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Lifetime Earnings Inequality in Germany

Timm Bönke[*], Giacomo Corneo[**] and Holger Lüthen[***]

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Abstract: This paper documents the magnitude, pattern, and evolution of lifetime earnings inequality in Germany. Based on a large sample of earning biographies from social security records, we show that the intra-generational distribution of lifetime earnings of male workers has a Gini coefficient around .2 for cohorts born in the late 1930s and early 1940s; this amounts to about 2/3 of the value of the Gini coefficient of annual earnings. Within cohorts, mobility in the distribution of yearly earnings is substantial at the beginning of the lifecycle, decreases afterwards and virtually vanishes after age forty. Earnings data for thirty-one cohorts reveals striking evidence of a secular rise of intra-generational inequality in lifetime earnings: West-German men born in the early 1960s are likely to experience about 80 % more lifetime inequality than their fathers. In contrast, both short-term and long-term intra-generational mobility have been rather stable. Longer unemployment spells of workers at the bottom of the distribution of younger cohorts contribute to explain 30 to 40 % of the overall increase in life-time earnings inequality.

Keywords: Lifetime Earnings, Earnings Distribution, Inequality, Mobility, Germany

JEL Classification: D31, D33, H24

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Introduction

Individuals often adopt their generation's earnings and living standards as a benchmark for evaluating how successful they are and how well they fare. Intra-generational inequality also determines the extent to which individuals who live in the same country have the feeling of sharing a common fate, with major consequences for people's trust in each other and their attitudes towards policies and institutions that redistribute resources in society. Such assessments of intra-generational inequality quite naturally take a lifecycle perspective. Lifetime inequality appears to be more relevant than inequality in short time spans because the former is not sensitive to income situations that are merely transitory, like low earnings during college years or especially high earnings thanks to temporarily skyrocketing bonuses. Furthermore, intra-generational lifetime inequality is measured with respect to a stable subgroup of the population, so that it is not affected by changes in the composition of the population of income recipients.

This paper documents for the first time the magnitude, structure and evolution of intra-generational lifetime earnings inequality in Germany. We exploit data on earning biographies from social security administrative records to shed light on the following issues: What is the magnitude of lifetime earnings inequality and how does it compare to usual measures of inequality of annual earnings? How do cohort-specific inequality and mobility evolve over the lifecycle? Is lifetime inequality for individuals who now are in working age going to be larger or smaller than the one experienced by their parents?

In order to answer those questions we analyze the earnings histories of thirty-one birth cohorts in Germany, ranging from individuals who were born in 1938 to those born in 1968. The dataset we scrutinize is a highly representative sample of the male employee population of West Germany. We define lifetime earnings as the present value of an individual's earnings until the individual reaches age sixty. For the eleven oldest birth cohorts in our dataset we observe all annual earnings until they reach age sixty, so that we can compute their lifetime inequality as well as their mobility in the intra-generational distribution of annual earnings during their entire active lifecycle. We observe younger cohorts' earnings only for an initial part of their lifecycle and can compute measures of earnings inequality and mobility up to some age between forty and sixty. Using both the information about cohorts that have completed their labor-market life-cycle and the information about the still active cohorts, we attempt to gauge how lifetime inequality is evolving across generations in Germany.

We find that the intra-generational distribution of lifetime earnings of male workers has a Gini coefficient around 0.2 for cohorts born in the late 1930s and that the extent of inequality of lifetime earnings is about 2/3 of the size of inequality of annual earnings. Age-specific annual earnings inequality follows a U-shaped pattern over the lifecycle, with a minimum reached around age thirty-five. Even controlling for age, measures of inequality of annual earnings substantially overestimate the inequality of lifetime earnings, the difference between the two measures being due to individuals' mobility in the distribution over time. Within cohorts, mobility in the distribution of yearly earnings is substantial at the beginning of the life cycle, decreases afterwards and virtually vanishes after age forty. Age-earnings profiles are concave and steeper for better educated individuals.

A comparison with the earning biographies of later cohorts reveals striking evidence of a secular rise of intra-generational inequality in lifetime earnings: West-German men born in the early 1960s are likely to experience about 80 % more lifetime inequality than their fathers. In contrast, both short term and long term intra-generational mobility have been rather stable for cohorts born after 1938. Intra-generational lifetime earnings inequality has increased both at the bottom half of the distribution and at the top half of the distribution, but the rise has been stronger at the bottom. We find that some 30 to 40 % of the rise of lifetime inequality in Germany can be attributed to an increase of the duration of unemployment for individuals at the bottom of the earnings distribution, while the rest is due to the increase of intra-generational wage inequality. The substantial rise of lifetime earnings inequality documented in this paper is likely to have profound repercussions for a number of policy issues in Germany, including the role of the welfare state, pension reform, and bequest taxation, as well as for broader cultural and social developments.[1]

This paper is related to various strands of literature. Firstly, it relates to the literature on the long-run evolution of wage and earnings inequality. Our finding of a secular rise of intra-generational lifetime earnings is, to the best of our knowledge, a novel one. There seem to be no other studies that attempt to pin down the evolution of the inequality of lifetime earnings. Closest to the current paper is probably the article by Kopczuk et al. (2010) about earnings inequality in the United States. Using social security data, they compute Gini-coefficients of cohort-specific long-term earnings distributions since 1937. Long-term earnings are defined as earnings over a twelve-year period and three benchmark periods are considered: from age twenty-five to age thirty-six, from age thirty-seven to age forty-eight, and from age forty-nine to age sixty. For cohorts born after the late 1930s, all three measures of long-term earnings exhibit a clear upward trend of cohort-specific inequality. If one takes that finding by Kopczuk et al. (2010) as evidence of an increase in the intra-generational inequality of lifetime earnings, our result points to a remarkable analogy in the development of inequality in the US and in Germany.[2]

