)	336	201	22.6
Coverage rate (in %)	565	346	35.7
	Fraction of households with		
	covered pension gap (%)	**non-covered pension gap (%)**	
Based on asymmetric wealth definition	78.6	21.2	

Source: Authors' own calculation based on FDZ-RV – SHARE-RV 3-0-0, all data are weighted. Note: Annuity calculations are based on cohort life expectancy (Version 1).