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Pension Entitlements and Net Wealth in Austria

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Pension Entitlements and Net Wealth in Austria*

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Abstract

This study combines data from the HFCS (Household Finance and Consumption Survey) and the social security registry to estimate the present value of public pension entitlements for Austria in the year 2017. The household averages of the present value of pension entitlements and of private net wealth turn out to be similar (both amounting to around €250,000) which is in line with the results for other countries like Switzerland, Germany and the US. Since pension entitlements are more equally distributed than other assets most inequality measures for augmented wealth (the sum of pension entitlements and net wealth) are lower than for net wealth. The Gini coefficient for Austria, e.g., decreases from 0.73 (for net wealth) to 0.53 (for augmented wealth) which is again fairly similar to the results for other countries. Furthermore, it is shown that the main results are robust to many alternative specifications. In particular, estimates based on statistical matching and on direct survey information lead to surprisingly similar results. The same is true for specifications with homogeneous or heterogeneous life expectancy and with retirement at the statutory or the individually expected retirement age. Finally, the paper compares the results to the ones of the related literature, sums up the limitations of the approach and discusses why the results have to be interpreted cautiously due to the fact that pension entitlements and net wealth are not perfectly commensurable concepts.

Keywords: Net wealth, Net worth, Pension entitlements, Augmented wealth, Life cycle, HFCS
JEL-Classification: D31, H55, J32

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Non-Technical Summary

In Austria, as in many other countries, there exists a well-developed public pension system that is the main source of old-age income for a majority of the population. Both theoretical models and basic intuition suggest that the presence of a well-developed and credible pension system will decrease the necessity to accumulate private wealth which should be reflected in individuals' decisions on life-cycle savings. In recent years a number of papers have tried to quantify the aggregate value of these public pension promises and to contrast them to the existing estimates of net wealth (i.e. the sum of financial and real asset minus total debts). So far this has only been done for a small group of countries including Germany, Switzerland, Italy, the US and Australia. In this present paper we add to this literature by conducting a similar exercise for Austria. To this end we combine data from the Household Finance and Consumption Survey for the year 2017 with data from the social security register.

The paper has three main contributions. First, we complement the existing literature on augmented wealth (i.e. the sum of pension entitlements and private net wealth) by expanding it to yet another country. We find that public pension entitlements are important for the average Austrian household. In our benchmark specification we estimate their value to being of almost the same size as private net wealth (both amounting to around €250,000). This underlines the size and importance of the public pension system for old-age security in Austria. Since most households receive pensions or have pension claims and since these pension entitlements are more equally distributed than other assets, most inequality measures for augmented wealth are lower than for net wealth. The Gini coefficient for Austria, e.g., decreases from 0.73 (for net wealth) to 0.53 (for augmented wealth).

The second contribution of the paper is the provision of a systematic overview of the existing literature, both with respect to the employed methods (Table 1) and to the estimated results (Table 10). We document that the cross-country results show a similar pattern for the majority of countries. In particular, we find that the share of pension entitlements in augmented wealth typically lies round 50% (as is the case for Austria). One difference across countries is, however, whether the value of pension entitlements is concentrated in the first (the public) pillar (as in Austria) or in the second and third pillars. For the distributional measures the pattern is also quite similar across most countries. The Gini coefficient, e.g., is reduced when moving from net wealth to augmented wealth by around 30% for Austria, Germany and Switzerland.

The third contribution of the paper is methodological. We show that the basic results are quite robust to various assumptions concerning life expectancy, the retirement age and the data source. In particular, the use of statistically matched data (our benchmark approach) leads to almost identical results as the use of direct survey information or an estimation of expected pension benefits based on recollected work history. These robustness results are relevant for cross-country comparisons since the papers of the related literature are often based on different methods and approaches to calculate pensions entitlements.

Contents

1 Introduction

In Austria, as in many other countries, there exists a well-developed public pension system that is the main source of old-age income for a majority of the population. If (or in as far as) the current stipulations of the system are taken as credible, these pension promises will reduce the necessity and the incentives to engage in life-cycle savings, thereby also reducing the fraction of wealth which is accumulated for this purpose. In recent years a number of papers have tried to quantify the aggregate value of these public pension promises and to contrast them to the existing estimates of net wealth (i.e. the sum of financial and real asset minus total debts).[1] This has been done, e.g., for Germany (Rasner et al. 2013, Bönke et al. 2019, Bönke et al. 2020), Switzerland (Kuhn 2020), the US (Bönke et al. 2020, Sabelhaus & Volz 2020, Catherine et al. 2020) and Australia (Longmuir 2021). In the present paper we add to this literature by conducting a similar exercise for Austria. To this end we combine data from the third wave of the Household Finance and Consumption Survey (the HFCS, which contains information about private wealth for Austrian households from the year 2016/2017) with data from the social security register (which provides information about public pension entitlements for the same period). Since it has not been possible to directly link the survey and the administrative data (e.g. via a unique identifier) we had to resort to the method of statistical matching in order to approach this task.

In line with the results of the related literature we find that public pension entitlements are important for the average Austrian household. In our benchmark estimation we find that their value is of almost the same size as private net wealth (both amounting to around €250,000). This underlines the size and importance of the public pension system for old-age security in Austria. Our results are completely in line with the ones for Germany and Switzerland that have found a similar quantitative importance of pension entitlements relative to private net wealth. One difference across countries is, however, whether the value of pension entitlements is concentrated in the first (the public) pillar (as in Austria) or in the second and third (the occupational and private) pillars as, e.g., in Switzerland. The presence of pension entitlements also affects the estimation of the distribution of resources across households. If one adds the value of pension entitlements to the value of net wealth then the resulting entity of "augmented wealth"[2] is more equally

[1] The literature sometimes uses the term "net worth" instead of net wealth. Acknowledging that there exist different definitions of these expressions we use them synonymously in the following and we will mainly stick to the term "net wealth".

[2] This term has been suggested by Wolff (1996) and Davies & Shorrocks (2000) and has been taken up

distributed than private wealth. In our analysis, e.g., the Gini coefficient for augmented wealth comes out as 0.53 while the Gini coefficient for net wealth is 0.73. These results are again comparable with the ones for Germany (where the Gini is reduced from 0.76 to 0.51) and Switzerland (where it drops from 0.75 to 0.55).

The inclusion of pension entitlements offers are more encompassing picture of households' economic possibilities across the life cycle. Households that expect sizable future public pension benefits are likely to hold less assets than households that have to provide by themselves for old-age security. The exclusion of public pensions might thus distort the assessment of the distribution of economic resources between households within a country and also the comparison between countries that are characterized by differently organized welfare states (see Fessler & Schürz 2018). At the same time it has to be noted at the outset that the combination of private net wealth and (public) pension entitlements is not without problems and the ensuing results have to interpreted with care. The first concern is of a more practical nature and refers to the difficulty of coming up with reliable estimates of future pension entitlements, especially if the goal is to produce an internationally comparable dataset. This concern is, e.g., emphasized in the Guidelines for Micro Statistics on Household Wealth by the OECD (2013).[3] The objection against the integration of public pension rights into households goes, however, considerably beyond these practical considerations. These fundamental objections focus on three important issues. The first one is that the valuation of wealth should be based on a concept of "marketable wealth". There does not exist a market for future pension entitlements and each calculation must be based on a number of specific and ultimately arbitrary assumptions.[4] Second, once the analysis is extended beyond the items for which markets and prices exist, it is no longer clear where to draw the line.[5] The third issue is even more fundamental and refers

frequently, e.g. also by the OECD (2013). The standard definition of augmented wealth adds public and occupational pension entitlements to net wealth. We want to clarify at the outset, however, that for our estimates of augmented wealth in Austria we abstract from occupational pension entitlements. We do this for reasons of data availability. This omission, however, is likely to be innocuous since occupational pensions play only a minor role for Austrian pensioners. We come back to this issue in section 6.4 where we also present estimates based on rudimentary data that are in line with this conjecture.

[3] "The exclusion of entitlements in social security schemes, as recommended here for micro statistics on household wealth, is primarily for practical reasons and to maintain consistency with the SNA's [System of National Accounts'] definition of financial assets. It reflects the view that reliable estimates of pension entitlements in social security schemes may not be readily available in many countries." (OECD 2013, p.71).

[4] "Once we depart from observed market transactions, any estimate of what assets 'would sell for' involves a number of speculative assumptions. This applies to various classes of assets but is particularly the case with defined benefit pension rights" (Alvaredo et al. 2018, p.28).

[5] "Including Social Security in wealth would thus call for including the present value of future health

to the different functions, disposabilities and capabilities of various categories of wealth. Financial assets are not only useful as a store of value for future consumption needs, they are typically also instantaneously available in case of an unforeseen emergency, as a down-payment for the purchase of real estate or the founding of a business enterprise. Furthermore, they can be inherited to the next generation and they can—depending on their size—also be drawn on to maintain and gain social status and to try to exert influence in the social or political arena.[6] Future pension entitlements do not fulfill any of these additional functions of wealth and based on this observation they should not get the same weight in a compilation of household wealth.[7] Ultimately, it depends on the focus of the investigation whether and to which extent pension entitlements should be included into the analysis. All of these obstacles and concerns are well-known and also briefly discussed in some papers of the related literature.[8] Typically, however, these objections are only mentioned in the introductory remarks while the rest of the papers treats the present value of public pension entitlements (often referred to as "pension wealth") as completely equivalent to the rest of the items of household wealth. In order to remind us and the reader of the fact that pension promises are a different entity than net wealth we stick in this paper to the term "(public) pension entitlements". We will use the expression "augmented wealth" for the sum of pension entitlements and net wealth, however, since it is an established notion (see Wolff 1996, Davies & Shorrocks 2000, OECD 2013). Also in this case, however, one should remain aware of the fact that this magnitude adds up two incommensurable, or at least heterogeneous entities.

The paper is structured as follows. In section 2 we summarize the existing literature and we also delineate the available methods that can be used to incorporate information on households' pension entitlements. In section 3 we present the basic structure of the Austrian pension system while in section 4 we describe the two main data sources—the

benefits (such as Medicare benefits in the United States), future government education spending for one's children, etc., net of future taxes. It is not clear where to stop, and such computations are inherently fragile because of the lack of observable market prices for these types of assets" (Zucman 2019, p.113).

[6]"It has also to be remembered that we are concerned about the distribution of wealth not only on account of the potential consumption. Wealth conveys power. [...] The degree of direct personal control over resources [...] is one of the major reasons for interest in the concentration of wealth.[...] It is [then] reasonable to omit assets, such as pension rights, over which the individual has only limited or no control" (Alvaredo et al. 2018, p.28).

[7]One could argue that the existence of survivor pensions provides for heritability of pension rights. This, however, would ignore major differences between survivor pensions and normal bequests. The recipients of survivor pensions cannot be freely chosen, the claims cannot be passed down to further generations and the eligibility depends on various conditions (e.g. income differences, remarriage etc.).

[8]See, for example: Bönke et al. (2020, p.38), Kuhn (2020, p.1), Catherine et al. (2020, p.3). See also Fessler et al. (2011).

HFCS and data from the social security registry—and we also sketch the technique of statistical matching used to combine these two data sets (details can be found in Lindner & Schürz 2021). Section 5 discusses the basic formula that is used to calculate the present value of public pension entitlements. We show how the estimates are based on the choice of several crucial parameters (the retirement age, the survival rates, the discount rate and the definition of pension benefits) and we state (and justify) the assumptions underlying our benchmark estimation. Section 6 contains the results for our estimates for Austria, divided in various sub-sections dealing with: the results for the aggregate values and the implications for the wealth composition (section 6.1), a breakdown with respect to various socio-demographic characteristics (section 6.2), the distribution of public pension entitlements across the population and various inequality measures (section 6.3). In section 6.4 we show how the benchmark results change for various alternative assumptions (with respect to the definition of pension income, life expectancy, the retirement age and the discount rate). We show there that the basic results are quite robust to the use of different data sources and methods to calculate the pension entitlements. in particular, the use of statistically matched data (our benchmark approach) leads to almost identical results as the use of direct survey information or an estimation of expected pension benefits based on survey respondents' recollected work history. These novel robustness results are relevant for cross-country comparisons since the papers of the related literature are often based on different methods and approaches to calculate pensions entitlements. We also show that the benchmark results remain almost constant for the assumptions of homogeneous instead of heterogeneous (i.e. income-dependent) life expectancy (as in the benchmark) and the same is true if we use the individually expected retirement age instead of the statutory retirement age (as in the benchmark). In section 6.5 we discuss a number of limitations of our approach (referring, e.g., to the exclusion of minimum and survivor pensions). In section 7 we provide an tabular overview of the related literature and we compare our results to the ones for other countries. This part is the second contribution of the paper that goes beyond the documentation of country-specific estimations for Austria. The international comparison shows a broad similarity of the results for the majority of countries and also offers some tentative explanations for the smaller group of countries that do not follow the general pattern. Section 8 finally concludes and discusses implications of the findings.

2 Related literature

The literature on the calculation of public pension entitlements is not excessively large and there exist only a small number of papers for a handful of countries. What is more, we are only aware of one paper (Bönke et al. 2020) which attempts to calculate comprehensive and comparable measures of (public) pension entitlements for more than one country (in this case Germany and the US). This has to do with the fact that both—wealth surveys and even more pension systems—are highly country-specific and it is often quite difficult to make them comparable. Table 1 provides a brief summary of the main papers of the related literature (including—for the sake of comparison—in the last line the present paper).[9] The table reports the country, the time period, the unit of observation (individual or household), the sample size, the data source and the method used to combine information on net wealth (defined as the sum of financial and real assets minus eventual debts) and on public pension entitlements. All papers use comprehensive national surveys to come up with estimates of net wealth while the methods employed to append public pension entitlements differ along two dimensions: the source of data (the survey itself, linked register data or statistically matched administrative data) and the construction of the pension entitlements (direct information on the present value or simulations based on individual work histories and prevailing regulations). In principle there could thus be six possible combinations of data source and pension calculation, although not all of them can actually be observed in the literature. The choice for one or another method depends mainly on data availability, institutional details and legal restrictions. In the following we provide a brief overview of the most popular methods ordered by the underlying data source.

Information on pension entitlements in wealth surveys: The first and self-evident possibility to amend the traditional wealth data recommends itself when the survey itself includes reliable information that can be used to estimate pension entitlements.

- *Survey questions on present values:* If the survey contains a specific question on the

[9] A number of papers have not been included below since they focus on special subgroups of the population: Maunu (2010), e.g., only includes non-retired Finnish households above the age of 45; Crawford & Hood (2016) British individuals aged between 65 and 79; Wolff (2015) and Jacobs et al. (2021) US households for age brackets between 40 and 64; Cowell et al. (2017) European households (in 13 countries) whose reference person is aged 65-84. Roine & Waldenström (2009) have a different perspective as they focus on the development of wealth concentration in Sweden over the long-term (1873-2006). An early attempt to quantify social security wealth for Austria is Holzmann (1981) which—due to data limitations—is based on national income data.

Table 1: Main features of the related literature

Paper	Country	Period	Unit	Sample size	Data Source	Method
Mazzaferro & Toso (2009)	ITA	1991-2002	HH	8,000	SHIW	Linkage survey/admin. data
Rasner et al. (2013)	DEU	2007	Ind.	20,000	SOEP/admin. data	Stat. Matching
Bönke et al. (2019)	DEU	2012/13	Ind.	16,200	SOEP	Admin. inform. plus imput.
Bönke et al. (2020)	DEU	2012	HH	8,500	SOEP	Admin. inform. plus imput.
Bönke et al. (2020)	USA	2012	HH	6,000	SCF	Admin. inform. plus imput.
Sabelhaus & Volz (2020)	USA	1995-2016	HH	4,000-6,000	SCF	Retrosp. work hist.
Catherine et al. (2020)	USA	1989-2016	HH	4,000-6,000	SCF	Retrosp. work hist.
Kuhn (2020)	CHE	2015	Ind./HH	10,164/7,468	SILC/admin. data	Linkage survey/admin. data
Longmuir (2021)	AUS	2018	HH	9,486	HILDA	survey information
This paper (2022)	AUT	2017	HH	3,072	HFCS/admin. data	Stat. Matching

Note: The abbreviations for the data sources are as follows: SHIW=Survey of Household Income and Wealth, SOEP=Socio-Economic Panel, SCF=Survey of Consumer Finances, SILC=Statistics on Income and Living Conditions, HILDA=Household, Income and Labour Dynamics in Australia, HFCS=Household Finance and Consumption Survey. Other abbreviations are: HH=households, ind=individuals, admin=administrative, stat=statistical, inform=information, imput=imputation, retrosp=retrospective, hist=history.

present value of future pensions entitlements then this approach is straightforward. The available responses can be treated like the other wealth components and simply added to the calculations. The problem with this approach is that it is often not enough to ask respondent about their pension entitlements since many individuals (especially when retirement seems far away in the future) do not have deep knowledge about their accrued pension entitlements (or—depending on the nature of the pension system—the benefits are not even easily observable in advance and are only calculated at the moment of retirement). It would thus be beneficial in this situation if the interviewer could resort to official information (e.g. pension account statements) either via inspection of documents provided by the respondents or via their agreement to access register information. This has, e.g., been done in special waves of the German Socio-Economic Panel (SOEP). Bönke et al. (2019) report that 41% of the respondents looked at the official information from the Gesetzliche Rentenversicherung to indicate the value. The paper uses imputed values if a respondent did not report a value or only provided an approximate value. This means, however, that the share of imputed pension information might still be fairly large even if respondents are asked (or motivated) to provide the official information.