Secondly, this paper complements various analyses of how wage inequality has evolved in Germany over the last three decades. The literature has mainly focused on the distribution of annual wages and discussed when inequality began to increase. Using social security records, Dustmann et al. (2009) find that earnings inequality has increased in West Germany in the 1980s, but only at the top half of the distribution; in the early 1990s, inequality started to rise for the entire distribution. They argue that skill-biased technological change drove the widening of the wage distribution at the top, while changes in labor market institutions and immigration shocks were responsible for the increasing inequality at the bottom. Using data from the German

[1] Wilkinson and Pickett (2009) have recently renewed the debate on the social effects of income inequality.

Socio-Economic Panel (GSOEP) and German Income and Expenditure Survey (EVS), Fuchs-Schündeln et al. (2010) confirm the rise of earnings inequality in West Germany after reunification, the upward trend of inequality being mainly driven by an increase in earnings inequality after the year 2000. By contrast, they find that inequality has not noticeably increased during the 1980s. Interestingly, they find that the experience premium has increased over time. Also using the GSOEP data, Gernandt and Pfeiffer (2007) find that inequality of hourly wages for prime-age male employees was stable in West Germany between 1984 and 1994 and increased thereafter. In the period of increasing inequality they find a significant positive gap between high-tenure and low-tenure workers in terms of respective wage growth rates. They suggest that the adjustment of wages to worsening labor market conditions mainly concerned the entrants in the labor market rather than the incumbents.[3] Our paper adds to the overall picture of the evolution of inequality in Germany by establishing how lifetime earnings inequality has changed across cohorts, an aspect which is key to assess the implications of rising inequality for the welfare of the various generations. Furthermore, our investigation of age-earnings profiles over the entire lifecycle confirms the importance of controlling for the age composition of the workforce when evaluating long-run changes in the distribution of annual earnings.[4]

Thirdly, our work is related to the literature on the relationship between annual and lifetime income inequality and the extent of intra-generational mobility.[5] The main study of complete income biographies is probably Björklund (1993), who exploits Swedish tax registers to compute the lifetime income before taxes of cohorts of men born between 1924 and 1936. Simi-

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[2] Björklund (1993) studied the distribution of lifetime income in Sweden for cohorts born between 1924 and 1936. The evolution of the corresponding Gini-coefficients does not exhibit a systematic pattern, possibly because of sampling variation since the samples for each cohort are small.

[3] Dell (2005) and Bach et al. (2009) investigate the evolution of top salaries in Germany using tax returns data, as earners at the very top of the distribution are not represented well in social security and GSOEP data. Consistently with results from other countries, they document an increase of top salary inequality after reunification. However, that inequality increase is much less accentuated than in the US.

[4] OECD (2008) gives an overview of the impact of demographic change on the income distribution. In a recent paper, Almas et al. (2010) provide evidence that changes in the age structure of the workforce had a significant impact on the Gini coefficient of annual earnings in Norway in the period 1967-2000.

larly to our result for the cohorts born in the late 1930s, he finds that the Gini coefficient of the distribution of lifetime earnings is close to 0.2 and that it is around 35-40 percent lower than the one for cross-sections of annual incomes.[6] Another common finding, shared by a number of studies of panels covering only subsets of the lifecycle, is the existence of substantial intra-generational mobility during the early stages of the lifecycle.[7] Björklund (1993) finds that age-specific annual income inequality follows an L-shaped pattern over the lifecycle, i.e. the Gini-coefficient of the distribution of annual income does not rise when individuals approach age sixty, as we find for earnings in Germany for later cohorts. That difference appears to be mainly due to the role of pensions, that are included in Björklund (1993)'s income concept whereas they do not count as earnings in our investigation.

Fourthly, this paper adds to the literature on the lifecycle variation in the association between annual and lifetime earnings by assessing that association over completed lifecycles for the case of Germany.[8] We confirm Björklund (1993)'s result that the correlation between annual income and lifetime income is quite high and stable after age thirty-five, while it is relatively low before. With respect to age-earnings profiles, our finding that they are much steeper for university graduates than for uneducated workers is in line with standard models of human capital investment. It also accords well with recent findings by Bhuller et al. (2011) based on Norwegian earning biographies for cohorts born in the 1948-1950 period.

The rest of the paper is organized as follows. In the next Section, we describe our dataset and define the variables of interest. Section 3 quantifies lifetime earnings inequality and com-

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5 See Burkhauser and Couch (2009) for an excellent survey of the literature.

6 Burkhauser and Poupore (1997) compare the distribution of annual earnings with the one of earnings over a six-year period from 1983 to 1988. Using the GSOEP, they find that when the Gini coefficient is computed over six years, its level falls by less than ten percent. See also Maasoumi and Trede (2001).

7 For West Germany, Trede (1998) analyzes short-run earnings mobility between 1983 and 1993 using the GSOEP. He finds that mobility declines with age until age thirty-five and does not change thereafter.