- *Survey questions on retrospective work history:* Sometimes surveys include information about respondents' past labor market experiences (like the start of their working career, their spell of unemployment or non-work periods and their received wages). This allows the researchers to calculate (or rather simulate) the expected pension benefits by using the existing legislation of the pension system. This approach is rather tedious since it requires not only the careful processing of the information of past work history (and also the filling in of missing information) but also an exact coding of the regulation that typically includes a good number of details, exceptions, special treatments etc. Furthermore, not many surveys include sufficiently detailed information such as to facilitate this approach. One exception is the US Survey of Consumer Finances (SCF) that includes a module that contains the retrospective work history and prospective work expectations of respondents in the SCF. This method has been chosen, for example, by Sabelhaus & Volz (2020), Catherine et al. (2020) and Jacobs et al. (2021). These authors also use various methods of validation to show that this approach leads to satisfying results.[10]

[10] In particular, the authors state that they "can match the aggregate estimate of Social Security wealth of the SSA [Social Security Administration], and that [their] estimates correctly match actual retirement-age benefits reported in the SCF" (Catherine et al. 2020, p.2).

Exact link to register data: The quality of the results can typically be improved if it is possible to use precise register data to get the necessary information about pension entitlements. This could, e.g., be done by using a unique identifier (like the social security number) that is present both for the survey respondents and also in the official register data. This approach has been used, e.g., by Kuhn (2020) for Swiss data. In particular, the author linked survey data for Switzerland coming from the SILC survey conducted in 2015 with various types of administrative data (including the registries for federal income, population, marriage, divorce, birth and death). The matching rate was an impressive 99% of the sample.[11] In processing the data one can again use the two possible ways to extract pension entitlements.

- *Register data on present values:* This approach is possible if the linked administrative data already contain present values of pensions entitlements or information that is closely related to these values, like—for example—the total pension points in a point system (cf. Germany), the pension account value in a notional defined contribution system (cf. Sweden) or the total credits in a notional defined benefit system (cf. Austria). In Germany there exists an ongoing project that follows this route by linking data from participants in the SOEP survey to their individual record in the pension insurance (Lüthen et al. 2022, forthcoming).

- *Register data on work history:* Even if the register data might not provide direct present values of entitlements they can sometimes still be used to provide more accurate estimates based on work history. This method (that again involves many assumptions and the coding of pension regulations) has, e.g., been followed by Kuhn (2020) in her work with Swiss register data.

Statistical matching: The final method of adding pension entitlements to wealth data is the use of statistical matching techniques. This is the method at hand if the survey neither contains reliable pension data nor sufficient work history information and if the exact linkage of survey and administrative data is impossible for technical or legal reasons. Again the statistically matched data can involve present values of pension entitlements or data on work history that have to be transformed into entitlement estimations. This method is followed, e.g., by Rasner et al. (2013) who statistically match administrative

[11] The author states that "two reasons explain the high matching rates for data linkage: social security number was contained in the sampling frame and the linkage required no additional consent from survey respondents" (p.5). In particular, the linkage of the SILC data and the administrative records was based on a project-specific contractual agreement.

data from the Gesetzliche Rentenversicherung to the German SOEP.[12]

For the Austrian data we also use the last approach based on statistical matching as our main method. The second method—based on a direct link between survey respondents and administrative data—has been impossible due to legal restrictions. The first method—based on survey information—was not chosen as the primary approach for practical reasons. On the one hand, the HFCS for Austria contains a block of question on the acquired public pension claims. The use of this direct survey information, however, proved to be problematic since many respondents did not give an answer to this question and, furthermore, the received answers do not seem to be completely reliable. The construction of pension entitlements based on retrospective work history, on the other hand, did not look promising since the HFCS contains only very sparse information about past labor market variables. In section 6.4 we analyze, however, how the benchmark results based on statistical matching change if we use the alternative methods based on (incomplete) direct survey information or (very rough) measures of the work history. Anticipating the results we find that the different methods lead to surprisingly similar estimates. This is an interesting finding that not only increases the confidence in the benchmark results of this paper but also supports the significance of cross-country comparisons that are based on papers that use different methods.

In closing this literature review we want to briefly mention that there exists an additional strand of literature that is related to our investigation. In particular, this literature focuses on one implication of the life-cycle model and tries to analyze the effect of public pension entitlements on private savings. The benchmark model (Modigliani 1986) suggests a one-to-one substitution between the two magnitudes. The empirical literature—starting with Feldstein (1974)—finds somewhat mixed results depending on the definition of future pension entitlement (in the US context often classed SSW, "Social Security Wealth"), the studied time period and the empirical method used. Some well-known papers in this literature include Attanasio & Brugiavini (2003), Bottazzi et al. (2006) and Chetty et al. (2014). The literature is too vast to be summarized here. Overall one can say that the studies find only weak evidence for a crowing out effect, typically considerably lower than the full set-off implied by the theoretical model. This is explained by additional savings

[12] In particular, they used the so-called "Versichertenkontenstichprobe" that contains the data of about 1% of the insured population in Germany. The authors use 4 different matching techniques (hotdesk, regression, predictive mean matching, Mahalanobis distance) and come to the conclusion that the latter measure shows the best performance.

motives (bequest, precaution etc.), liquidity constraints, risk-aversion, individual myopia, incomplete information and less-than-rational behavior. For the context of our analysis it has to be stressed that these papers are not so much concerned with the effect of future pension entitlements on the estimation of average wealth or the wealth distribution but rather with a test of behavioral predictions in the context of the life-cycle model.

Finally, we want to mention that the period OECD publications *Pensions at a Glance* (e.g. OECD 2019) also include numbers for country-specific pension wealth. These, however, are based on hypothetical individuals with stylized employment careers and are thus not directly related to the orientation of this paper.

3 The Austrian pension system

The majority of the working population in Austria participates in a mandatory public pension scheme that is specified in the General Pension Act (Allgemeines Pensionsgesetz, APG). Some (liberal) professions like doctors and lawyers have separate systems that follow specific rules and that are excluded from our calculations. Civil servants also had and in certain areas still have separate system which are briefly described in appendix A.3.2. Occupational pensions only play a minor role in the current Austrian pension landscape. In the year 2016 the total accumulated asset of the second pillar amounted to only 6% of GDP (considerably below the OECD average of 100%) and only 10% of pensioners received any occupational pension benefits. In the following we abstract from these occupational pension benefits but come back to the issue in section 6.4.

The APG system is organized on a pay-as-you-go basis and it is based on "individual defined benefit pension accounts". The contribution rate stands at 22.8%, of which 10.25% are paid by employees and 12.55% by employers (there are some exceptions for farmers and for self-employed persons). The main element of the benefit side of the system is the formula: "80/65/45": After 45 years of insurance and retirement at the age of 65, the system provides an initial pension benefit that corresponds to 80% of average lifetime income. This target is implemented by means of an accrual rate ("Kontoprozentsatz"). Every year 1.78% of total earnings (up to a ceiling, the "Höchstbeitragsgrundlage")[13] are credited to the account ("Teilgutschrift", annual credit AC) while past credits are revalued by the growth rate of the average contribution basis. The revalued past credits and the annual new credit add up to the total pension value ("Gesamtgutschrift", total credit

[13]The ceiling in the year 2016 was set at €4,860 per month or €68,040 per year (14 monthly installments). About 5% of all employees receive earnings that exceed this upper threshold.

TC). The credits are recorded in the pension accounts that can be retrieved either via online access or (on demand) by normal mail by the insurance agency. The information given in the pension account statement can be easily transformed into pension benefit levels. In fact, by construction the total credits correspond to the annual initial pension benefit that an insured person could expect if he or she retires at the statutory retirement age (65 years for males and increasing until 2033 from 60 to 65 for women) and if there would not be any additional credits to the account and no further revaluation. Although these total credits thus do not provide reasonable forecasts of individual expected pension benefits, they are a highly useful concept for our purpose since they correspond exactly to the pension rights that have been accrued up to a certain point in time (i.e. they are the "accrued-to-date" value; see section 5.1 below).[14]

For early retirement within an age corridor between the age of 62 and 65 there are deductions of 5.1% for each year of earlier retirement and supplements of 4.2% for each year after 65 up to the age of 68. Only persons with a record of at least 40 years of insurance can use the pension corridor. Once the initial pension benefits are calculated according to the rules specified above, the ongoing pensions are (typically) adjusted with the rate of inflation. For non-contributory qualifying periods (due to childcare, unemployment, sickness etc.) the pension accounts are credited with specified amounts that are financed from the general government budget.

As stated above, our estimates of pension entitlements are defined as the present value of the entire stream of expected public pension benefits. For the later calculations of these present values (see equation (4) in section 5) it is useful to express the determination of pension benefits in formal terms. The (annual) initial pension benefit $PBI_i \equiv PB_i(R_i)$ for individual i is given by:

$$PBI_i = \kappa \overline{Y}_i D_i (1 - \lambda \times (R_i^s - R_i)) = TC_i \times (1 - \lambda \times (R_i^s - R_i)), \tag{1}$$

where $\kappa = 0.0178$ is the accrual rate, $\overline{Y}_i$ is the average lifetime pensionable labor income,

[14]It should be noted that the pension accounts of the APG were only introduced in the year 2005 for all birth cohorts born 1955 or later. Individuals born before this date remained in the old system while people that entered the labor market in or after 2005 have been covered entirely by the new system. For individuals born after 1954 that have worked before 2005, however, the original law had stipulated a mixed calculation that contained elements of the new and the old system. This turned out to be rather complicated and in 2013 the old claims were "summarized" in an "initial credit" ("Kontoerstgutschrift", IC) which was intended to compensate for the discontinuation of the mixed calculation. This initial credit is included in the value of the total credit as reported in the pension account statement. In our datatset—see section 4—we also have information about the precise value of initial credits for all insured individuals.

D_i stands for the number of contribution (or insurance) years, R_i is the retirement age of individual i, R_i^s is his or her statutory retirement age and λ the annual deduction (supplement) for early (late) retirement ($\lambda = 0.051$ for $R_i < R_i^s$ and $\lambda = 0.042$ for $R_i > R_i^s$). Total credits are given by $TC_i = \kappa \overline{Y}_i D_i$ (where for notational simplicity we abstract from the presence of initial credits). Ongoing pensions are adjusted with the rate of inflation π (for simplicity here assumed to be constant). This means that for ages $x > R_i$ it holds that:

$$PB_i(x) = PB_i(x-1)(1+\pi). \tag{2}$$

A final element one has to take into account when determining the disposable pension incomes is the tax system. It is given by applying the tax rate $\tau_i(x)$ (which follows from the income tax schedule) to the gross pension of individual i at age x. This disposable pension income $P_i(x)$ can thus be written as:

$$\begin{aligned} P_i(x) &= (1-\tau_i(x)) \times PB_i(x) = (1-\tau_i(x))PB_i(x-1)(1+\pi) \\ &= (1-\tau_i(x))PBI_i(1+\pi)^{x-R_i} \\ &= (1-\tau_i(x))(1+\pi)^{x-R_i}(1-\lambda \times (R_i^s - R_i)) \times TC_i, \end{aligned} \tag{3}$$

where $\tau_i(x)$ is the (expected) tax rate at age x and where we use equations (1) and (2) for the substitutions. We use equation (3) later as the basis for the calculation of public pension entitlements.[15]

4 Data and methodology

Our main data source for net wealth is the Eurosystem Household Finance and Consumption Survey (HFCS) to which we match data from the social security register. Both data sources are briefly described in the following. Details of the data and the statistical matching methodology can be found in Lindner & Schürz (2021).

4.1 HFCS

The HFCS is a comprehensive survey of households' balance sheets that covers incomes, expenditures as well as real assets, financial assets and debt and thus allows the calcula-

[15] Importantly, we take the total credits TC_i^{2016} of individual i at the end of 2016 and revalue them up to the year of retirement, i.e. we use hypothetical total credits amounting to: $TC_i^{2016}(1+g)^{R_i - a_i}$, where a_i is individual i's age in 2017 and g is the average revaluation rate.

tion of net wealth. We use the third wave of the HFCS for Austria that has been carried out between late November 2016 and July 2017. A total of 3,072 households have been interviewed which contain 6,414 persons, 5,476 of which were 16 years old or older and are used for our analysis. In order to deal with the issue of non-responses the HFCS uses multiple imputations. In particular, the dataset provides five imputed values (replicates) for every missing value. In addition, the dataset also contains 1000 replicate weights that can be used to estimate standard errors without having the full sampling information. These weights refer to the household level and we will also use it when presenting weighted results on the person level. The information about persons in the HFCS is somewhat less extensive than on the household level. Nevertheless, it contains a number of questions about occupation, work history, income sources and various pension rights that are valuable for the calculation of pension entitlements. In particular, we have also made use of a set of special variables (e.g. about the pension account statement) that are not part of the harmonized set of core variables present in all participating countries.

4.2 Data from the social security register

The second bulk of data stem from the social security register (SSR). In particular, we managed to obtain a complete snapshot of social security data for the year 2016. These data contain (i) information about the pension account statements of all active individuals born between 1955 and 2001, (ii) information about the pension payments for all retired individuals (except retired civil servants). The data do not contain information about active person that have been born before 1955 since for them the pension account system does not apply (see section 3). The information for the active population (more than 4 million individuals) includes: gender, the age group (in 5-year intervals), the social security institution, the postal code, the initial pension credit, the annual pension credits for the year 2016 and the total pension credits at the end of the year 2016. The information for the retired population (about 650,000 individuals) is similar, only that now the information about the pension account is substituted by data on the monthly gross pension (for December 2016), the pension type (old age, survivor, disability etc.) and the point of time when the pension payments started.

4.3 Statistical matching

In order to amend the information from the wealth survey with information about public pension entitlements the SSR data (the donor) have been matched to the HFCS data (the recipient). The matching procedure has been implemented at the person level making use of the following matching variables: age, gender, income, geographical information (postal code), social security institution. Each person implicate in the HFCS data is taken as a separate observation and matched to a specific observation in the SSR data. The matching is based on the random hotdesk procedure and two variants were conducted (that differ in whether income is treated as a categorical or a continuous variable). For details on the matching procedure and the results see Lindner & Schürz (2021).

The first matching procedure (based on income categories) which we also use as our benchmark specification below resulted in an average total pension credit (for individuals) of €11,340 (which is above the unweighted average of the SSR data amounting to €9,800).[16] The median is €9,150 while the highest value is close to €50,000. We can aggregate the individual total credits to the household level and arrive at a (weighted) household mean of €18,500 with a median of €15,500 and a largest value of €91,500.

5 Calculation of pension entitlements

Once we have the matched values for the individual total pension credits (see the previous section) we can proceed to use this information to transform it into a unique number that can be regarded as a suitable estimation of the present value of public pension entitlements. This process involves several important assumptions as will be discussed in the following.

5.1 "Accrual method" vs. "ongoing concern method"

The first issue in this endeavor is related to the range of expected pension payments that should be included into the present value term of the active population. Should this encompass only entitlements that have been acquired up to the valuation date or should it also cover pension rights that are likely to be gained in the future (after subtracting future pension contributions)? The first approach is typically called the "accrual method" while the latter approach is referred to as the "ongoing-concern method". Most papers of the related literature use the first method, although there are a number of important exceptions (see e.g. Sabelhaus & Volz 2020, Catherine et al. 2020). We join the majority

[16] The difference is likely due to the fact that the SSR contains a larger fraction of people with low or very low incomes in 2016. In fact, every individual who has worked at some time in Austria has a pension account even if he or she did not have any income in 2016. As a consequence the share of individuals with income below the minimum income threshold is higher in the SSR than in the HFCS data.

of researchers and base our calculations on the accrual method. In our view this approach is in line with the general logic of household surveys (as it excludes future revenues) and as a by-product it also involves less assumptions about the expected working career which necessarily introduce a considerable degree of uncertainty.[17]

5.2 The present value formula

In this section we describe how one can use the information on total credits (for active workers) and pension payments (for pensioners) to calculate the present value of public pension entitlements. This present value can be calculated on the basis of the following formula:

$$PE_i = \sum_{x=max(a_i,R_i)}^{\omega} \frac{s_i(x)}{s_i(a_i)} \frac{P_i(x)}{(1+\delta_i)^{x-a_i}}, \tag{4}$$

where we use the following notation: PE_i stands for the pension entitlements (the present value of expected public pension entitlements) of person i, a_i for his or her age in the year 2016 and R_i for his or her retirement age. For an active (not-retired) person the retirement age lies in the future while for an already retired individual the retirement was an event of the past. The maximum function implements this distinction between active workers ($a_i < R_i$) and retirees ($a_i > R_i$) and equation (4) thus applies to both groups. $s_i(x)$ denotes the survival rates, i.e. the probability that person i is still alive at age $x \geq a_i$.[18] The use of an index i in this expression captures the fact that there exists a strong correlation between specific individual characteristics (like education or income) and mortality. The parameter ω stands for the maximum age (say 110) that is assumed to be the same for all cohorts. δ_i denotes the discount rate that is used today (i.e. in 2016) to discount a pension payment that is delivered in the year $2016 + x - a_i$. Note that for a person who has just retired in this year ($x = a_i$) this first pension benefit is not

[17]The papers that use the ongoing-concern method often have a different focus. For example, they want to study how the pension system treats different cohorts and if there are changes over time in the degree of sustainability of the system and in government subsidies.