8 Implications of that variation for regression models are discussed by Jenkins (1987) and further worked out by Haider and Solon (2006). Böhlmark and Lindquist (2006) apply Haider and Solon's model to high-quality Swedish data. An application of the proposed methodology to correct for the lifecycle bias that uses German earnings data is Brenner (2010).

pares it with annual earnings inequality. Section 4 is devoted to the pattern of earnings mobility during the entire active lifecycle. In Section 5 we attack the issue of determining the evolution of intra-generational lifetime inequality and dissect its main driving forces. Section 6 concludes.

1 Data and Methodology

Our investigation of lifetime earnings exploits administrative data of the German social security. Virtually all employees in Germany mandatorily participate in its national pay-as-you-go pension system which, being of the Bismarckian variety, carefully records all contributors' earnings biographies.[9] We analyze an excerpt of the social security data, namely the Insurance Account Sample ("Versicherungskontenstichprobe", VSKT in the following). That is a stratified random sample of individuals who live in Germany, have at least one entry in their individual social security record, and are aged between thirty and sixty-seven in the reference year of the sample. Insurance Account Samples are provided for the reference years 2005, 2006, 2007 and 2008 by the Data Research Center of the German Federal Pension Insurance. Each sample contains the earnings biographies of the observed individuals up to the reference year. Data are collected following individuals over time so as to form a panel. For each individual, its monthly history of employment, unemployment, sickness and, especially, of its contributions to the pension system is recorded. Information about contributions allows one to recover individual gross wages. Individual records cover the period from the year the insured reached age fourteen until the year the individual turned sixty-seven.[10] We use the records of male earners who have only been working in West Germany. For each birth cohort, we are left with a number of individuals

[9] A few categories of employees have distinctive pension systems and do not appear in the social security data, like civil servants, or are treated different to an ordinary insurant like miners and employees of the federal railways.

[10] We use all four samples in our analysis. Information on birth cohort 1938 is picked from the 2005 sample; information on the 1939 cohort comes from the 2006 sample; information on the 1940 cohort is taken from the 2007 sample. Later birth cohorts are covered using the 2008 sample.

that roughly oscillates between 1,000 and 2,000; the exact numbers are reported in the Appendix.

Albeit the data we scrutinize is of high quality, some limitations remain. In order to ensure a consistent time series of earnings, three major adjustments were performed. The first one concerns the imputation of one-time payments. Those payments were not included in the social security data before 1984. In order to work with a time invariant definition of earnings, we follow a route suggested by Fitzenberger (1999) and also followed by Dustmann et al. (2009): we adjust earnings above the median for the years before 1984 using an earnings specific growth factor.

The second adjustment is the addition of employers' social contributions (to unemployment, health, pension and nursing care public insurances) to the individuals' gross wages. Adding those elements of pay is necessary in order to determine the market value of the individuals' skills and in order to take into account the changes of contribution rates and assessment ceilings that have occurred over the years across various branches of the social insurance system and across various subgroups of the working population.

Third, we deal with the issue of top-coded earnings. In Germany, employees contribute a share of their gross wage to the mandatory pension system up to a wage ceiling. As a result, the social security data is right-censored as individuals whose wages exceed that ceiling are recorded as if their wages were equal to that ceiling. Over all years and cohorts in our sample, censoring affects about 9.1 percent of the recorded yearly earnings. In order to better approximate the true distribution of top earnings, we impute them to individuals affected by top coding. Our imputation method rests on the assumption that the upper tail of the earnings distribution follows a Pareto-distribution. In our baseline approach, we posit that also the top 10 percent of individual earnings below the contribution ceiling are Pareto-distributed. Then, we estimate the corresponding Pareto-coefficient by OLS. The estimation is conducted separately for all years and birth cohorts. The estimated Pareto-coefficients are then used to determine the distribution of the unobserved earnings above the contribution ceiling. The assignment of estimated earnings to individuals is done so as to preserve the individual rankings in the earnings distribution. Thereby, the rank of an individual is based on the last observable rank in relation to all individuals at or above the contribution ceiling in the birth cohort specific earnings distribution. A cross-check by comparing the obtained annual earnings distributions to uncapped distributions from survey-based micro data reveals a good fit.[11] We also explore the implications of two alternative imputation procedures: an imputation of the estimated mean income above the ceiling to all individuals with top-coded earnings and a maximum mobility scenario where the ranking order is reversed every year. Results from those alternative imputation methods are reported in the Appendix. They do not differ much from those obtained under our preferred rank-preserving assumption.

2 Inequality of Lifetime Earnings

A key objective of this paper is to determine the extent of lifetime earnings inequality within annual birth cohorts. Lifetime earnings are computed from the earnings an individual has received from age seventeen to age sixty. We exclude earnings received in older age so as to avoid that measured lifetime earnings be significantly affected by early retirement decisions. The chosen age restriction implies that with the data at hand lifetime earnings can be computed for eleven cohorts born between 1938 and 1948. When computing lifetime earnings, we discount yearly earnings to the year the individual turned seventeen and then determine the corresponding present value of earnings. Two discounting methods are applied. The first one uses the average nominal return on German government bonds obtained from an official time series pro-

[11] For details, see Bönke (2009).

vided by the German central bank.[12] The second one simply uses the consumer price index, so that lifetime earnings equal the unweighted sum of real annual earnings.