This issue is also related to the appropriate measurement of pensions liabilities (or implicit debt) when one moves from the perspectives of the households (or individuals) to the one of the state (or the pension system). This literature (see Holzmann et al. 2004) makes similar distinctions and works with different definitions of pension liabilities, e.g., "accrued-to-date liabilities", "projected liabilities of current workers and pensioners" and "open-system liabilities" (ibd., p.12). The concept of "accrued-to-date liabilities" corresponds to the "accrued assets" that we are going to use as the basis of our calculations.

[18]Alternatively one could also write $s_i(a_i, x)$ instead of $\frac{s_i(x)}{s_i(a_i)}$ in equation (4) with $s_i(y, x)$ denoting the survival probability for individual i from age y to age $x \geq y$. Note that it holds that $s(a_i, x) = \frac{s(0,x)}{s(0,a_i)}$ and thus the two expressions are identical.

discounted. Otherwise pension payments that lie in the future do not enter the individual valuation at full value as is commonly assumed in these kinds of calculations. There exists a long controversy about the determination and the right choice of discount rates and we come back to this issue below. In order not to jump ahead of this discussion we again allow for the possibility that discount rates differ across individual members of these cohorts. $P_i(x)$ finally stand for the pension income that person i expects to receive at age $x \geq max(a_i, R_i)$ and it has been specified above in equation (3). The term $P_i(x)$ contains the entire effective legislation concerning the pension system. This comprises, on the one hand, the stipulations determining the size of the initial pension and pension adjustments as described above. In addition, the amount of pension income will also depend on whether one uses a gross or net concept where the latter accounts for taxes and social security contributions. Furthermore, one could also try to include the system of survivors' pension into this framework. Finally, the accurate size of future pension benefits will also depend on the expectation about future changes in the regulations ("pension reforms") and on the probabilities individuals (or the modelers) assign to the size and the extent of these adjustments.

On the whole, there exist a large number of possible specifications for the various parameters and variables that are necessary to calculate the PE_i. The (somewhat complicated) expression in equation (4) is a distinct reminder of the plethora of assumptions needed to complete these calculations and it also serves as a useful structure to organize later extensions, refinements and discussions.

5.3 Benchmark specification

In the following we list the assumptions that we chose for our benchmark specification and we briefly explain the underlying rationale behind the choices. Details can be found in the appendix while the results of alternative assumptions are discussed in a later section.

- **Statutory retirement age**. For R_i we assume that every individual will retire at the current statutory retirement age. For men this amounts to the age of 65 while for women it will gradually be raised from 60 to 65 years in the period from 2024 to 2033 (by steps of sixth months). In this case we do not have to take deduction (supplements) for early (late) retirement into account. In section 6.4 we will also look at the case where the retirement age R_i is set equal to individuals' expected retirement ages.

- **Life expectancy related to household income**. Numerous studies covering various countries and time periods have documented that life expectancy of low-income individuals is considerably below the one of high-income individuals. Chetty et al. (2016), for example, report that the life expectancy gap between the richest and the poorest percent of the American population is 14.6 years (for men) and 10.1 years (for women).[19] In order to come up with income-specific mortality rates for Austria we followed a procedure that has also been used by Sabelhaus & Volz (2020) (see their Appendix B). This method starts with the mortality rates for the year 2017 provided by Statistics Austria that are differentiated by gender and age. In the next step we make an adjustment for differential mortality based on the pattern reported in Chetty et al. (2016) for the US. This adjustment is specified in such a way that the *average* mortality rate corresponds to the officially documented mortality rate for each gender/age group while within each group the mortality rates are allowed to differ with respect to the household income decile with *relative* mortality rates corresponding to the ones in Chetty et al. (2016). Details of the method are described in appendix A.2.2.[20]

- **Discount rate** $\delta_i = \delta = 3\%$. For the discount rate we assume a rate that is identical for all individuals and given by 3%. This follows the assumptions of and facilitates the comparison with the related literature (Bönke et al. 2019, Sabelhaus & Volz 2020). We want to emphasize, however, that this assumption is neither inconsequential nor trivial. In section 6.4 we come back to this issue when we discuss the effect of different choices of the discount rate.

- **Net pension benefits**: The final element in equation (4) that is necessary to calculate total public pension entitlements PE_i is evidently the stream of future disposable pension incomes $P_i(x)$ (see equation (3)). These entitlements are determined by the specific regulations of the pension system and it is here that one can observe a huge amount of cross-country diversity. For the calculations of the initial pension benefit we need an assumption on the real growth rate (chosen as $g = 1.3\%$,

[19] Data for Germany can be found in von Gaudecker & Scholz (2007) and Breyer & Hupfeld (2009).

[20] One might argue that the pattern of relative mortality differences for the US is not applicable to Austria. The available data, however, do not confirm this conjecture. In particular, there exists a study for Norway—a country with an arguably similar demographic structure as Austria (life expectancy of 82.5 vs. 81.8) —that finds very similar results to the ones reported in Chetty et al. (2016) for the US: "The difference in life expectancy between the richest and poorest 1% was 8.4 years for women and 13.8 years for men. The differences widened between 2005 and 2015 and were comparable to those in the United States" (Kinge et al. 2019).

a value that is in line with the assumptions made in European Commission (2021)) and an assumption on tax treatment. We use a net concept since in Austria contributions to the public pension system are exempt from taxation while the pensions payments are treated like earned income and are subject to income tax (for details see appendix A.3).[21] In the benchmark specification we do not take survivor and minimum pensions into account. Also we assume that all individuals will meet the conditions concerning the minimum insurance years that are necessary to be eligible for a pension.

In section 6.4 we discuss how the results of the benchmark specification are affected if the main assumptions are changed.

6 Results

In the following we will first present the estimates for the main aggregates (net wealth, pension entitlements and augmented wealth) in section 6.1 before we show various socio-economic breakdowns of the aggregate measures (section 6.2) and the implications for distribution and wealth inequality (section 6.3). In section 6.4 we show how the benchmark results change for alternative specifications and in section 6.5 we discuss some limitations of our analysis.

6.1 Aggregates and wealth composition

In this section we present estimates for households' net wealth, total pension entitlements and augmented wealth. The results for net wealth correspond to the figures reported in Fessler et al. (2019) and are discussed there in detail. In Table 2 we only repeat some important measures for the sake of comparison with the novel results.[22] In particular, we show the unconditional means and medians, the fraction of households that holds a specific wealth component (last column) and finally the mean and median for this subsample of households (i.e. the conditional values). For net wealth the conditional and unconditional measures coincide since every household holds some form of wealth (or liability).

[21]On different models of how to tax pension contributions and payments see Genser & Holzmann (2021).

[22]Following the standard practice in the analysis of HFCS data the computations are based on a bootstrap procedure using the five multiply imputed datasets.

The mean of household net wealth is around €250,000 which is considerably larger than the median of around €83,000. This is an indication of the unequal distribution of net wealth across household. We come back to the issue of the wealth distribution below in section 6.3. In Table 2 we also report aggregate measures for the most important subcomponents of net wealth which is defined as the sum of real assets and financial assets minus total debt. We have further subdivided real assets into the main residence, investment in self-employed business and all other real assets. The information about the ownership of the main residence is interesting since it represents for many households the most important category of wealth. In particular, almost 46% of households are owners of their main residence with a (conditional) mean value of €289,000 and a median of €250,000. For the subgroup of owners the conditional mean of net wealth is around €470,000 and thus the value of the main residence is on average 60% of their total wealth. Investment in unincorporated enterprises, on the other hand, is only observed for a minority of households (7%) for whom, however, the conditional mean is fairly high (€662,000).

Financial assets and other (real) assets (like vehicles, valuables and other real estate property) are less important for household net wealth with means of around €39,000 and €51,000, respectively. The participation rates in these categories are, however, high with 99.7% and 83.3%. Finally, the conditional mean of total (collateralized and uncollateralized) debt is around €57,000 where it is important to note that in Austria more than two-thirds of households do not have any debt (which is arguably the mirror image of the comparably low rate of home ownership).

We turn now to the estimates for household (public) pension entitlements. For this we added up the measures of the individual present values of pension entitlements that have been calculated from equation (4) under the assumptions specified above. We find that almost all household (around 99%) either receive or can expect to receive a pension[23] and that these (intangible) pension entitlements are large when compared to the tangible measure of net wealth. In particular, the median is around €200,000 which is more than twice the median of net wealth while the mean is about €245,000 which is only slightly below the mean value for net wealth.

One can add up net wealth and pension entitlements to arrive at a measure of "augmented wealth".[24] As discussed above, this is not innocuous since it adds two different

[23]The households without pension entitlements are mostly households that consist of young adults who have not yet contributed to the public pension system.

[24]The concept of "augmented wealth" is typically defined as also including the present value of occu-

(strictly spoken incommensurable) categories of wealth but it is a common practice in the related literature. The median comes out as around €330,000 which is four times larger than the median of net wealth. The mean, on the other hand, is calculated as €495,000 which is thus about twice as large as the mean for net wealth.

Table 2: Aggregates and wealth composition

Wealth aggregate	Mean (in €)	Median (in €)	Cond. Mean (in €)	Cond. Median (in €)	Participation (in %)
Net wealth	**250,272**	**82,681**	**250,272**	**82,681**	**100.00**
	(23,547)	(3,301)	(23,547)	(3,301)	(0)
Financial assets	38,637	15,460	38,738	15,539	99.74
	(1,927)	(735)	(1,930)	(736)	(0.1)
Main residence	132,825	0	289,112	250,000	45.94
	(2,851)	(0)	(5,772)	(0)	(4967)
Investment in self-employed business (incl. farms)	46,284	0	661,534	108,133	7.00
	(19,960)	(0)	(279,724)	(37,446)	(0.6)
Other (real) assets	51,292	7,900	61,570	10,000	83.31
	(5,940)	(346)	(6,939)	()	(0.7)
Total debt	18,766	0	57,328	17,140	32.73
	(1,395)	(0)	(3,768)	(1,869)	(1.0)
Public pension entitlements	**245,051**	**197,232**	**247,605**	**199,530**	**98.97**
	(4,169)	(5,046)	(4,026)	(4,724)	(0.2)
Augmented wealth	**495,324**	**327,456**	**495,324**	**327,456**	**100.00**
	(24,762)	(6,187)	(24,762)	(6,187)	(0)

Note: This table shows statistics for various aggregates of households' wealth and pension entitlements. The last column shows the percentage of households that have non-empty (but not necessarily positive) entries in the respective category. The conditional means and medians are the aggregate values for all household with non-empty observations. All statistics are based on imputed values. Bootstrapped standard errors using 1000 replica weights are shown in brackets.

6.2 The influence of socio-economic characteristics on wealth and pension entitlements

In this section we report the influence of various socio-economic characteristics on households' pension entitlements. In the first subsection 6.2.1 we approach this topic by presenting breakdowns with respect to various socio-economic indicators and we compare the results to the breakdowns with respect to net wealth. In subsection 6.2.2 we use a (multivariate) regression analysis to study the factors that have the largest impact on these entitlements.

pational pensions. Due to the lack of reliable data we leave out occupational pensions in our benchmark estimation. Since the second pillar only plays a minor role in Austria this omission is likely to have only negligible effects on the results as is confirmed in a robustness exercise in section 6.4.

6.2.1 Breakdowns by socio-economic characteristics

In this part of the analysis we provide a breakdown of the aggregate measures with respect to various socio-economic characteristics. The breakdowns refer to the characteristics of the reference person according to the Canberra Group standard (see OECD 2013). The results are summarized in Table 3.[25]

Table 3: Wealth and pension entitlements for socio-economic subgroups

	Net wealth (in €)	Public pension entitlements (in €)	Augmented wealth (in €)
Age			
16-29 years	50,788	34,451	85,240
30-39 years	131,281	82,908	214,189
40-49 years	276,019	184,271	460,290
50-64 years	396,873	355,416	752,290
65-74 years	238,084	395,834	633,917
75+ years	176,988	216,426	393,413
Household size			
1 person	147,931	155,913	303,843
2 persons	246,694	332,478	579,172
3 persons	322,373	256,401	578,774
4 persons	337,953	243,651	581,604
5+ persons	634,821	262,880	897,701
Gender of single households			
Male	154,202	138,122	292,323
Female	143,317	169,003	312,319
Education			
Below upper secondary school	162,715	215,265	377,980
Upper secondary school (completed)	261,161	266,783	527,943
University, technical college	567,941	309,135	877,075
Occupation			
Self-employed (incl. farmers)	1,127,846	281,198	1,409,044
(Skilled) blue-collar worker	147,080	169,086	316,166
White-collar worker	227,561	196,223	423,785
Civil servant	281,559	349,670	631,229
Pensioner	203,502	327,984	531,486
Other	70,103	77,789	147,892
Homeownership			
Renter (incl. free usage)	58,175	185,270	243,445
Owner	476,301	315,392	791,694

Note: This table shows the means of net wealth, public pension entitlements and augmented wealth for various socio-economic subgroups. The subgroup always corresponds to the reference person (according to the Canberra Group standard). The category "Other" for occupation includes a mixed group of subcategories ranging from unemployed and disabled to students and homemakers.

[25] For the sake of better readability we leave out the standard errors here and in the following tables. The complete results are available upon request.

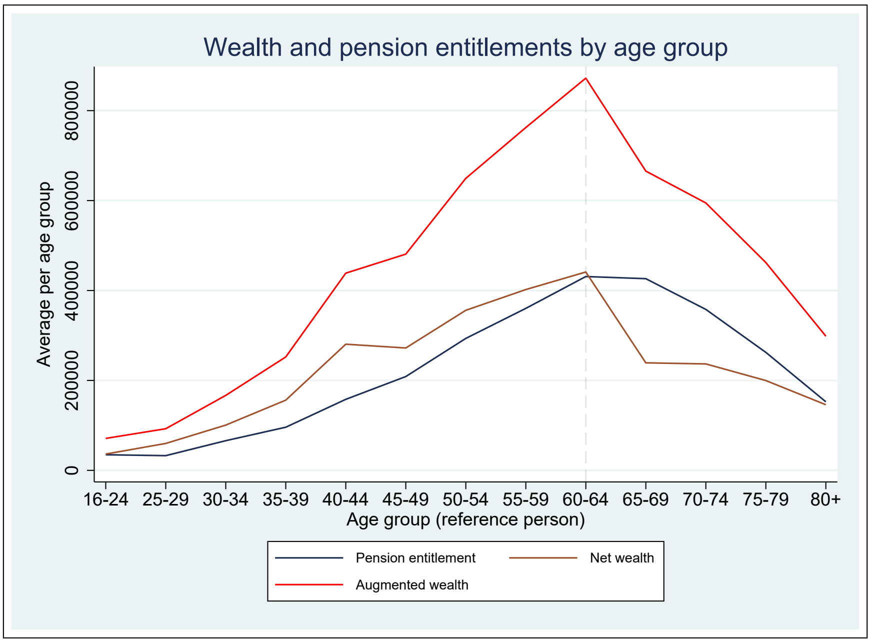

Figure 1: The figure shows the average values for various age groups.

Age: A first approach to look at pension entitlements in an disaggregated manner is by age group. Due to the basic principles of the Austrian pension system one would expect to see a clear hump-shape pattern, i.e. a steady increase of the value of pension entitlements up to the retirement age followed by a constant decrease. As shown in the first subtable of Table 3 this conjecture is in fact (and not surprisingly) confirmed by the data. The values of pension entitlements increases up to the age group *65-74* and then drops again. The age-pattern is even better visible if we define smaller age groups as illustrated in Figure 1. Pension entitlements peak for the age group *60-64* with a value of around €435,000 from which point on they decrease up to the age group 80+. The pattern is slightly different for net wealth for which the hump shape is less pronounced and less smooth. It is also noticeable that net wealth stays positive even for old age groups. This pattern is reminiscent of the old debate about whether the standard life-cycle model gives a good description about savings behavior, savings motives and the accumulation of wealth over the life cycle. For augmented wealth, however, the hump is again better visible and the peak is also for the age group *60-64*.

Household size: Pension entitlements are largest for households of size two and smaller for larger household sizes as reported in the second subpanel of Table 3. The reason for this is arguably that larger household sizes are associated with less full-time work of the (adult) household members. The lowest entitlements can be observed for single-person households. The pattern is somewhat different for net wealth which seems to increase monotonically with household size. Interestingly, when adding pension entitlements and net wealth together the resulting augmented wealth is almost identical for households of size 2, 3 or 4.

Gender: A breakdown by gender (for single households) reveals the interesting fact that females have higher pension entitlements than males, while for net wealth the relation is reversed. One factor which contributes to this outcome is the fact that females have a longer life expectancy (which enters the calculation of pension entitlements).