Results about the Gini coefficient of the cohort-specific distribution of lifetime earnings are displayed in the lower part of Figure 1. The lowest curve represents the Gini coefficient of lifetime earnings when annual earnings are discounted using the returns from German federal bonds. The Gini coefficient oscillates between a minimum of 0.166 for the 1938 cohort and a maximum of 0.216 for those born in 1942. Discounting clearly affects the results, as shown by the second curve from below which is obtained without real discounting. Real discounting reduces intra-generational inequality because of the steeper rising age-profile of earnings for better educated workers, who are also those with the larger lifetime earnings. We display those age-earning profiles in Section 4.

Inequality in lifetime earnings is of an order of magnitude smaller than inequality in annual earnings. In order to assess the extent to which lifetime earnings inequality is overestimated by measures of yearly earnings inequality, we compare it with an average of measures of yearly earnings inequality. The curve lying in the middle of Figure 1 shows the average of the Gini coefficients of the distribution of yearly earnings for each cohort. Across all observed cohorts, that average Gini coefficient ranges from a minimum of 0.273 for the 1938 cohort to a maximum of 0.337 for the 1948 cohort.

The above comparison draws from distributions of yearly earnings for individuals who have the same age. A comparison with yearly earnings distributions defined over individuals with possibly different age can be performed by constructing from each cohort a fictitious population of individuals with yearly earnings. Thereby, yearly earnings of the same individual in two different years are treated as two observations of individual earnings in the same year. Time effects are taken into account by discounting to a common year, namely the year when the co-

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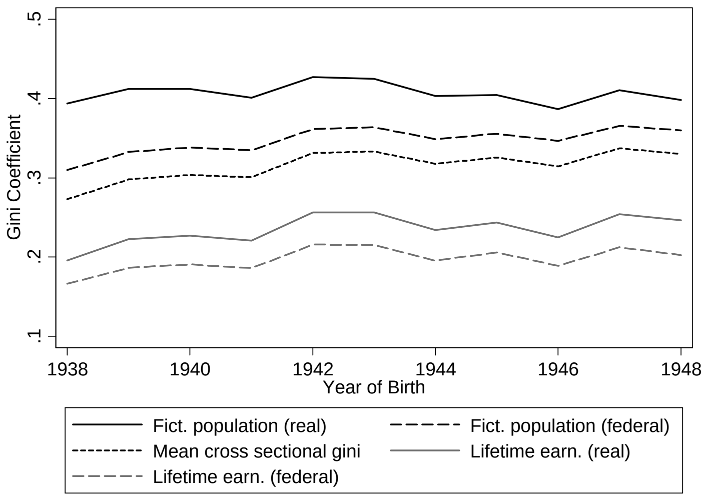
12 Details on the methodology used to compute the time series are available at

hort turned seventeen. Results for, respectively, the case of discounting using the German federal bonds and the case of real undiscounted earnings are depicted by the two curves in the upper part of Figure 1. Comparing those curves with the two corresponding curves in the lower part of Figure 1 reveals that cross-sectional Gini coefficients of annual earnings inequality tend to overestimate the inequality of lifetime earnings by about one third.

In order to illustrate the implications of our finding, an interpretation of the Gini coefficient stressed e.g. by Sen (1973) may be useful. Accordingly, the Gini coefficient equals one half of the expected income difference between two randomly selected individuals divided by the average income in the population. A Gini coefficient of 0.3, which roughly corresponds to our finding for annual earnings inequality, means that in a hypothetical two-person economy the lower income amounts to 7/13 of the higher income. A Gini coefficient of 0.2, which roughly corresponds to our finding for lifetime earnings inequality, means that in a two-person economy the lower income amounts to 2/3 of the higher income. Thus, inequality measured from annual earnings substantially overestimates the inequality of lifetime earnings but the latter is by no means negligible.

Figure 1: Gini coefficients of fictitious populations, means of the cross sectional Gini coefficients, and Gini coefficients of lifetime earnings.



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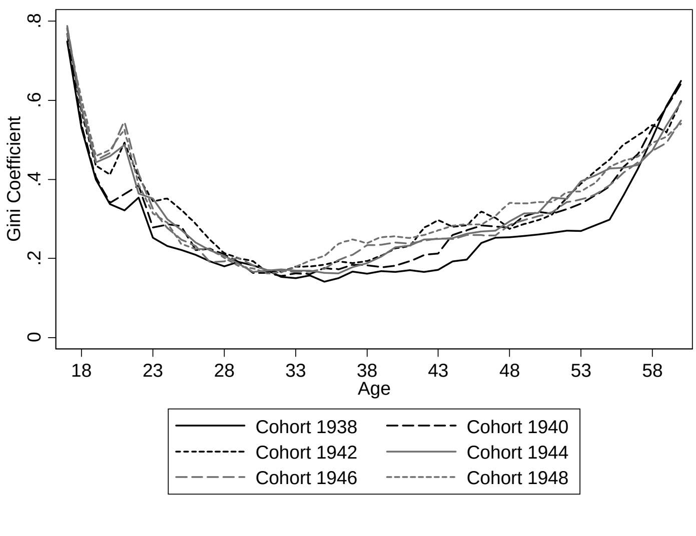
http://www.bundesbank.de/statistik/statistik_zeitreihen.php?lang=de&open=zinsen&func=row&tr=WU0004.