Education: Table 3 also includes a breakdown by education. As is apparent from the second column, pension entitlements do not seem to differ strongly across educational categories. They amount to around €215,000 for households for which the highest educational level of the reference person is below upper secondary school ("Matura"). This value, however, is only about 50% higher for households with university degrees (€309,000). For net wealth the educational divide is much higher and amounts to more than 300%. This observation, however, is not so astonishing considering the fact that in the pension formula the longer contribution periods for working individuals without a tertiary (or secondary) eduction counterbalance their lower incomes.[26]

Occupation: A similar picture as for education also emerges if one looks at the disaggregation with respect to the occupation. The variation of pension entitlements across occupational categories are much smaller than with respect to net wealth. The entitlements are highest for pensioners and for civil servants which does not come as a surprise. Pensioners have higher entitlements since they are older and age is probably the most important positive correlate of entitlements (see the first subpanel of Table 3 and Figure 1). The higher entitlements for civil servants are due to their higher average age and due to the fact that the legacy pension system promised higher pension to civil servants. The difference between blue-collar and white-collar workers is again rather modest which is the mirror image of the educational breakdown. The group of self-employed (which includes

[26]In fact, this observation continues to hold if one uses finer educational categories. Households in which the reference person indicates that he or she has not even completed compulsory schooling has pension entitlements of almost €180,000, only slightly less than individuals who have completed their vocational training (€225,000). The highest value (€423,000) can be observed for the rather small group of households where the reference person has a doctoral degree.

here the rather small group of farmers) stands out if one looks at net wealth (over one million euros), while their pension entitlements are less exceptional (around €280,000).

Homeownership: Finally, we can also look at the difference between households that rent or that own their main residence. The difference in pension entitlements between owners and renters is pronounced which is mainly due to the fact that the probability of homeownership is itself positively correlated with socio-economic characteristics that tend to go hand in hand with higher pension entitlements (like age, income, education and household size). For renters the value of pension entitlements amounts to €185,000 which is about three times the value of net wealth (€58,000). For owners the corresponding figures are €315,000 (pension entitlements) and €476,000 (net wealth).

6.2.2 Regression analysis

In the previous section we have presented breakdowns of the value of households' pension entitlements with respect to various socio-economic characteristics. Since this analysis has been conducted one variable at a time it is, however, not possible to infer the importance of a variable relative to the importance of other variables. Homeowners, e.g., have been shown in Table 3 to have considerably larger pension entitlements, but this is most probably due to the fact that homeowners are on average older and better educated and these confounding variables might be mainly responsible for the larger pension entitlements. In order to look at the entire set of variables at the same time we have also performed a regressions analysis as documented in Table 4.[27] At the end of the table we also report values for the adjusted R^2.[28]

As shown in the first column of Table 4, the most important determinant of pension entitlements is age. Households with a reference person who is between 50 and 75 years old have pension entitlements that are on average €240,000 larger than households in the lowest age group (*16-29*). This is not surprising given the structure of the pension system

[27]The models have been estimated with the Stata command *mi estimate* which takes the multiply imputed data structure into account. In particular, coefficients and standard errors are adjusted in order to account for the variability between imputations.

[28]This needs some explanation since the command *mi estimate* does not return this information. In order to get some crude indication of the respective models' goodness-of-fit we have also estimated each model with (household weighted) ordinary least square (disregarding the structure of multiple imputation) and report the adjusted R^2 of these estimations. The coefficients of the OLS estimations are almost identical to the ones of the multiple-imputations-estimations, while the standard error are typically smaller (by about 50%). These adjusted R^2 should thus not been taken literally but they are mainly meant to indicate the *relative* performance of the different estimation models.

where the total pension claims accumulate steadily up to the moment of retirement. A second important factor is the household structure. Single households have total pension entitlements that are smaller by about €145,000 than for two-person households (the base category). Again this is not surprising since it simply reflects the fact that two (working) individual will have pension entitlements that are about twice as large as single households. Even larger household sizes do not have a significant effect on the value of total entitlements which suggests that these additional household members typically do not have separate pension entitlements (mostly because they are children). Education and occupation (of the reference person) have some effect on the size of household pension entitlements but this is smaller than age and household structure. The largest effects are for university eduction (€95,000), (completed) upper secondary education and civil servants (each €48,000) and self-employed (€36,000). The variable "pensioner" has a large effect *in addition* to the age effect. This could be interpreted in the way that old persons who are still working have on average small pension entitlements. In fact, this could perhaps be the reason why they are still working in the first place (see Kuhn et al. 2022, forthcoming).

In columns (2) and (3) of Table 4 we repeat the analysis for net and for augmented wealth. Age is also a determinant of (household) net wealth, but the hump shape is less pronounced than for pension entitlements as has already been discussed in relation with Figure 1. Household size seems to be less important while the impact of education and in particular the occupational status is significant. In particular, the net wealth of self-employed household (which also includes farmers) is more than €750,000 larger than for the base category (blue-collar workers). The results for augmented wealth broadly follow the ones for net wealth. Also the values for the adjusted R^2 are similar (and considerably below the one for pension entitlements). This suggests that household differences in net wealth are affected by factors that go beyond socio-economic characteristics, in particular the presence of inheritances. For pension entitlements, on the other hand, inheritances do not play a (direct) role and the small set of socio-economic characteristics already help to explain more than 50% of the observed variation.

6.3 Distribution

In the previous section we have already discussed how pension entitlements differ across specific subgroups of the population. Now we turn to a discussion of the entire distribution.

Table 4: Determinants of pension entitlements, net wealth and augmented wealth

	Pension Entitlements (in €) (1)	Augmented Wealth (in €) (2)	Net Wealth (in €) (3)
Gender			
Female	−3,691	18,825	22,516
Age			
30-39 years	−9,205	−77,390**	−68,184**
40-49 years	76,615***	70,666	−5,949
50-64 years	242,269***	390,218***	147,950***
65-74 years	238,010***	384,535***	146,524***
75+ years	88,152***	221,385***	133,233***
Education			
Upper secondary school	48,421***	82,823***	34,402
University, technical college	94,655***	353,531***	258,875***
Occupation			
Self-employed (incl. farmers)	35,553**	804,883**	769,330**
White-collar worker	1,513	10,561	9,048
Civil servant	47,520**	−43,578	−91,098*
Pensioner	98,745***	23,299	−75,446
Other	−47,231***	−77,238**	−30,007
Household size			
1 person	−144,587***	−150,887***	−6,300
3 persons	−195	81,476**	81,671**
4 persons	6,343	61,603*	55,260*
5+ persons	21,585	275,027	253,442
Homeownership			
Owner	32,770***	370,794***	338,023***
Constant	82,330***	6,304	−76,026*
(Adj. R-squared)	(0.569)	(0.174)	(0.113)

Note: The dependent variable are households' public pension entitlements, augmented wealth and net wealth, respectively. All models have been estimated with consideration of the multiply imputed data (using the Stata command *mi estimate*). In particular, coefficients and standard errors have been adjusted to account for the variability between imputations. The values for the adjusted R^2 come from analogous OLS models (that deliver basically identical estimated coefficients but different standard errors). ***, **, * denote significance at the 0.01, 0.05 and 0.10-level.

6.3.1 Means by percentile

To gain a first impression of wealth inequalities, Figure 2 plots mean net wealth for each percentile (leaving out the five bottom and five top percentiles for the reasons given in Fessler et al. (2019)), i.e. households are sorted in increasing order of their net wealth. The picture shows that more than 70% of households have less net wealth than the average of around €250,000 and only 10% exceed a level of €500,000. All household with a net wealth above one million are in the top 5% of the distribution (and thus not shown in Figure 2).

Figure 2 also shows the average value of pension entitlements for each percentile of net wealth. As one can see the relation between pension entitlements and net wealth is somewhat rugged and there does not appear a monotonic pattern. This might be a property of the underlying relation but—more likely—it is due to the fact that we only have around 3,000 households and that—in addition to this—we had to use statistical matching to assign each household a pension value. Nevertheless, as shown by the fitted curve in figure 2 there exists a positive relation between net wealth and pension entitlements. While the household at the first decile has average pension entitlements of about €120,000, the corresponding value for the ninth decile is around €370,000. The reason for this positive relation is threefold: first, pension entitlements and net wealth both increase in age; second, both net wealth and pension entitlements are larger for household with larger number of (adult) members; third, pension entitlements and net wealth are higher for people with larger (lifetime) incomes.[29] The same relation is also reflected in the pattern for augmented wealth that is shown in in Figure 2 as well (together with the fitted curve). The value increases from about €120,000 to about €880,000 from the first to the ninth decile. For the lower decile pension entitlements dominate while for the upper end of the distribution they play much less of a role. This can also be illustrated by looking at the share of pension entitlements in augmented wealth for different subgroups. It comes out as an average share of 91% for the first decile and shrinks to 29% for the top decile. Also there are only a small number of households (less than 1%) with negative augmented wealth, all in the first percentile (while the corresponding number of net wealth is 4.3%).

[29]The correlation between net wealth and pension entitlements comes out as 0.17 (0.33 for the subgroup of retired and 0.19 for the subgroup of non-retired households). This is similar to the results in Kuhn (2020) who reports a correlation of 0.19 (p.11).

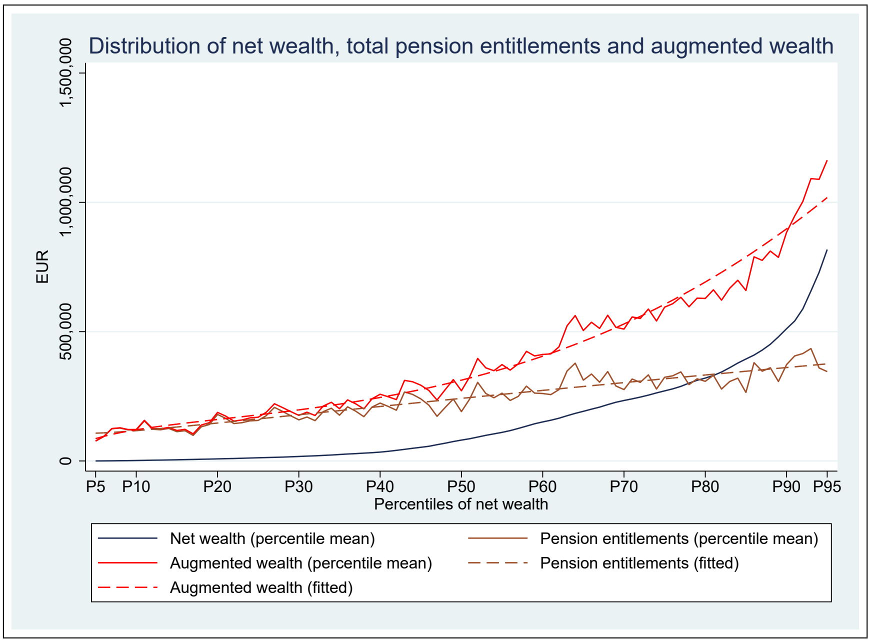

Figure 2: The figure shows the average values of pensions entitlements, net wealth and augmented wealth for each percentile of net wealth, together with polynomial fitted curves for pensions entitlements and augmented wealth.

6.3.2 Lorenz curves

The percentiles of Figure 2 can also be used in a different way to get an immediate illustration of the extent of inequality. In particular, we can plot for each wealth percentile the share of wealth that is associated with this percentile. These Lorenz curves are shown in Figure 3 for net wealth, pension entitlements, augmented wealth and (gross household) income. As already discussed above, pension entitlements are distributed more equally than net wealth which also shifts the Lorenz curve for augmented wealth. Both net wealth and augmented wealth are, however, distributed more unequally than gross household income. The curve for augmented wealth seems to lie somewhat in the middle between gross income and tangible net wealth. The Lorenz curves for pension entitlements and income cross above the 9th decile and move almost parallel beyond this point of intersection.

6.3.3 Inequality measures

In a further step we depict in Table 5 some well-known summary measures of wealth inequality. It is well-known that there does not exist a single inequality measure that satisfies a complete list of desirable properties at the same time and could thus be regarded

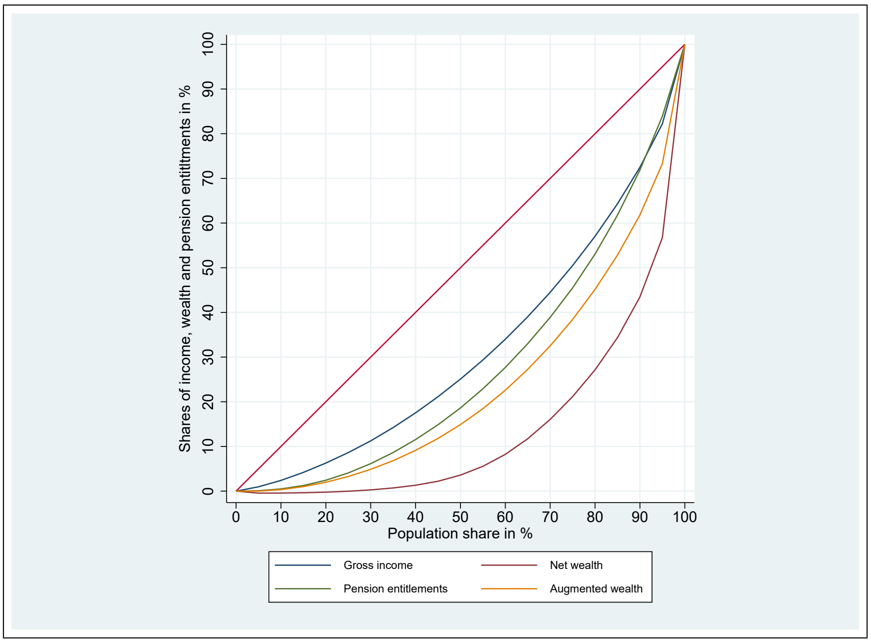

Figure 3: Lorenz curves

as unambiguously preferable to all other measures (Cowell 2011). There are trade-offs involved and different inequality measures emphasize different aspects of the distribution. An encompassing assessment of inequality should thus look at several of these inequality measures. The Gini coefficient for example, arguably the most prominent inequality measure, is more sensitive to changes in the middle of the distribution than to changes at the tails. The top shares and percentile ratios, on the other hand, are popular measures since they are easy to calculate and straightforward to interpret. The Atkinson index (or the corresponding General Entropy index), finally, is based on first principles and can furthermore be decomposed into within and between-group inequality. In consideration of these difficulties we report in Table 5 various inequality measures that must be considered simultaneously in order to get an encompassing picture of the distribution. Net wealth in Austria is distributed highly unequally with a Gini coefficient of 0.73, percentiles ratios ranging from 262 (for 90/10) to 6.4 (for 90/50) and a share of 43% (23%) that is concentrated among the top 5% (1%) of households.

For public pension entitlements the inequality measures are lower across the board. Here the Gini coefficient is only 0.45, the percentile ratios are reduced to 19.4 (for 90/10) and 2.7 (for 90/50) and the top 5% (1%) of households has 16% (4%) of pension entitlements. For the bottom 50%, however, the difference is less pronounced as it amounts to 3.6% for net wealth and 18.6% for pension entitlements. The distribution of (household) pension entitlements are to a certain degree a reflection of the distribution of (household) income. This is due to the fact that the Austrian pension system is "Bismarckian" in the sense that pension entitlements closely follow the development of lifetime income. The Gini coefficient for household income amounts to 0.37 which is lower than the one for pension entitlements. This has to do with the fact that the latter increase more sharply in age. If we only look at constant age groups, the Gini coefficient for the two magnitudes becomes more similar. For the households where the reference person is between 40 and 59 years of age, e.g., the Gini coefficient for household income comes out as 0.34 which is only slightly below the one for the present value of pension entitlements which amounts to 0.36.[30] One has to bear in mind, however, that there exists a ceiling (an upper limit) for pension contributions and pari passu for pension entitlements. Many well-paid jobs provide employees with special occupational pension plans (of a defined benefit or defined contributions nature) that are intended to insure the part of income that is not covered by the public pension system. These occupational pension plans are excluded from our analysis since we did not have enough reliable information about them (see the discussion in section 6.4). Therefore the results have to be regarded as a lower bound of the true extent of the inequality of pension entitlements (and thus also of augmented wealth).

Table 5: Summary measures of wealth inequality

	Net wealth	Pension entitlements	Augmented wealth
Inequality measure			
Gini coefficient	0.73	0.45	0.53
GE(2)	8.46	0.34	2.43
P90/P10	262.0	19.4	20.4
P75/P25	21.6	3.8	4.3
P90/P50	6.4	2.7	3.0
Top shares (in %)			
Top 1	22.6	4.0	12.5
Top 5	43.1	16.0	26.6
Top 10	56.4	28.0	38.1
Top 20	72.8	46.9	54.8
Bottom 50	3.6	18.6	14.9

[30]In this context and in order to classify and sort out the different sources of inequality it is interesting to focus on a hypothetical situation in which all households have the same income and inequality across pension entitlements is only caused by the age distribution. In a stylized "Modigliani benchmark" (Modigliani, 1986; no premature mortality, $\delta = g = 0$, etc.) one gets the well-known triangular wealth distribution. It can be shown that this situation is characterized by the Gini coefficient of a uniform distribution which amounts to 1/3. Using realistic values for the Austrian situation (concerning mortality, retirement age, pension parameters etc.) leads to Gini coefficients in this identical-income constellation between 0.2 and 0.3.

6.4 Alternative specifications

So far we have looked at pension entitlements for the benchmark specification as described in section 5.3. As stated there, the calculation of pension entitlements involves many assumptions and it is often not clear—for practical and theoretical reasons—which assumption is most reasonable. In this section we are going to investigate how the main results change if we choose alternative specifications for the main parameters of the calculation. We divide the analysis into three parts where in Tables 6 and 7 we look at different specifications for the calculation of pension income, in Table 8 we discuss alternative assumptions concerning the development of life expectancy and the retirement age and in Table 9 we deal with different choices for the discount rate. For each case we report four aggregate measures (the mean and median of public pensions entitlements and augmented wealth) and a number of distributional measures for augmented wealth (the Gini coefficient and various percentile means, percentile ratios and shares). As a preview it can be stated that the benchmark results are rather insensitive to most of the alternative specifications. The biggest effects can be observed for changes in the discount rate.

6.4.1 Pension income

In **Table 6** we investigate the effect of different methods to estimate individuals' expected pension income. In the benchmark specification we have used a net concept and we have thus subtracted expected tax payments from the expected stream of future pension benefits. If one disregards taxes and embraces a gross concept than this will increase the estimation of pension entitlements and augmented wealth as shown in column (2) of Table 6. The average value increases by about 10% to €543,000. This is broadly in line with the average individual tax rates which have been estimated to amount to about 12% (see appendix A.3.1). In columns (3) to (6) of Table 6 we stick to the benchmark assumption of a net concept but use different methods to estimate the expected pension benefits for the non-retired population. For the benchmark specification (underlying the results in column (1) of Table 6) we have used statistical matching to assign each person who is still participating in the labor market a "total pension credit" (see section 4.3).

As a first alternative, shown in column (3) of Table 6, one could use a series of questions in the HFCS survey to come up with an estimation of future pension benefits. In particular, respondents have been asked first about whether they have received a pension account statement and second about the expected monthly pension that has been stipulated in this account statement. This is a more direct way to gain information about "total pension credits" that have been accumulated in the pension account until 2016. In fact, at first sight this seems to be the superior method to estimate expected pension payments since it is based on direct answers provided by the survey respondents and one does not need to resort to the less precise techniques of statistical matching. There are, however, two problems with this direct question that impairs its use as the main method. First, many respondents have not heard about the pension account model, did not or do not remember having received a pension account statement (which, e.g., is true for 30% of respondents) and/or cannot remember the exact amount specified there (about 50% of the answers have been imputed). Second, in case they do not provide information about the expected monthly pension stipulated in the account statement the questionnaire asked the interviewers to encourage the respondents to come up with an estimation of "the expected monthly pension under the assumption that the occupational circumstances remain unchanged until retirement".[31] This formulation, however, is somewhat unfortunate since it asks the respondents to also include future entitlements in their estimation (in line with the "ongoing concern" approach) while the "total pension credits" only include all entitlements that have been acquired until now ("accrual method"). Following the ongoing concern approach tends to increase expected pension payments. This seems to be confirmed in the data. The average annual pension payment amounts to €11,300 when using our benchmark method (based on statistical matching), while it is higher at €13,800 when using the survey answers. On the other hand, however, the difference is not so large as one would expect if all respondent who were ignorant about the account statement really used an estimation based on the ongoing concern method. In fact, if we distinguish between the respondents who gave direct answers about the account statement and the ones who provided their own estimates about future pension payments the difference is also surprisingly low: €13,400 for the first group and €14,400 for the latter. All in all, there seems to be a good amount of confusion (both from the side of respondents and also in the questionnaire itself) which induced us to refrain from using this method as our main source of information about future pension entitlements.

As a second alternative method one can use the very rudimentary information about "work history" available in the HFCS survey to construct a measure for future pension entitlements. This is shown in column (4) of Table 6. We include this measure since the

[31] The exact wording in the commentary to the questionnaire is: "Interviewer: Wenn der Respondent kein Schreiben erhalten hat, bitte fordern Sie ihn zu einer Schätzung der erwarteten monatlichen Summe auf wenn sich seine beruflichen Umstände bis zur Pensionierung nicht mehr verändern würden."

related literature (especially for the US, see Sabelhaus & Volz (2020) and Catherine et al. (2020)) often relies on a work-history-approach to come up with estimations for pension entitlements. Due to lack of more extensive data our own measure is crude and only uses two variables: current income (from which we take 1.78% to calculate the annual pension credits) and the years of work.[32] Multiplying these two magnitudes gives us another rough estimate for total pension credits. The estimate is rough since it implicitly assumes that (real) income in previous years has been identical to the present income. This will most likely lead to an overestimation of total pension credits (since wage profiles typically increase with age). On the other hand, however, this calculation neglects all potentially higher, pre-reform pension entitlements which are captured in the real pension accounts via the "initial pension credits". This neglect will tend to underestimate the true pension entitlements. If we look at the average value of our work-history calculations it comes out as €12,500 which is surprisingly close to the benchmark value of €11,300. The potential sources of under- and overestimation thus seem to more or less counterbalance each other. The correlation between the two measures is also rather high (0.8).[33]

In the survey data there are around 3.3% civil servants. The pension entitlements for this subgroup of our population has also been based on statistical matching using as donor data the pension account values of all civil servants in the 2016 data base. This, however, only includes those civil servants who fully participated in the new pension account system. A large group of civil servants, however, do still not yet fully participate in the new pension account system and are still subject to a mixed calculation regime which weights together benefits from the old scheme and the new one (see appendix A.3.2). In order to account for the fact that the old pension regulation for civil servants has been more generous than for the general population we have included the specification in column (5) of Table 6. Based on exploratory data analysis (e.g. of the already retired civil servants in the HFCS dataset) we correct for this fact by simply increasing the annual pension claims of all civil servants by 20%.[34]

Finally, in column (6) of Table 6 we use a different method for statistical matching. In particular, while the procedure underlying our benchmark specification has used 12

[32]The exact wording of the question is: "How many years have you been working for the entire (or most parts of the) year?".

[33]The correlation between the benchmark measure and the one based on the survey information is lower (0.43) and this is also true for the correlation between the work history and the survey measures (0.5).

[34]Special pension systems also exist for other groups like the liberal professions (doctors, lawyers, notaries etc.). These often follow rather idiosyncratic rules and we do not take them into account.

income categories to perform the matches, the second matching procedure takes income as a continuous variable and uses the Manhattan metric distance function to identify the best matches.

Comparing the results in columns (3) to (6) of Table 6 with the results of the benchmark specification in column (1) reveals that the impact of the alternative specifications are small, almost minuscule. Differences in the aggregate measures for pension entitlements and augmented wealth are below 1% and also the Gini coefficients remain basically the same across all specifications. The lower part of the table shows that the use of survey measures (and to some extent also of work history) leads to higher estimated pension entitlements for the lower percentiles of the distribution which is also reflected in somewhat lower values for the percentile ratios P90/10 and P75/25. But overall, the benchmark estimation of public pension entitlements and augmented wealth holds up surprisingly well under alternative methods to calculate expected future pension benefits. This result is reassuring for cross-country comparisons since these are often based on a wide variety of methodological approaches.

One element that is missing from our definition of pension income are occupational pension benefits, as already mentioned at various instances above. In fact, in HFCS publications it is often especially emphasized that the measure of net wealth excludes public and occupational pensions. The reason for this exclusion is most likely the fact that the available numbers are incomplete, difficult to transform into entitlements and hard to compare across countries. This is also true for our data set. In particular, the HFCS survey for Austria includes a question about whether the respondent is "entitled to future occupational pension benefits". There exist, however, various reasons why we do not believe that the answers to this question provide a firm basis for reliable estimates of occupational pension entitlements and why we have therefore excluded them in our benchmark specification. As a final robustness exercise we have nevertheless also performed an analysis that includes these imperfect responses as will be shown below. Before coming to these results we want to briefly sketch the limitations of our available data. As a starting point we can note that about 9% of all respondents indicate that they participate in an occupational pension plan of which 85% state that this plan comes with an account statement. Since we do not have information about the remaining 15% this part of the occupational pension has to be neglected which is problematic since particularly generous occupational pension benefit are often of the defined benefit type. But even for the 85% of occupational pension schemes that come with account statements the evaluation is not straightforward. First, we do not know whether these plans also include defined

Table 6: Alternative specifications 1 (different pension calculation)

	Benchmark (1)	**Pensions** (Gross) (2)	**Pensions** (Survey) (3)	**Pensions** (Work History) (4)	**Pensions** (Civ. Serv. +20%) (5)	**Pensions** (Diff. Match) (6)
Pub. Pens. Ent. (Mean)	245,051	292,220	245,493	246,002	246,902	244,795
Pub. Pens. Ent. (Med.)	197,232	228,120	199,561	197,516	198,251	197,760
Augment. Wealth (Mean)	495,324	542,493	495,766	496,274	497,174	495,068
Augment. Wealth (Med.)	327,456	367,191	328,350	331,039	328,658	329,085
Inequality measures for augmented wealth						
Gini	0.53	0.52	0.52	0.53	0.53	0.53
P90/P10	20.36	20.89	15.72	18.4	20.3	19.37
P75/P25	4.33	4.37	4.07	4.28	4.35	4.28
P90/P50	3.02	3.03	2.98	3.01	3.02	3.02
Mean/Median	1.51	1.48	1.51	1.5	1.51	1.5
Top1	12.48%	11.6%	12.37%	12.41%	12.44%	12.49%
Top5	26.62%	25.67%	26.5%	26.45%	26.6%	26.63%
Top10	38.13%	37.3%	37.84%	37.94%	38.1%	38.08%
Top20	54.81%	54.34%	54.23%	54.62%	54.79%	54.79%
Bot50	14.9%	15.04%	15.5%	15.12%	14.88%	14.97%
P1	907	996	182	640	907	1,590
P5	20,893	22,740	23,470	24,403	20,935	22,968
P10	48,706	53,369	62,157	54,240	48,970	51,287
P20	112,902	124,056	123,201	115,324	113,004	112,809
P50 (Median)	327,456	367,191	328,336	331,039	328,658	329,085
P80	709,971	787,992	699,058	709,234	715,710	709,501
P90	989,698	1,112,754	976,868	997,991	992,480	993,066
P95	1,319,884	1,464,652	1,298,119	1,323,252	1,327,202	1,300,916
P99	2,613,781	2,841,403	2,584,936	2,573,271	2,613,781	2,625,270

Note: The table shows aggregate and distributional results for different specifications of the pension parameters. The benchmark specification (cf. Tables 2 and 5) is in column (1). For column (2) we use a gross instead of the net concept while for columns (3) and (4) we use different measures for total pension credits (based on survey information and work history, respectively). For column (5) the credits for civil servants are increased by 20% and for column (6) we use a different matching approach.

benefit elements. Second, about 87% of the respondents indicate that their occupational pension plan will lead to an annuity payment. Since we do not have information about the calculation, the eligibility conditions and the specifics of the annuity it is unclear whether one should take the account value as the estimation of the pension entitlement or whether one has to make adjustments for future returns, life expectancy developments etc. Third, most of the occupational account values in the dataset have been imputed—only 28% of the respondents have given an explicit number and for an additional 19% a number was imputed based on a categorical answer.[35] Fourth, since 2003 there exists a new severance pay regulation in Austria that in certain respects resembles a mandatory occupational pension scheme. In particular, employers pay a contribution amounting to 1.53% of employees' income and this amount is transferred to an occupational pension fund selected by the employer. At the moment of retirement the beneficiaries can require a lump-sum payment, leave it in the pension fund (or transfer it to a different fund) to obtain a monthly pension. We do not have any information about these new severance pay accounts and we do not know whether some respondents have referred to these accounts when answering the question about occupational pension benefits.

Having stated the reasons for the exclusion of occupational pension from our benchmark model we nevertheless—and for the sake of completeness—want to present now the results when including the imperfect measures. In particular, for respondents who are not yet retired we simply take the current account value of the occupational pension plan. The average account value of those people with occupational pension accounts amounts to almost €30,000. The occupational entitlements also seem to be distributed rather unequally. Only 6% of the lower three deciles (with respect to net wealth) participate in such a program with an average account value of €7,500. For the upper three deciles the corresponding values are 11% and €42,500. For households that already receive occupational pension benefits (only about 4% of households) we calculated the present value of these entitlements following the same steps as before for public pension benefits. In Table 7 we present the results if occupational pension entitlements are added to the benchmark measure of augmented wealth.[36] The effect is tiny since the (unconditional) mean of occupational pension entitlements amounts to only around €5,000 with a median of zero. Only 9% of households have some occupational entitlements in our dataset. On the

[35]As a comparison, for the values in the public pension account statement 50% gave an exact number and another 47% have been imputed based on categorical answers.

[36]We have used the same tax rates as for the benchmark model. This might lead to a small overestimation since households with occupational pension benefits might fall into higher income tax brackets.

one hand, this result points to the weak importance of the second pillar in the Austrian pension landscape, on the other hand, however, we have to reiterate that it is also quite likely due to underreporting and problems with the available data. The unequal presence of occupational pensions is also reflected in the inequality measures (not shown in Table 7). The Gini coefficient for occupational pension entitlements, e.g., comes out as 0.8.

Table 7: Alternative specifications 2 (Inclusion of occupational pensions)

	Benchmark (1)	**Occupational Pensions** (2)
Pub. Pens. Ent. (Mean)	245,051	245,051
Pub. Pens. Ent. (Med.)	197,232	197,232
Occup. Pens. Ent. (Mean)		5,053
Occup. Pens. Ent. (Med.)		0
Augment. Wealth (Mean)	495,324	500,377
Augment. Wealth (Med.)	327,456	329,629
Inequality measures for augmented wealth		
Gini	0.53	0.53
P90/P10	20.36	20.65
P75/P25	4.33	4.34
P90/P50	3.02	3.06
Mean/Median	1.51	1.52
Top1	12.48%	12.49%
Top5	26.62%	26.64%
Top10	38.13%	38.25%
Top20	54.81%	54.96%
Bot50	14.9%	14.83%
P1	907	928
P5	20,893	20,981
P10	48,706	48,939
P20	112,902	113,684
P50 (Median)	327,456	329,629
P80	709,971	717,204
P90	989,698	1,009,278
P95	1,319,884	1,335,739
P99	2,613,781	2,643,720

Note: The table shows aggregate and distributional results for the benchmark specification (cf. Tables 2 and 5) in column (1) and an estimation that includes occupational pensions in column (2).

6.4.2 Life expectancy and retirement age

In **Table 8** we collect the results of various specifications that use alternative assumptions involving life expectancy and the retirement age. As described at length in appendix A.2 our benchmark specification uses mortality rates that are differentiated by gender, age and income decile. The *relative* mortality differences are based on US data as calculated in Chetty et al. (2016) and the income deciles correspond to the decile of each HFCS household among all household incomes of its age group (i.e. the age group—in 5 year intervals—of its reference person). In Table 8 we investigate how the results are affected when each of these assumptions is changed.

As a starting point in column (2) we report the results for the assumption of homogeneous life expectancy, i.e. for the (erroneous) assumption that mortality rates are independent of the socio-economic status. For this specification we simply use the (gender-specific) values from the life-tables for the year 2017 as provided by Statistics Austria (2020).

In column (3) of Table 8 we determine the income decile of a household in the HFCS data not by its rank among an age group but simply by the decile within the entire distribution of household incomes.

In column (4) we use a different method to calculate differential mortality. Instead of using the *relative* mortality rates based on Chetty et al. (2016) we were able to get differential mortality data from Statistics Austria. The exact sources and the methodology is described in appendix A.2. As a brief description we can say that it is based on a match of various waves of microdata from EU-SILC and official mortality data.

In column (5) of Table 8 we turn to different assumptions concerning the retirement age. In the benchmark scenario we have assumed that all individuals retire at the statutory retirement age. In column (5) we make use of a question on the expected retirement age that has also been asked in the HFCS: "At what age do you plan to stop working for pay?" 25% of individual indicate to retire at the age of 60 (37% for women, 12.5% for men), 34.3% do so for the age of 65 and 6.7% at the age of 70. In appendix A.1 we describe how we adjusted the answers to this question to correct for outliers and implausible values. Once one departs from the equality of actual and statutory retirement, the pension entitlements will be affected by the exact stipulations of the pension system concerning the rates of deduction (supplements) for early (late) retirement. In the Austrian system the current deduction rate is 5.1% for each year an individual retires before the statutory retirement age (and a supplement of 4.2% for each year thereafter). Using a stylized model one can show that the rate of deduction can be regarded as more or less actuarial (see e.g. Knell 2021). One would thus conjecture that this alternative assumption concerning the retirement age should not have large effects on the magnitude of estimated pension entitlements.

In column (6) we study the implications if the statutory retirement age would be increased instantaneously for both genders to the age of 67. This might, e.g., be due to an effort to increase the sustainability of the Austrian pension system.

The results show again surprisingly low variability across the specifications. Probably most surprising was to observe that the assumption of differential mortality (that underlies our benchmark specification) has only a weak effect on the estimates of the aggregate and the distributional measures. Average augmented wealth under the assumption of homogeneous life expectancy comes out as €488,500 which is only by about 1.5% lower than the estimate of €495,000 with differential mortality. Since households with higher incomes and higher future pension payments can expect a longer continuation of these pension payments one would probably have expected to see a larger effect. In fact, the expected pattern is confirmed qualitatively as one can see by looking at the percentile values in the lower part of Table 8. The assumption of differential mortality leads to higher estimates for the top percentiles (P80, P90, P95, P99) and lower estimates for the bottom percentiles. But quantitatively speaking, the effect is rather attenuated. For the distributional measures it is visible that the percentile ratios increase for differential mortality (due to the dispersion at the tails) but the other measures (including the shares) are hardly effected. For the other specifications of life expectancy and the retirement age in columns (3) to (5) there is almost no noticeable impact on neither the aggregate nor the distributional measures. Only for the retirement age at 67 in column (6) we observe a considerable reduction of the aggregate measures. This is due to the fact that an increase in the statutory retirement age corresponds to a pension cut. This is most clearly evident by considering the fact that an individual who continues to retire at the age of 65 will have to face deductions that amount to 10.2%. In fact, the results show that the reduction in pension entitlements are in fact close to 10%. The lower part of Table 8 indicates that in this scenario the inequality measures also show a slight increase.