3 Inequality and Mobility over the Lifecycle

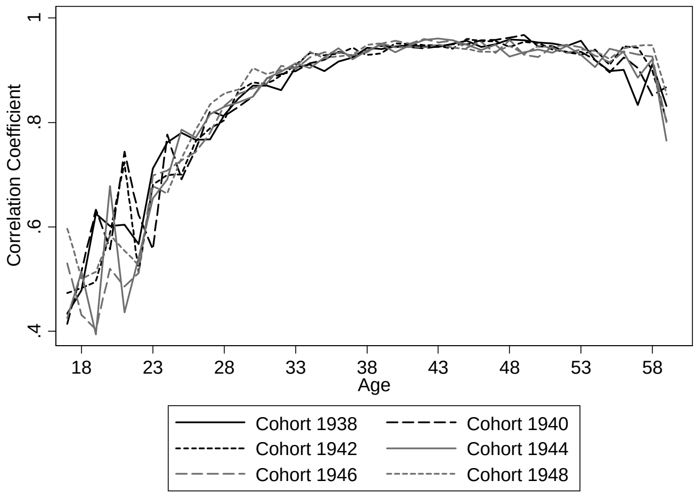
We are now in a position to assess how intra-generational inequality develops along the lifecycle of each cohort and how it relates to lifetime inequality. Figure 2 shows for each cohort the development of the Gini coefficient of annual earnings as a cohort grows older. A U-shaped pattern clearly emerges from the data. Inequality is maximal when the cohort is below twenty because many individuals have not yet entered the labor market and have thus zero earnings. Inequality then declines and reaches a minimum when the cohort is in its mid-thirties. After that, a period of rising inequality of annual earnings sets in. When individuals are sixty-years old, the distribution of their annual earnings has about the same Gini coefficient as the distribution that prevailed when they were twenty-years old. This pattern is consistent with the presumption that better educated workers have a relatively steeper age-earnings profile, something to which we return below. The sudden and short-lived rise of annual inequality when individuals are in their early twenties can be attributed to mandatory military and civil service, which entail a temporary lack of earnings. Older cohorts are less affected by that because the serving time increased from twelve to eighteen months in 1963.[13]

Figure 2: Annual Gini coefficients from age 17 to 60 sixty for cohorts 1938-1948.



If age-earnings profiles systematically differ across members of the same cohort, some mobility in the intra-generational distribution of yearly earnings should be expected. Figure 3 shows for each cohort the correlation of individuals' ranks in the distributions of two consecutive years. The displayed correlation coefficients are inversely related to the short-run mobility of individuals in the earnings distribution: the lower the coefficient, the higher is the mobility. According to Figure 3, some intra-generational mobility always exists and that mobility decreases with age. While there is significant mobility when the cohort is in its twenties, mobility virtually vanishes when the cohort enter its forties. This suggests that most of the intra-generational mobility is the effect of the better educated catching up and then leaving behind the less educated, and that this process is almost completed when individuals are in their forties.

Figure 3: Rank correlations of consecutive years for cohorts 1938-1948.



The correlation between annual and lifetime earnings is far from perfect and changes with age. Figure 4 shows that relationship for various cohorts for which lifetime earnings can be computed. When adulthood begins, annual earnings contain virtually no information about lifetime earnings as their mutual correlation is close to zero. The correlation between annual and lifetime earnings then rapidly increases with age. A correlation coefficient of 0.9 is reached when the cohort is at the end of its thirties and such a high level persists until the mid fifties.

[13] The serving time was later reduced to fifteen months in the 1970s.

Thus, in that period of the lifecycle the level of individuals' annual earnings can be considered representative of their respective lifetime earnings. A similar conclusion can be drawn from Figure 5, where the rank correlation between annual and lifetime earnings are depicted.[14]

Figure 4: Correlation coefficients of annual and lifetime earnings with federal bond discounting for cohorts 1938-1948.

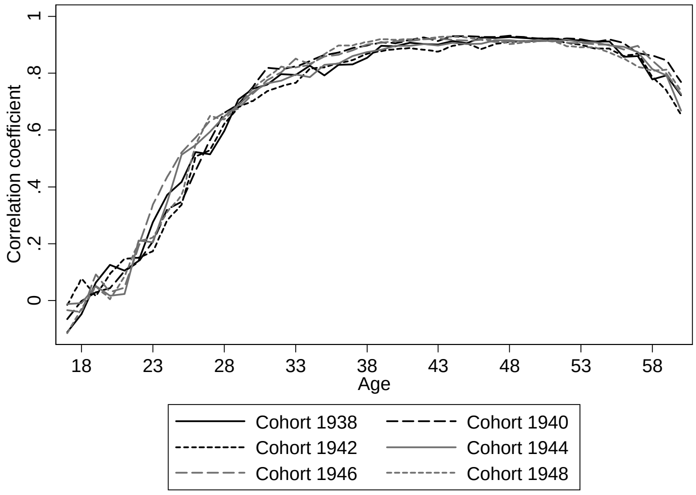
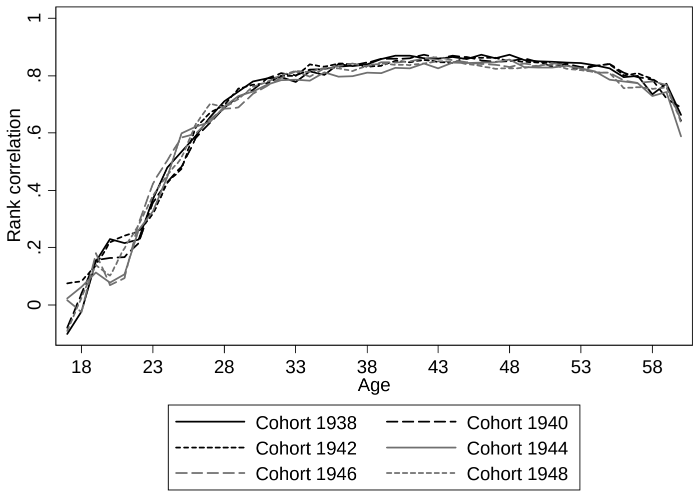