6.4.3 Discount rate

For the benchmark specification we have used a uniform discount rate of $\delta_i = \delta = 3\%$. This corresponds to the value that is typically chosen in the related literature (Bönke et al. 2019, Sabelhaus & Volz 2020) and it is thus a natural reference value that facilitates the comparison with this research. The choice of the discount rate, however, is not innocuous as it has a non-negligible effect on both the level and the distribution of the wealth estimates, as documented in **Table 9**.

Before discussing these result we want to emphasize that it is not an easy and straightforward tasks to choose a "correct level" of the discount rate and there does not exist an

Table 8: Alternative specifications 3 (different mortality and retirement)

	Benchmark (1)	Life Exp. (Homog.) (2)	Life Exp. (Only Inc.) (3)	Life Exp. (Alt. Source) (4)	Retirement (Exp. Ret.) (5)	Retirement (Age 67) (6)
Pub. Pens. Ent. (Mean)	245,051	238,267	245,775	243,267	241,866	225,829
Pub. Pens. Ent. (Med.)	197,232	200,215	198,768	199,533	194,933	178,003
Augment. Wealth (Mean)	495,324	488,540	496,048	493,539	492,139	476,101
Augment. Wealth (Med.)	327,456	330,117	328,766	331,830	324,407	311,388
Inequality measures for augmented wealth						
Gini	0.53	0.52	0.53	0.53	0.53	0.54
P90/P10	20.36	18.73	20.09	19.69	20.97	21.48
P75/P25	4.33	4.09	4.28	4.26	4.4	4.45
P90/P50	3.02	2.86	2.99	2.91	3.03	3.05
Mean/Median	1.51	1.48	1.51	1.49	1.52	1.53
Top1	12.48%	12.47%	12.46%	12.42%	12.54%	12.83%
Top5	26.62%	26.51%	26.64%	26.48%	26.73%	27.3%
Top10	38.13%	37.79%	38.1%	37.87%	38.24%	38.85%
Top20	54.81%	54.14%	54.72%	54.39%	54.88%	55.48%
Bot50	14.9%	15.5%	14.94%	15.13%	14.81%	14.5%
P1	907	992	955	955	827	662
P5	20,893	21,630	20,518	21,160	20,044	18,684
P10	48,706	50,534	49,068	49,067	47,041	44,372
P20	112,902	116,910	113,909	114,581	111,061	103,977
P50 (Median)	327,456	330,117	328,766	331,830	324,407	311,388
P80	709,971	693,437	711,483	706,358	709,159	679,129
P90	989,698	944,432	983,385	964,394	984,130	950,656
P95	1,319,884	1,281,170	1,324,182	1,303,612	1,304,109	1,280,710
P99	2,613,781	2,536,078	2,606,520	2,570,849	2,611,950	2,572,649

Note: The table shows aggregate and distributional results for different specifications of life expectancy and the retirement age. The benchmark specification (cf. Tables 2 and 5) is in column (1). Column (2) assumes income-independent life expectancy, while for columns (3) we use a different categorization for the income deciles. For column (4) we use a different source of information about heterogeneous life expectancy. For column (5) we take survey answers as a measure of the expected retirement age while in column (6) we assume that the statutory retirement age is increased to the age 67.

unanimous agreement on the right approach. As a general principle the calculation of household wealth is based on market evaluations ("marketable wealth", see OECD, 2013) and this should also be true for the evaluation of pension entitlements PE_i. Unfortunately, however, this concept of marketable wealth is not directly applicable for pension entitlements since there does not exist a market where these claims are traded.[37] It is sometimes argued that one should use a risk-free government bond rate to substitute for this missing markets but this proposal is not convincing. A tradable government bond is located in a different asset class than an intangible pension entitlement and both assets involve different payment streams, different fundamentals and different types of risk. This can be further elaborated on by the use of two examples involving wage risk and pension reform risk, respectively. First, one can consider the fact that government bonds are normally specified in nominal terms and thus subject to inflation risk. Initial pension benefits, on the other hand, are typically tied to the development of average real wages and thus better secured against inflation while subject to real wage risk. The second crucial difference is related to the fact that the Austrian pension system does not contain an automatic adjustment mechanism and is thus not guaranteed to develop in a sustainable manner for the decades to come.[38] In fact, it is thus highly likely that the system will have to undergo major reforms. This prediction of an inevitable pension reform, however, has a twofold affect for the calculation of future pension payments. On the one hand, it provides a reason to adjust the expected value of future pension entitlements downwards such as to be in line with the requirements of a long-run sustainable system. This was, e.g., suggested by Sabelhaus & Volz (2020) who also present the results for a "payable scenario". On the other hand, however, these foreseeable but undetermined changes to the pension system introduce a considerable amount of risk which should also be reflected in the discount rate.

The importance of wage risk and pension reform risk for the choice of the discount rate has been emphasized by Geanokoplos & Zeldes (2010) and Luttmer & Samwick (2018), respectively. In light of these considerations it therefore does not seem unreasonable to choose a higher discount rate of $\delta = 5\%$. The results for this specification are shown in column (2) of Table 9, while in column (3) we show the results for $\delta = 1.3\%$ which corresponds to the expected growth rate of real GDP over the next decades and might

[37] For proposals to establish such markets see Valdés-Prieto (2005) and Geanakoplos & Zeldes (2009).

[38] According to the most recent *Ageing Report* of the European Commission (European Commission 2021) total public pension expenditures in Austria are projected to rise from 13.3% of GDP in 2019 to 14.3% of GDP in 2070 (with a peak of 15.4% in 2035).

also be a reasonable assumption for the expected government bond rate.

The results in Table 9 indicate that the choice of the discount rate has a strong effect. The average estimation of pension entitlements decreases by almost 25% (from €245,000 to €186,000) if the discount rate is chosen as $\delta = 5\%$ instead of $\delta = 3\%$. For a lower discount rate ($\delta = 1.3\%$), on the other hand, the estimate increases by almost 33%. For augmented wealth these percentage changes are of course less pronounced, but still sizable (with −12% and +16%, respectively). Also the changes in the inequality measures are now no longer weak. They increase for higher discount rates and decrease for lower ones. For $\delta = 5\%$, e.g., the Gini coefficient increases by 5% (from 0.53 to 0.56) while it drops by 5% for the lower value of δ (from 0.53 to 0.5). A similar movement can be observed for the percentile ratios, the top shares and the mean to median ratio. It is not surprising that the discount rate plays an important role for the estimation of pension entitlements. What is probably surprising, however, is the magnitude of the effect and the fact that it dwarfs all other changes of assumptions that have been considered in Tables 6 to 8. The result is also somewhat unsettling given the large amount of uncertainty and theoretical debate underlying the choice of the discount rate.[39]

6.5 Limitations

The results presented so far give our best estimates of the present value of public pension entitlements in Austria. We want to stress, however, that this can only be regarded as a first attempt since data availability has restricted us in various dimensions. First, we had to use statistical matching techniques to assign each individual a value of total pension credits. It would be preferable to directly match the survey information with administrative data in order to come up with more precise estimations as has, e.g., been done by Kuhn (2020). Second, our benchmark data on income-dependent mortality rates (see section 5.3) are based on a transformation of US mortality differences to Austrian data. As explained in footnote 20 this is less implausible than it might sound at first sight, but it is nevertheless only an approximation. It would be highly valuable to have a

[39] The literature on discount rates is wide and there exists, e.g., also an intense discussion around the correct choice of the *social* discount rate (Gollier 2011). This concept, however, is less relevant in our context. More relevant is probably the existing research on individual discount rates δ_i which are often used interchangeably with the notion of rates of time preference. The literature has established a considerable amount of heterogeneity with respect to age, gender and wealth concerning these rates (Frederick et al. 2002, Epper et al. 2020). In the absence of a market for pension rights it would be defensible to use individual discount rates δ_i to evaluate individual future entitlements. This extension, however, is beyond the scope of the present work.

Table 9: Alternative specifications 4 (discount rates)

	Benchmark (1)	Disc. Rate ($\delta = 5\%$) (2)	Disc. Rate ($\delta = 1.3\%$) (3)
Pub. Pens. Ent. (Mean)	245,051	185,937	325,525
Pub. Pens. Ent. (Med.)	197,232	143,062	269,118
Augment. Wealth (Mean)	495,324	436,210	575,798
Augment. Wealth (Med.)	327,456	274,724	401,749
Inequality measures for augmented wealth			
Gini	0.53	0.56	0.5
P90/P10	20.36	29.39	14.28
P75/P25	4.33	4.95	3.94
P90/P50	3.02	3.2	2.8
Mean/Median	1.51	1.59	1.43
Top1	12.48%	13.81%	10.99%
Top5	26.62%	28.79%	24.37%
Top10	38.13%	40.62%	35.54%
Top20	54.81%	57.2%	52.28%
Bot50	14.9%	13.22%	16.69%
P1	907	−31	2,117
P5	20,893	11,869	37,108
P10	48,706	29,982	78,979
P20	112,902	80,007	155,532
P50 (Median)	327,456	274,724	401,749
P80	709,971	619,070	832,555
P90	989,698	878,695	1,125,976
P95	1,319,884	1,212,309	1,488,951
P99	2,613,781	2,462,867	2,817,920

Note: The table shows aggregate and distributional results for different specifications of the discount rate. The benchmark specification (cf. Tables 2 and 5) is in column (1) where $\delta = 3\%$. In columns (2) and (3) we use values of $\delta = 5\%$ and $\delta = 1.3\%$, respectively.

dataset on differential mortality rates for Austria that is based on a similar methodology and similarly encompassing datasets as in Chetty et al. (2016). Third, specific types of direct pension entitlements are missing from our analysis due to problems with data availability. Civil servants had a special pension system in the past and are to some extent still subject to this scheme (see appendix A.3.2). Since we do not have direct information about these old pension claims we subsumed civil servants under the private sector population in our benchmark estimation. In a similar vain, liberal professions are also not insured under the standard public pension system, but have separate compulsory systems with often very specific rules. Since members of liberal professions have, on average, higher incomes than the average population one would expect that the inclusion of these special schemes would increase average pension entitlements and also the extent of inequality. Finally, the omission of occupational pensions (as discussed in section 6.4) is also likely lead to a (slight) underestimation of augmented wealth and also of inequality.

Furthermore, as a fourth field of concerns, there is the issue of survivor pensions. In Austria, as in many other countries, widow(er)s and orphans are granted survivor pensions. The level of these pension depends on the level of pension benefits of the deceased partner and on the difference to the income or pension of the surviving partner, on the duration of the marriage and on an eventual new marriage. In order to calculate the present value of future survivor pension entitlements one would have to make assumptions about all of these parameters together with assumptions about the development of incomes and the probability of divorce until the death of the partner etc. All of these assumptions are fraught with a high degree of uncertainty and we therefore abstain from calculating these survivor pensions.

Finally, we have to turn to the issue of minimum pensions. The Austrian pension system promises supplementary payments ("Ausgleichszulage", AGZL) if the regular pension benefits are below certain reference levels. In 2017 these thresholds were defined as €883 per month for single person households and €1,324 for couples. There are 14 payments per year and also additional supplements of €136 for each child younger than age 18 (age 27 if the child is still in education). The supplementary AGZL is only paid if the *total* household income (i.e. pension benefits plus other income sources) is below these thresholds. Each year around 9% of all pensioners receive such supplements (of which about half are widows, widowers or orphans). Given these data one could thus expect that between 5% and 10% of each cohort will receive a supplementary pension payment which will increase the present value of pension entitlements. It is, however, inherently difficult to take these putative payments into account for our calculations since it only becomes clear in the temporal vicinity of retirement who will ultimately be eligible for the supplementary payments.[40] For these reasons we do not consider the supplementary pension payments in our calculations.

7 International comparison

In this section we want to compare our results to the existing international findings. As said before this is not an easy task since there only exists rather sparse evidence for a handful of countries and only one paper (Bönke et al. 2020) which contains a direct comparison of two countries (Germany and the US) based on comprehensive measures of (public) pension entitlements. Given the idiosyncratic and highly country-specific nature of pension systems it is inherently difficult to undertake comparisons of this kind. Acknowledging these challenges we have nevertheless collected central results of the main papers of the related literature in Table 10. There are three differences across the studies that have to be mentioned right at the beginning. First, two papers in the table (Rasner et al. 2013, Bönke et al. 2019) refer to individual entitlements and these results are thus not directly comparable to the household results. Second, the studies use data from different time periods (ranging from 2002 to 2018) and they are also stated in different currencies. It is therefore not reasonable to compare the *absolute* values of the estimates listed in Table 10. Third, the pension systems in different countries are highly specific, not only with respect to the size of the systems but also to the mix between (i) unfunded and funded, (ii) public, occupational and private, (iii) income-related and unconditional (or means-tested) elements and (iv) the possibilities of withdrawal (lump-sum pay-out) of pensions funds before or at retirement. While in Germany and Austria, e.g., the PAYG pension pillar is by far the most important source of old-age income, the systems in the US, Switzerland and Australia are of a more mixed nature. We will therefore focus our comparison primarily on percentages (the share of public pension entitlements or total pension entitlements in augmented wealth) and on changes (in the Gini coefficient between net wealth and augmented wealth).

The share of pension entitlements in augmented wealth lies round 50% for a majority

[40] One could be induced to simply take the total credits for each household that came out of the matching process, compare them to the thresholds for the AGZL and—in case these total credits are below €12,359 (14 × 883) for single person households and €18,531 (14× 1,324) for couples—substitute them by the respective thresholds. This approach, however, would lead to artificially high rates of expected supplements for younger cohorts and distort the estimates of aggregate pension entitlements and—even more so—their distributional dimension.

Table 10: Main results of the related literature

	This paper (2022)		**Mazzaferro & Toso (2009)**		**Rasner et al. (2013)**		**Bönke et al. (2019)**		**Bönke et al. (2020)**		**Bönke et al. (2020)**		**Kuhn (2020)**		**Longmuir (2021)**	
Country	AUT		ITA		DEU		DEU		DEU		USA		SUI		AUS	
Time	2017		2002		2007		2012		2012		2012		2015		2018	
Unit	HH		HH		Ind.		Ind.		HH		HH		HH		HH	
Currency	EUR		EUR		EUR		EUR		USD		USD		CHF		AUD	
	Mean	Gini	Mean	Gini	Mean	Gini	Mean	Gini	Mean	Gini	Mean	Gini	Mean	Gini	Mean	Gini
NW	250,272	0.73	284,500	0.63	83,077	0.8	85,348	0.79	182,329	0.76	337,570	0.89	265,181	0.75	692,618	0.66
Pub. PE	245,051	0.45	156,200	0.57	78,479	0.56	81,240	0.57	200,424	0.46	161,481	0.44	146,953	0.39	75,805	
Occup. PE							10,200	0.91	89,648	0.8	153,453	0.81	123,264	0.61	240,726	
AW	495,324	0.53	440,700	0.54	161,556	0.6	176,789	0.59	472,401	0.51	652,504	0.7	535,397	0.55	1,009,149	0.59
AW/NW	198%		155%		194%		207%		259%		193%		202%		146%	
Share PE	49%		35%		49%		52%		61%		48%		50%		31%	
Share PPE	49%		35%		49%		46%		42%		25%		27%		8%	
Δ Gini		-28%		-14%		-25%		-24%		-33%		-21%		-27%		-11%

Note: The table contains results from the related literature involving other countries. The upper part of the table shows main characteristics of the studies (country, time, unit and currency). The second part reports crucial results of the papers. In particular, the mean and the Gini coefficient of net wealth (NW), of public pension entitlements (Pub. PE), of occupational pension entitlements (Occup. PE) and of augmented wealth (AW). The third part of the table contains shares and changes that allow for an easier comparison across studies. In particular, we show the relation of augmented wealth to net wealth (AW/NW), the share of pension entitlements in augmented wealth (Share PE), the share of public pension entitlements in augmented wealth (Share PPE) and the change in the Gini coefficient when moving from net wealth to augmented wealth (Δ Gini).

of studies. It is exactly 50% for Switzerland, 48% for the US and 49% for Austria. The values for Germany in Rasner et al. (2013) and Bönke et al. (2019) are also close to 50% but these are based on individual data. The household value in Bönke et al. (2020) comes out as 61% and is thus the highest in our cross-country sample. Two studies stand out from the rest with a lower share of pension entitlements in augmented wealth of 31% and 35%, respectively. Both of these studies are, however, not directly comparable since they show methodological differences and do not include crucial parts of pension entitlements. The paper by Mazzaferro & Toso (2009) for Italy uses the ongoing-concern method which is a different concept than the accrual method used in this paper (and in the other papers in Table 10).[41] Furthermore, the pension entitlements do not include a number of private pension arrangements (life insurance, severance pay) and the public pension entitlements for a part of the population (for people unemployed and out-of-labor force).[42] Australia, on the other hand, has a different—a "Beveridgean"—pension system that is built on two important pillars. The first pillar is a means-tested social security pension (called "Age Pension") which is tax-funded and does not rely on individuals' employment history while being subject to an income and asset test at retirement. The second pillar is a compulsory occupational pension scheme (called "Superannuation") that is based on investments in pension funds. In the results reported in Longmuir (2021) the entitlements for the first pillar have not been included for the working population.[43] For the already retired population, however, the Age Pension is quite crucial. In 2018, e.g., it was still the pension scheme with the most participants and the average pension in this scheme amounted to about 60% of the average pension in the Superannuation scheme (see Table 4 in Longmuir 2021). The exclusion of the Age Pension from the accounts of the non-retired will thus lead to an underreporting of the value of public pension entitlements. The different importance of public and occupational pension schemes is also reflected in the data for other countries. Occupational pensions are more important for Switzerland

[41] "Social security wealth is defined as the discounted sum of all expected future pension benefits, less the discounted sum of contributions an individual expects to pay between the time of observation and his/her retirement" (Mazzaferro & Toso 2009, p.784).