Figure 5: Rank correlation of annual and lifetime earnings with federal bond discounting for cohorts 1938-1948.

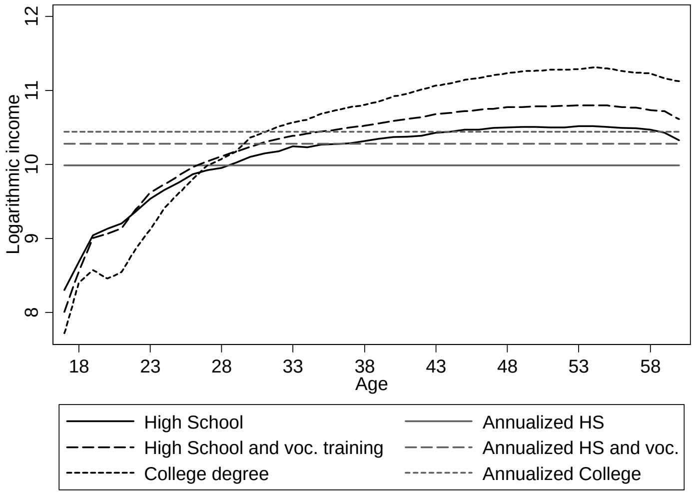


Cohort-specific age-earnings profiles for various educational attainments help to make sense of the observed mobility patterns. In Fig. 6 we plot those profiles for three levels of education for the pooled cohorts from 1938 to 1948. The horizontal lines depict the annuitized value of the corresponding present value of lifetime earnings. All earnings are in real terms on the

[14] Figures 4 and 5 use lifetime earnings discounted at the German federal bond rate. The corresponding figures for

basis of prices in 2000 and expressed in logs. For each educational group, the profile has a mainly rising, concave shape. However, the higher educated individuals experience more rapid earnings growth through the entire lifecycle. Hence, the earnings dynamics triggered by human capital investment and the subsequent effects of accumulated knowledge in the accomplishment of intellectual tasks is consistent with the kind of mobility in the earnings distribution that is exhibited by the data.

Figure 6: Age-earning-profiles for pooled cohorts 1938-1948.



4 Evolution of Lifetime Inequality

Are cohorts becoming more or less equal in terms of their lifetime earnings? This question cannot be satisfactorily answered by examining just the cohorts born between 1938 and 1948 for which lifetime earnings can be computed. We now exploit also the data available for younger cohorts in order to uncover patterns of the long-run evolution of lifetime earnings inequality in Germany.

A natural generalization of the concept of lifetime earnings is "up-to-age-X" earnings, UAX for short. For a given individual, UAX is just the present value of all his earnings before he becomes X-years old. For each cohort, the Gini coefficient of the distribution of UAX can be

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the case with real discounting are in the Appendix.

computed for different values of X. The higher the X, the closer that earnings measure to lifetime earnings, and the two concepts coincide if X = 60. Establishing how the Gini coefficient of the distribution of UAX has evolved over successive cohorts may provide valuable hints about the underlying evolution of lifetime earnings inequality. If younger cohorts display higher Gini coefficients for the same X and if this applies to all X, that would strongly suggest that there is a trend of increasing lifetime earnings inequality. The opposite conclusion would be drawn from observing lower Gini coefficients for younger cohorts; in that case one would argue that younger cohorts are characterized by less inequality and are likely to experience more equal lifetime earnings.

The results in Section 4 indicate that mobility in the earnings distribution is significant until about age forty. Therefore, we focus on the distribution of UAX for X>39. The VSKT excerpt from the social security data allows us to compute UAX for X>39 for the thirty-one cohorts born between 1938 and 1968. For each cohort and each definition of X, one can then compute the Gini coefficient of the distribution of UAX. Representative results are displayed in Figures 7 and 8 for earnings up to the ages of 40, 45, 50, 55, and 60 (lifetime earnings). The results are surprisingly clear. Gini coefficients trend upwards for each value of X. This strongly suggests that younger generations are likely to experience more intra-generational lifetime economic disparity than their fathers.

Figure 7: Ginis of UAX- earnings with federal bond discounting for cohorts 1938-1968.