[42] "Our definition of total wealth does not include severance indemnity and the cash value of life insurance and private retirement accounts, which are not recorded in our data source [...] We do not compute social security wealth for individuals that in the year of observation are unemployed and/or out of the labor force. This choice implies a likely underestimation of social security wealth" (Mazzaferro & Toso 2009, p.783f.).

[43] "In my analysis, I include them [the means-tested benefits] in the present value calculation, because Age Pension is the major social security scheme in Australia. As I cannot observe whether cohorts below the retirement age will qualify for Age Pension, I only include their savings in Superannuation accounts" (Longmuir 2021, p.12).

and the US (about half of the value of total pension entitlements) than for the other countries.

For the change in the Gini coefficient one can observe a similar picture across countries as for the share of pension entitlements. The reduction is quite similar for Austria, Germany and Switzerland (between 27% and 31%)[44], slightly less for the US (21%) and considerably smaller for Italy and Australia. For the latter two countries, however, the caveats mentioned above still apply and the underestimation of public pension entitlements also confound the results for the change in the Gini coefficient.[45]

In closing this section we want to mention a recent study by Cowell et al. (2017). This paper seems closely related since it also uses data from the (first wave of the) HFCS and includes results for Austria. The big difference, however, is that Cowell et al. (2017) only focus on elderly households whose reference person is aged 65-84.[46] The data are thus not directly comparable to our results. The authors report for Austria a Gini coefficient of 0.7 for net wealth and one of 0.45 if one includes public pension entitlements[47]—a change of 36% which is somewhat larger than our reduction of 28%. The largest drop in the Gini coefficient in Cowell et al. (2017) is reported for Germany (0.68 to 0.44), the smallest for Spain (from 0.55 to 0.48).

8 Conclusions

In this study we have used data from the HFCS and the social security registry to calculate estimates for the present value of public pension entitlements for Austria in the year 2017. We found that the value of public pension entitlements is about the same size as the private net wealth (both amounting to around €250,000) which is in line with the results for other

[44] As an aside, in one of the first papers that have attempted to quantify the role of pension entitlements Feldstein (1976) found a Gini coefficient for net wealth of 0.72 and a Gini coefficient for augmented wealth of 0.51. These values are almost identical to our findings for Austria, 50 years later. This is, however, a mere coincidence since our study is not only based on data from a different time period and a different country but also on different methodological choices (the analysis in Feldstein (1976) is limited, e.g., to households in which there is a man between the ages of 35 and 64).

[45] As is acknowledged in Longmuir (2021): "Net worth is more equally distributed than in Germany, Switzerland or the US. However, adding pension wealth reduces the Gini coefficient less than in the other countries, so that augmented wealth in Australia is less equally distributed than in Germany and Switzerland. The main reason for this is the means-tested social security pension wealth, which covers only retired Australian households and is not an asset for those still in employment. This also shows the limits of the accrual method in Australia" (p.40).

[46] "In order to simplify the computation of pension wealth and reduce the abuse of *ad-hoc* assumptions, the analysis is focused on elderly households" (p.6).

[47] If also private pension provisions are included then the Gini of augmented wealth is 0.48.

countries like Switzerland, Germany and the US. Since most households receive pensions or have pension claims and since these pension entitlements are more equally distributed than other assets, most inequality measures for augmented wealth are lower than for net wealth. The Gini coefficient for Austria, e.g., decreases from 0.73 (for net wealth) to 0.53 (for augmented wealth) which is again fairly similar to the results for other countries. The calculation of the benchmark results has been based on a long list of assumptions and we have studied a large number of alternative specifications in order to assess the robustness of these results. It was quite astonishing and reassuring to observe that the choice of assumptions had mostly an only trivial effect on the main findings. Particularly interesting was that different methods of calculating pension entitlements (statistical matching or survey information on either the present values or the work histories) lead to almost identical results. The same was true for the use of homogeneous instead of heterogeneous (i.e. income-dependent) life expectancy and for the use of individually expected retirement age instead of the statutory retirement age. Only the choice of the discount rate was found to have a noticeable impact on the results. Altogether, however, the robustness of the findings to most of the necessary assumptions is good news for cross-country comparisons since these are often based on a wide variety of methodological approaches and underlying assumptions.

Despite the robustness of the result to changes in many parameters a number of caveats have to be borne in mind for their interpretation and the derived conclusions. Most of them have been mentioned throughout the preceding pages but we want to collect them here once more. First, the documented results can only be regarded as a first estimations since (i) we did not have access to direct information and had to use statistical matching techniques, (ii) estimates of heterogeneous life expectancy were provisional, (iii) the results exclude estimates for occupational, survivor and minimum pensions. Missing segments are, however, not only an issue for the calculation of pension entitlements but also for net wealth. It is a well-known problem of wealth estimations based on survey data that rich households are underrepresented thus leading to a downward bias in the estimation of average wealth and wealth inequality. An accurate comparison of net wealth and public pension entitlements thus would have to deal with the shortcomings on both sides of the aisle. Second, pension entitlements are not directly comparable to the components of private net wealth as already discussed in the introduction. The existence of promises for future pension payments will likely have an effect on important economic decisions like saving, labor supply and retirement. In this respect these promises will resemble private wealth. On the other hand, however, net wealth—being marketable and liquidatable—

fulfills a number of additional function that are absent for pension entitlements. Net wealth (in particular financial assets) can also be used to absorb economic shocks in case of an emergency, to finance the front-loading of larger purchases (like real estate or the formation of enterprises) or to simply function as a source of status and political or social influence. The appropriate concept of wealth thus depends on the topic of investigation. For questions of intertemporal economic decisions it is important to take the value of future pension entitlements into account. If, on the other hand, the issue is, e.g., the political consequences of the increasing concentration of wealth, then pension entitlements are less relevant (since they are a small share of augmented wealth for the top percentiles). Third, cross-country comparisons of augmented wealth figures are not straightforward and have to be handled with care, in particular if they are collected from different papers. Pension systems differ widely across countries and the use of different methods will affect the results. We have discussed a number of these potential pitfalls in section 7. Fourth, for a meaningful interpretation of inequality measures one has to compare them with a different country (as discussed in the last point) or a previous time period. It is almost vacuous to state that inequality decreases when moving from net wealth to augmented wealth. For the case of Austria we cannot engage in intertemporal comparisons since we have estimates for pension entitlements only for one period.[48] Taking up the last two points it would be interesting for future comparative research to expand the sample of estimates of pension entitlements and augmented wealth both across countries and time periods.

[48]In this respect it is instructive to look at other countries where measures exist for various points in time. This has been done, e.g., by Sabelhaus & Volz (2020) for the US concluding: "Although incorporating SSW [Social Security Wealth] into household wealth has a substantial impact on wealth inequality *levels*, it does not change overall *trends* in top wealth shares. For example, while the top 10% share of household wealth (within age-sorted and person-weighted) increased from 53% to 63% between 1995 and 2019, the expanded wealth share that includes SSW increased from 45% to 55%"(p.5, emphases in the original).

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Appendices

A Main assumptions

A.1 Retirement age

For the benchmark scenario as described in section 5.3 we assume that all individual retire at the currently valid statutory retirement age. For men this is the age of 65 while for women it is currently 60, but is already scheduled to be adjusted upwards in the future. In particular, starting in the year of 2024 the statutory retirement age for women will be raised by six months per year until 2033, when it will reach the age of 65. The first cohort affected are women who are born on or after 2 December 1963 (they will be legally obliged to retire at the age of 60.5 years). The transition process is completed for women born on or after 2 June 1968 and for whom their 65th birthday will be the statutory retirement age.

In our dataset, however, we do not have the exact date of birth (for reasons of confidentiality) and thus we cannot implement the half-year steps and instead have to use an approximation. In particular, we assume that all women of at least 52 years of age have a statutory retirement age of 60 and these values are moved up by one year until the group of women who in 2016 have been 47 years old or younger for whom the statutory retirement age is 65, the same as for men.

In an alternative scenario, we do not use the assumption that all individuals retire at the statutory retirement age but we rather make use of a question on the expected retirement age that has also been asked in the HFCS: "At what age do you plan to stop working for pay?" We had to make a number of assumptions in order to come up with a reasonable data-set. First, we only consider answers that are close to the range of the pension corridor, i.e. between ages 62 and 70. This may look like a strong assumption but it has to be noted that retirement before the age of 62 is only possible under specific circumstances (like disability, particularly harsh jobs or long contribution years) while retirement after the age of 68 does not lead to special supplements. For respondents who indicate an expected retirement age below 62 we stipulate an retirement age of 62 (or the statutory retirement age if this is lower). On the other extreme we cut all expected retirement ages at the age of 70 (except for the few cases of people that are above age 70 and indicate to be still working). The answers to the expected retirement question show some focal points. 25% of individual indicate to retire at the age of 60 (37% for women, 12.5% for men), 34.33% do so for the age of 65 and 6.7% at the age of 70. 95% of the answers are between the ages of 60 and 70.

A.2 Life expectancy

A.2.1 Basic formulas

In this section we want to briefly summarize some basic demographic relations that underlie the calculations in life tables that we need to derive present values. Even though life tables are presented in discrete time we start our discussion with a continuous time model since it leads to more compact and arguably more intuitive expressions. We assume that the force of mortality stays constant over time. $s(x)$ gives the probability that a person survives to age x. It holds that $s(0) = 1$, $s(\omega) = 0$ (where ω denotes the maximum age) and that survivorship declines with age, i.e. $\frac{ds(x)}{dx} \leq 0$ for $x \in [0, \omega]$. The mortality (hazard) rate at age x is given by $m(x) \equiv -\frac{ds(x)}{dx}\frac{1}{s(x)}$. It holds that:

$$s(x) = e^{\int_0^x -m(z)\,\mathrm{d}z}. \tag{5}$$

The formulas for remaining life expectancy at age a can be obtained from the demographics literature as:

$$e(a) = \int_a^\omega e^{\int_a^x -m(z)\,\mathrm{d}z}\,\mathrm{d}x = \frac{\int_a^\omega s(x)\,\mathrm{d}x}{s(a)}. \tag{6}$$

The definitions for discrete mortality models are somewhat different. For the sake of comparison we stick to a notation that is commonly used for life tables. The mortality rate is denoted by q_x (instead of $m(x)$) and the number of survivors by l_x (instead of the normalized expression $s(x)$). The main difference to the continuous model is that the discrete life tables need to use a number of approximations for the force of mortality *within* a discrete time interval. In particular, the mortality rate q_x is defined as the probability that a person with exact age x will die within the next year (i.e. between exact age x and exact age $x+1$). l_x stands for the number of persons surviving to age x and d_x for the number of deaths between ages x and $x+1$. The size of the newborn cohort is typically normalized to $l_0 = 100{,}000$. It holds that $q_x = \frac{d_x}{l_x}$. Using the fact that $l_{x+1} = l_x - d_x$ one can thus conclude that $l_x = l_{x-1}(1 - q_{x-1})$. In order to calculate life expectancy, the discrete mortality model defines two further variables that can be regarded as a compromise between the "beginning-of-period" and "end-of-period" concepts. In particular, L_x stands for the number of person-years lived between ages x

and $x+1$ and $T_x = \sum_{y=x}^{\omega} L_y$ for the total number of person-years lived after age x. Under the assumption that deaths are uniformly distributed over each age interval one can write $L_x = \frac{1}{2}(l_x + l_{x+1})$. Remaining life expectancy e_a at age a, i.e. the average number of years of life remaining at exact age a is then given by:

$$e_a = \frac{T_a}{l_a} = \frac{\sum_{x=a}^{\omega} L_x}{l_a} = \frac{\sum_{x=a}^{\omega} \frac{1}{2}(l_x + l_{x+1})}{l_a}. \tag{7}$$

This can be compared to the continuous-time equivalent $e(a)$ in equation (6).

We use the life-tables for the year 2017 provided by Statistics Austria (2020). From there we get estimates for the mid-point values L_x, separated for males and females. In the specification with homogeneous mortality rates we use these (gender-specific) values as our estimates of the survival probabilities $s_i(x)$ in our basic present-value formula (4). They are available up to the age $x = 99$ and thus we set the maximum age at $\omega = 100$.

A.2.2 Differential mortality

It is well-documented that mortality is highly correlated with various socio-demographic characteristics, in particular with (long-run) income and wealth. Unfortunately, we are not aware of estimates for differential mortality in Austria that are based on an encompassing data analysis. Despite this lack of official, reliable data we have used two provisional methods that allowed us to come up with approximate estimations for the extend of differential mortality in Austria. The first method is based on the US data in Chetty et al. (2016) while the second method uses direct estimates provided by *Statistics Austria* (based on matches from EU-SILC microdata with mortality data). Both methods are described below.

Differential mortality based on data from the US: The first method to construct income-specific survival probabilities for each HFCS respondent follows the approach that has been outlined by Sabelhaus & Volz (2020). This approach uses various steps. As basic inputs we use the average mortality rates by gender and age for Austria in the year 2017—$q_m^{AT}(x)$ and $q_f^{AT}(x)$—provided by Statistics Austria (2020). In the next step we make an adjustment for differential mortality that is based on the data by Chetty et al. (2016) who use US mortality. In particular, we use the *relative* mortality rates for different income classes for the US and apply it to the Austrian data such that the *average* mortality rates for each age/gender group stay unaffected.

In order to delve deeper into this issue we have to briefly summarize the set-up developed in Chetty et al. (2016). The paper uses linked income tax and Social Security death records for the period 2001 to 2014. In particular, the authors use these data to estimate life expectancy at 40 years of age by *household* income percentile, gender and geographic area. The basic steps were to estimate differential mortality rates for the ages of 40 to 76 years and then to extrapolate mortality rates beyond the age of 76 years by a Gompertz model. The main results of these calculations are available online at https://healthinequality.org/data/ and we use these data for our own calculations.

In a first step we compute the death rates for each of the groups differentiated by gender, age, and the income percentile. In a next step we average these death rates over the 14 years of available data. Following this procedure we get a set of differentiated mortality rates for each gender, income percentile and age from 40 to 76. In order to derive mortality rates for the higher ages we follow the same procedure as Chetty et al. (2016) and estimate a Gompertz model for each income percentile up to the age of 100. Thus we finally arrive at mortality rates $q_{g,j}^{US}(x)$ for income percentile j, gender $g \in f, m$ and age $x \in [40, 100]$.[49] For the application to Austrian data we need to calculate the relative mortality rates. Therefore in a third step we also calculate the average mortality rate $\overline{q}_g^{US}(x) = \sum_{j=1}^{100} q_{g,j}^{US}(x)$ for each gender/age. Finally, we divide the percentile mortality rates by this average mortality to arrive at relative mortality $\frac{q_{g,j}^{US}(x)}{\overline{q}_g^{US}(x)}$ for each percentile/gender/age group.[50]

In the last step, the mortality rate for income group j in Austria can then be calculated by the following expression (for $x \geq 40$):

$$q_{g,j}^{AT}(x) = q_{j,g}^{US}(x) \frac{\overline{q}_g^{AT}(x)}{\overline{q}_g^{US}(x)}, \tag{8}$$

where $\overline{q}_g^{AT}(x)$ is the average mortality rate for gender g and age x as reported by Statistics Austria (2020). Note that it holds that $\overline{q}_g^{AT}(x) = \sum_{j=1}^{100} q_{g,j}^{AT}(x)$. For $x < 40$ we use

[49]The Gompertz model is based on the assumption that mortality rates increase exponentially with age. This is implemented by regressing the logarithm of the mortality rate on age, i.e. $\log(q_{g,j}(x)) = \alpha + \beta x$. This Gompertz log-linear approximations have a good fit for the income-specific mortality rates (with R^2 values that are typically above 0.99).

We also look at an alternative specification in which we only use these Gompertz estimations for the income-specific mortality rates for ages $x \in [77, 90]$ while for higher ages we use identical mortality rates for all income groups.

[50]Sabelhaus & Volz (2020) explain: "By working with relative mortality rates [...] we know that the weighted average (across income percentiles) mortality within a given gender and age group will match the average mortality when we merge to a data set with mortality by gender and age across birth cohorts, so long as the matching data has 100 equally weighted income percentile groups." (p.65)

homogeneous mortality rates, i.e. $q_{g,j}^{AT}(x) = \overline{q}_g^{AT}(x)$ for $x \in [0, 39]$.