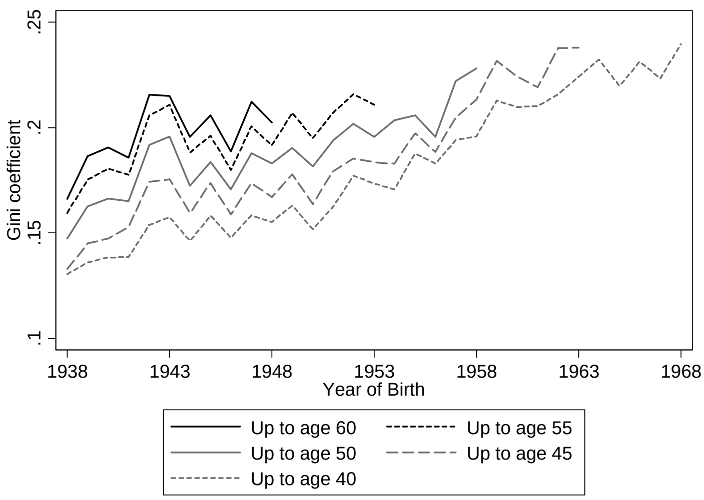
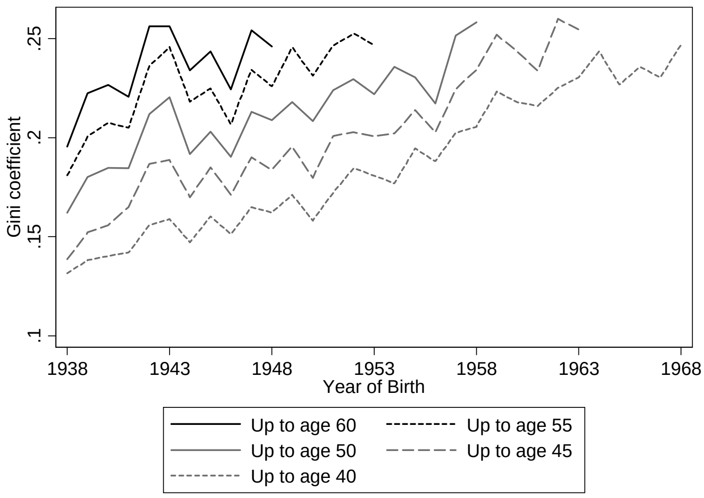


Figure 8: Ginis of real UAX- earnings for cohorts 1938-1968.



The increase in intra-generational earnings inequality is remarkable. To illustrate, one may compare the cohort born in 1938 with the cohort born in 1963, which may respectively be seen as "parents" and "children". When they reached age forty-five, the parents' generation was characterized by a distribution of accumulated earnings with a Gini coefficient of about 0.133. At the same age, their children's generation was characterized by a distribution of accumulated earnings with a Gini coefficient of about 0.238, an increase of inequality by nearly 80 %. A similar order of magnitude obtains when focusing on interquantile ratios. Figures 9 and 10 plot the evolution of the ratio between the UAX at the 85^{th} quantile and the one at the 15^{th} quantile, computed according to our two discounting methods.

Figure 9: 85^{th} / 15^{th} ratio of UAX- earnings with federal bond discounting for cohorts 1938-1968.

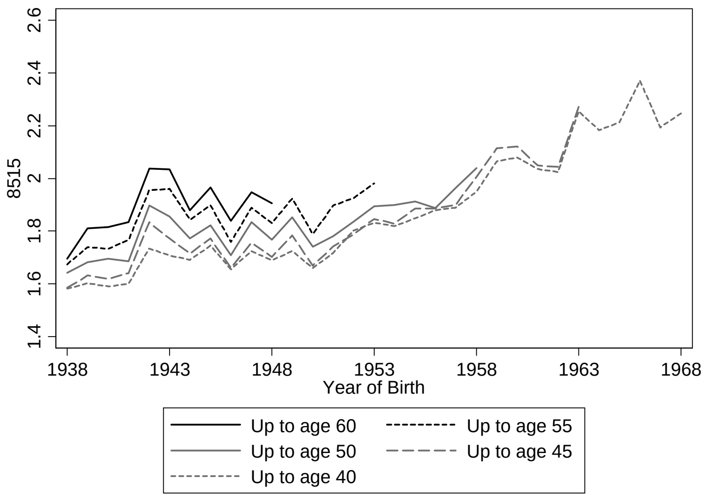
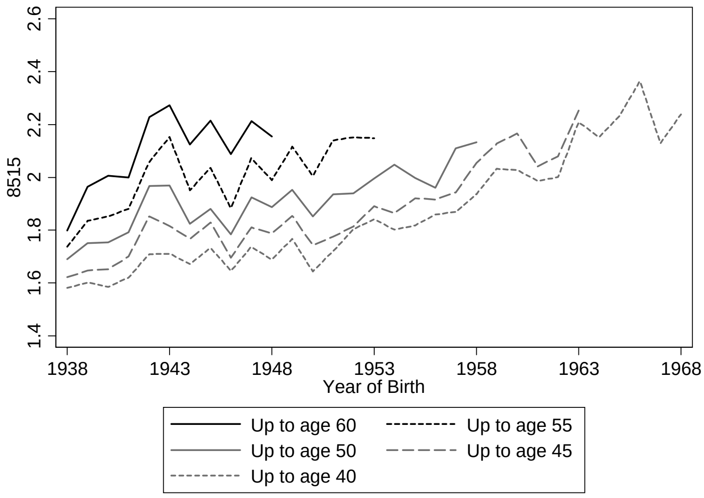


Figure 10: 85th / 15th ratio of real UAX- earnings for cohorts 1938-1968.