The last question is how we identify the different income groups j. In Chetty et al. (2016) this is based on household income around the age of 40. In particular, for individuals aged 63 years or younger they used the income percentile 2 years before death in order to account for the issue of reverse causality that arises due to income changes near death. Chetty et al. (2016) show that the use of mortality rates conditional on income percentile 2 years earlier are a good approximation for the income percentile at the age of 40 years for all age groups up to 61 because individuals' earnings are highly correlated over time between the ages of 40 years and 61 years. From then on, however, this correlation is less pronounced due to the sharp increase in retirement and thus the authors use the income percentile at age 61 for older ages up to age 76. Beyond the age of 76 years, data limitations made it necessary to estimate income-specific mortality rates based on Gompertz models.

Unfortunately, we do not have a panel data set and thus we cannot use lagged household income in order to determine the rank in the distribution. We therefore had to base our categorization on current household income. This is certainly not a perfect indicator for the long-run (or even life-time) income position. On the other hand, the problem of revere causality does not arise here since we do not use these data to calculate income-specific mortality rates (which are taken from Chetty et al. (2016)), but rather to allot households to the different income bins. In particular, the rank of a household was determined by the decile of household income in the age group of the household's reference person. The age groups were formed in 5 years intervals $16-24, 25-29, 30-34, \ldots, 75-79, 80+$. The idea here was that the income rank within an age groups stays rather constant over time, even if average income changes with age. This is particularly relevant for pensioner households that typically have lower income than active households even though their differential mortality is dependent on lifetime income (i.e. mostly their income earned in the active period) rather than the pension income. For this reason we formed two subgroups for the age group $60-64$, one where the household reference person was still active and one where he/she was already retired. The income rank was then determined as the decile within each subgroup. We had to use deciles for our categorization since we did not have enough observations within each age subgroup to form meaningful percentiles. In a robustness exercise we used the rank of household income in the overall distribution (thus abstracting from the age groups). In this case we had enough observations to also look at the income percentile in this overall distribution (in addition to the deciles). The effects of using these different income categorizations were minuscule (both for the aggregates

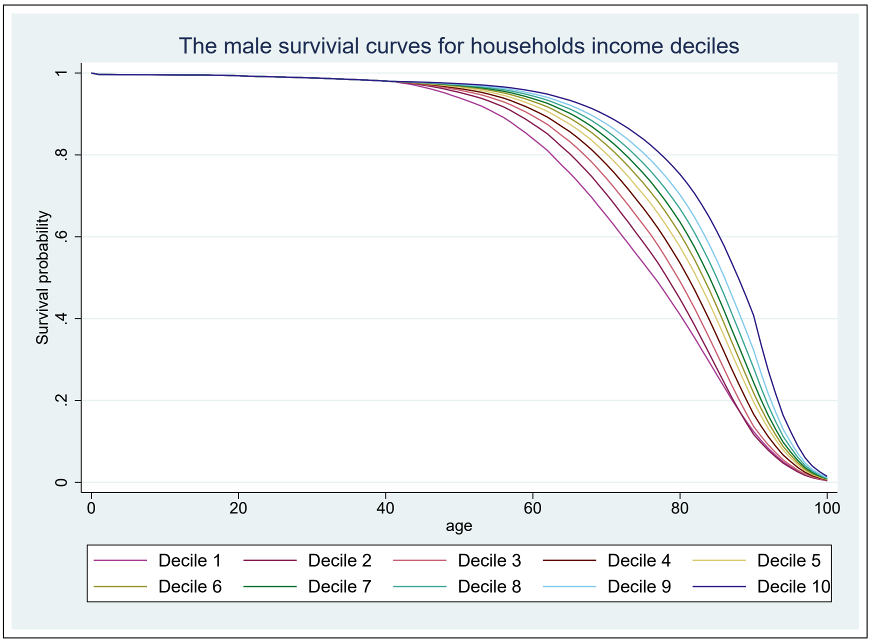

Figure A.1: The figure shows the survival probabilities for men split for ten deciles of household income

and for the distributional values).

In figure A.1 we show the survival curves for the ten deciles of household income when using the method described above. In particular, we use the relative mortality rates based on Chetty et al. (2016) for the ages between 40 and 76, Gompertz estimates for ages between 77 and 89 and gender-specific homogeneous mortality rates for ages below 40 and above 90. The differences are considerable. While for the top decile 93% of the cohort members are still alive at the age of 65 and 37% at the age of 90, the same is only true for 75% and 11%, respectively, for the first decile.

In the next step one can use equation (7) to calculate gender-specific life expectancy for the ten deciles. The results of this calculation are shown in figure A.2. For men, life expectancy (at birth) for the lowest decile comes out as 74.4 while it is estimated to be 10 years longer for the top decile. For women the corresponding values are 80.9 (for the bottom decile) and 87.3 (for the top decile). The differences are somewhat compressed when compared to the ones reported in Chetty et al. (2016) which is mainly due to the fact that they use percentiles instead of deciles.

Differential mortality based on data from Austria: The second source of data on differential mortality was provided by Statistics Austria. These data are based on

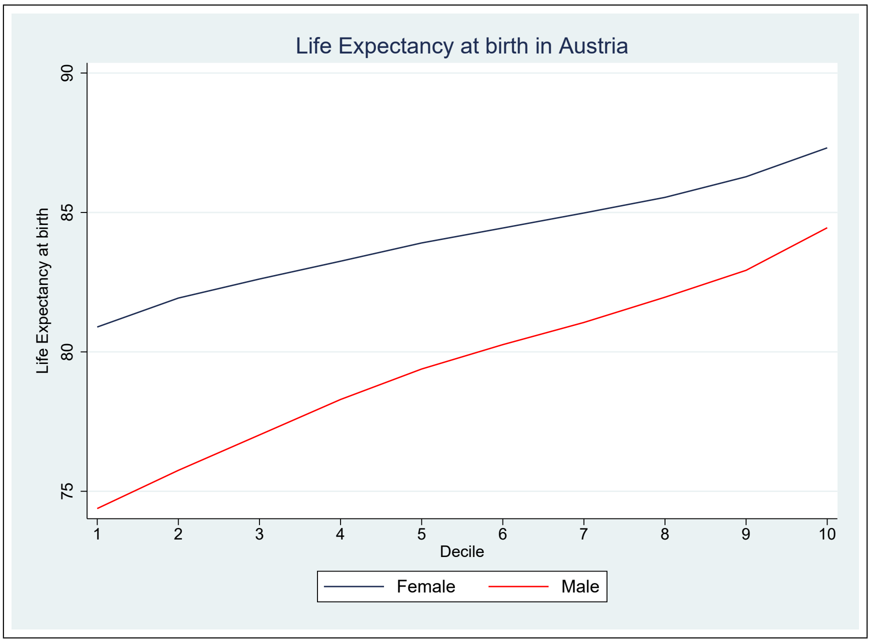

Figure A.2: The figure shows life expectancy at birth for Austria (separated for males and females) for ten deciles of household income.

a link of official data on deceased in Austria with EU-SILC data for individuals who participated in the surveys between 2008 and 2019 and were between 35 and 84 years old (during their respective first surveys). Around 29,000 individuals fell into this category in the different survey waves (15,000 females and 14,000 males). The differential mortality rates were calculated on the basis of Cox proportional-hazards models (separately for males and females). In particular, the deciles of the equivalised household income (in the survey year) were used as predictors in the regression model to derive estimates for the relative hazard rates of the ten deciles. These coefficients were then transformed into decile-dependent mortality rates via the calculation of population marginal means (and the use of smoothing in order to provide for a monotonic pattern). Mortality rates before the age of 35 and after the age of 65 were linearly interpolated. Details of this approach and the underlying assumptions are available upon request.

The use of this alternative method for calculating differential mortality leads to smaller magnitudes. Life expectancy (at birth) for men in the lowest income decile is calculated as 76 while it is estimated to be 83.2 for the highest decile. For women the corresponding values are 81.2 (for the bottom decile) and 86 (for the top decile). Reasons for the differences between this approach and the one based on the relative mortality rates of Chetty et al. (2016) are likely to be due to both different data sources (Austria vs. the

US) and different methodologies. Chetty et al. (2016) were able to link the complete records for income taxes and Social Security deaths for the period 2001 to 2014 while the data-set of Statistics Austria was much more limited (e.g., there were less than 1,000 deaths among all survey respondents). Furthermore, Chetty et al. (2016) used the income position at the age of 40 as the reference value for the long-run income rank and they allowed for non-proportional hazard rates.

A.3 Pension income

A.3.1 Tax rates

Countries differ in the way how pension contributions and public pension benefits are taxed. In some countries the contributions are paid from net income after taxes while pension benefits are tax-exempt. In other countries, like in Austria, contributions are paid from gross income before taxes and other social security contributions while the pension benefits are subject to the normal income tax schedule (and also to health insurance contributions). The use value of the total pension entitlements corresponds to the stream of *disposable* pension income, i.e. to the pension benefits *after* taxes.

To this end, one needs to find the appropriate tax rate for every individual in our dataset.[51] Our basic assumption in this exercise is that after retirement individuals will have no other significant sources of income in addition to their pension income. Therefore it is sufficient to calculate the tax rate that is likely to apply to the expected pension benefit. The first element is the mandatory health insurance premium which amounts to 5.1% for each pensioner. The additional steps, however, are not straightforward since the tax system is characterized by a number of special regulations, e.g. for low incomes (tax-exempt basic income) or for the martial status (different tax credit for single-earners and for couples). In addition, in Austria most employees earn fourteen monthly salaries where the 13th and the 14th salary are called “holiday pay” and “Christmas allowance”, respectively. These 13the and 14th payments also apply to the public pension benefits and these remunerations are taxed according to a specific tax schedule. In particular, the first €620 of these payments are tax-exempt (all values in the following refer to the legal regulations as of 2016) while for the part exceeding this threshold a uniform

[51] We use the regulation as of 2017 and do not take later changes into account. The top tax rate of 55% was scheduled to be decreased to 50% by 2020 (which was later repealed), but since we do not have individuals with incomes above €1 million in our dataset this is inconsequential.

tax rate of 6% is applied.[52] The "normal" monthly salaries (or pensions) are taxed according to a income tax scale that starts at a marginal tax rate of 25% for annual incomes above €11,000 and proceeds at tax rates of 35%, 42%, 48%, 50% and 55% for thresholds values of €18,000, €31,000, €60,000, €90,000 and €1,000,000, respectively. In addition, there exist a number of special allowances and deductions (like transportation and child deductions) that are, however, mostly no longer applicable for pensioners and we exclude these unlikely possibilities from our calculations. We take account, however, of the pension deduction that amounts to €400 up to a pension income of €17,000 per year. This deduction is reduced linearly for an income between €17,000 and €25,000. For incomes above €25,000 no deduction is applicable. Using these tax rules we calculate the expected net pension payments in the following manner. We start by the matched values for the total pension credits TC_i. If we would apply the tax schedule directly to these values this would lead to an underestimation of the tax rates since the pension benefits will increase until retirement (especially for the younger cohorts). Therefore we calculate a rough estimation for the expected total initial pension benefit PB_i^e by simply assuming that the individual will continue to work at the current income level until retirement. In particular we calculate: $PB_i^e = TC_i + 0.0178 \times Y_i^{2016} \times (R^i - a_i)$, where Y_i^{2016} stands for the pensionable income of individual i in year 2016 and PB_i^e for the expected initial pension benefit. This is certainly a rather rough estimation and it disregards possible income increases until retirement and also the possibility of unemployment, sickness etc. Note, however, that we do not use PB_i^e for the calculation of total pension entitlements in equation (4) but *only* to get an estimation of the expected individual tax rate that is then applied to $PB_i = TC_i$. This is in line with the "accrual method" (while the use of PB_i^e would correspond to the "ongoing concern" approach).[53] The individual tax rate τ_i is based on the tax regulation as described above (thus including the mandatory health insurance premium, the special treatment of the 13th and the 14th monthly salary, the income tax scale and the pension deduction).

After applying this stylized tax code to our data, the average expected tax rate for active individuals with pension entitlements comes out as 12.2%. If we apply the same calculations for the (gross) pension of the pensioners in the HFCS we get a rather similar average tax rate of 12.6%.[54] What is more, these rates are also similar to the observed tax

[52] There exist higher tax rates for very high incomes which we disregard here. The same is true for some special laws related to very low pension income.

[53] Alternatively, one could also use the tax rate that would apply for TC_i without taking further increases into account. The differences to our approach are, however, tiny.

[54] Put differently, this results implies that the average expected pension benefit based on the crude

data for pensioners in 2016. Statistics Austria (2017) report an average tax rate of 11.8% for the group of pensioner (see Table 1: "Haupterhebungsmerkmale der Lohnsteuerstatistik 2016"). This value is slightly lower than the figure 12.6% which might be due to the fact that we have abstracted from some special deductions and exemptions (e.g. involving social security contributions for very low pensions).

A.3.2 Civil servants

As mentioned in the main text, in Austria we can observe separate pension schemes for the civil service, separately for core federal government civil servants, employees of the federal railways with civil service status, (the majority of the small group of) federal theater employees and—under the autonomous legislations of the nine states—state and local government civil servants.

The pension reform in the civil service did not follow completely the described path of the legislation covering the general pension scheme as summarized in section 3—for basically two reasons: First, civil service exponents were generally, and from the very beginning, able to somewhat moderate the regime change for their clientèle and, second, civil service pension legislation has generally experienced a certain trend towards diversity in the last two decades (which is in contrast to the declared goal of pension harmonization and is particularly pronounced for the sub-federal government level). Already the federal civil service legislation, which was supposed to serve as a blueprint for the sub-federal government level, went—from the very beginnings—its own way in an number of points. Only those who would be granted civil service status after 2004 were fully harmonized with and are now subject to the contribution and benefit regime in the general pension scheme and the General Pension Act. Those who were born after 1954 and granted civil service status before 2005 were subject to a parallel calculation of the General Pension Act and their old civil service pension scheme, and already the original parallel calculation regime of the year 2004 legislation applied a larger weight to the (usually more generous) old scheme benefit: not a pro-rata-temporis weight as in the general scheme, but—actually completely counterintuitively by any account—the pension accrual percentage accumulated before year 2005. And also the year 2012 legislation, which finally, as described above, was supposed to put an end to the overcomplicated parallel calculation regime and to replace the old scheme benefit by an initial credit to the pension account, was

method sketched above, leads to similar average pension benefits as could be observed in the year 2016 for the then retired population.

implemented only halfway: Birth cohorts up to year 1975 were spared from the "reform of the reform" and are still, up until today, subject to the parallel calculation regime.

Pension matters of state and local government civil servants are—as mentioned above—subject to state legislation. Up until the late nineties, state pension legislation in Austria was heavily shaped by a special "homogeneity principle" (laid out in the federal constitution), according to which state legislators were basically explicitly forced to orient themselves closely towards the federal law. State pension legislation therefore often copied—after a certain time lag—one-to-one the recent enactments of the federal parliament or transferred it to state pension law by simple cross-reference. In 1999 this "homogeneity principle" was removed, actually and amusingly at around the same time when the harmonization of pension schemes became a major issue on the agenda, and inadequate care was taken to somehow synchronize and coordinate the resulting new pluralism of legislations. As a final consequence, all nine states have basically gone their own individual ways and this is also true as far as the adaption of the pension account system is concerned, to which we owe the donor data in our matching exercise. The current status quo is that four out of the nine states (Burgenland, Salzburg, Tyrol and Vienna) have never introduced and taken part in this system, two states (Carinthia and Upper Austria) have done so but have avoided a "parallel calculation" right from the beginning, two states (Styria and Vorarlberg) have not taken part in the initial credit legislation and do still fully adhere to a parallel calculation regime and only one state (Lower Austria) has completely followed the federal legislation with a combination of initial credits and the parallel calculation.

This complicated system of federal and state pension laws implies that for the case of civil servants the direct use of our normal method to derive the present value of future public pension entitlements on the basis of the pension account data might not give a completely accurate result. In order to deal with this issue we have proceeded as follows. First, we have calculated for each civil servant the pension entitlements under the assumption that these specific legislations were absent and the pension would be derived in the same manner as for pensioners of the private sector. In a second step we calculated the expected pension levels on the basis of the actual civil sector pension laws for a number of stylized cases in order to investigate the potential error-proneness of the benchmark approach. In particular, we looked at the birth cohorts of 1955, 1960, 1965, 1970 and 1975 in the core federal civil service under the assumption of retirement at the age of 65 and under different assumptions about labor force entry (15, 20 or 25 years of age) and hence also about the total length of service (50, 45 or 40 years) and also for different wage career profiles (either average wage growth or an increasing profile from 75 to 100 percent of the maximum contribution base). It turns out that under most reasonable assumptions the benchmark values based on the pension account delivers results for pension benefits which are not too far away from what would have been expected under the old scheme and particularly from what would have been expected under the parallel calculation regime. This is particularly true in the case of younger birth cohorts for whom the old scheme carries less and less weight. We therefore use the pension account data in our benchmark specification as a proxy for expected pension income also in the case of retirees under the parallel calculation regime. In one robustness exercise (see column (5) of Table 6) we look at an alternative specification where we simply assume that the pension income of civil servants is higher by 20%. As we show there this has almost no effect on our main results.

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