Figures 7 and 8 clearly show that the inequality of accumulated earnings increases with age after age forty and that this is true for all cohorts. Thus, individuals who by age forty have received larger earnings tend to experience earnings growth at a higher rate at a later age. Furthermore, inequality comparisons across cohorts tend to be rather unaffected by the age at which they are made. By way of an example, relative to its neighbouring cohorts, the cohorts of 1942 and 1943 are characterized by a large inequality of UAX and that is true for all X>40. This suggests that the evolution of inequality of lifetime earnings is likely to mirror the evolution of inequality of earnings up to age forty.

Our finding of rising intra-generational inequality does not hinge on the expansion of tertiary education. Indeed, the same pattern as in Figures 7 and 8 obtains if UAX are computed starting with a higher age so that virtually all individuals in the sample participate in the labor market in all years when their earnings are taken into account. Representative results for UAX computed from earnings starting at age twenty-five are displayed in the Appendix.

Further insights into the evolution of intra-generational inequality come from an analysis of the evolution of mobility after age forty. For each cohort, we compute the correlation between the individuals' ranks in the distribution of UAX for X = 40 with their ranks in the distribution of UAX for 40<X≤60. Results for X = 41, 45, 50, 55, and 60 are plotted in Figures 11 and 12. No major change in mobility can be detected. By way of an example, the rank correlations ob-

served for the 1938 cohort are virtually undistinguishable from those observed for the 1963 cohort for the same X. The only noticeable change is an increase in mobility going from the cohort born in 1947 to the one born in 1950; that increase was however reversed by later cohorts.[15]

Figure 11: Rank correlation of UA-40 earnings with UAX earnings, federal bond discounting.

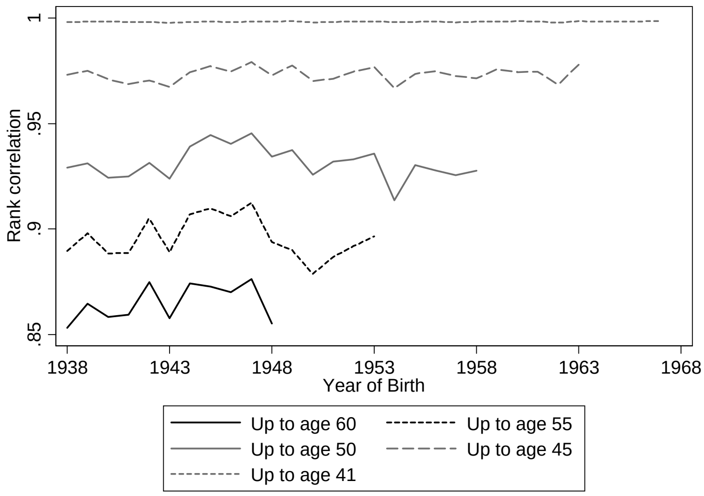
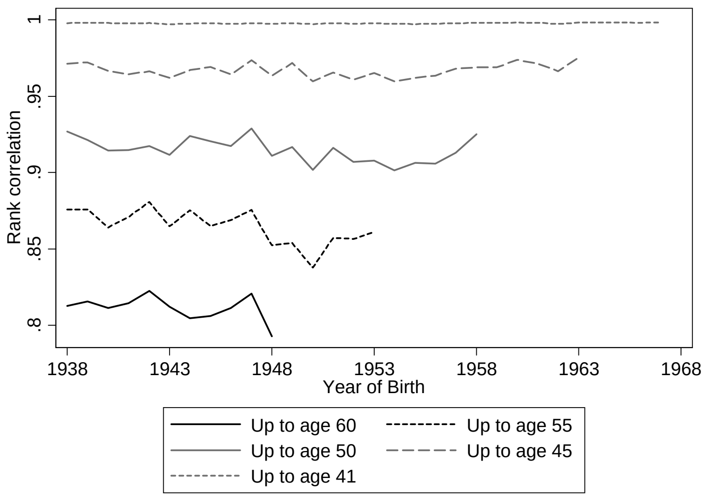


Figure 12: Rank correlation of UA-40 earnings with UAX earnings, real incomes.



In order to get some insight into the proximate causes of the observed rise of lifetime earnings inequality in Germany, it is useful to assess how that inequality has evolved at various parts of the distribution. We have therefore replaced the Gini coefficient with generalized en-

[15] The cohorts born in West Germany in the late 1940s were the protagonists of the 1968 movement against bourgeois way of life. Possibly, many future highly skilled employees who participated as students in that movement participated less intensely in the labor market as compared to other generations and thus received relatively low earnings during the initial part of their lifecycle. This might explain why those cohorts exhibit greater intra-generational long-term mobility.

tropy inequality indices that are more sensitive to distinctive parts of the distribution. Results for the Theil index, the mean logarithmic deviation and half the squared coefficient of variation are exhibited in the Appendix. They suggest that intra-generational lifetime inequality has significantly increased both at the bottom and at the top of the distribution. Here, we merely present the evolution of two interquantile ratios of the UAX distribution that respectively capture inequality at the bottom and at the top of the distribution. Figures 13 plots the 50^{th} / 15^{th} ratio while Figures 14 plots the 85^{th} / 50^{th} ratio, both using the discount factors based on Federal bonds.

Figure 13: 50^{th} / 15^{th} ratio of UAX- earnings with federal bond discounting for cohorts 1938-1968.

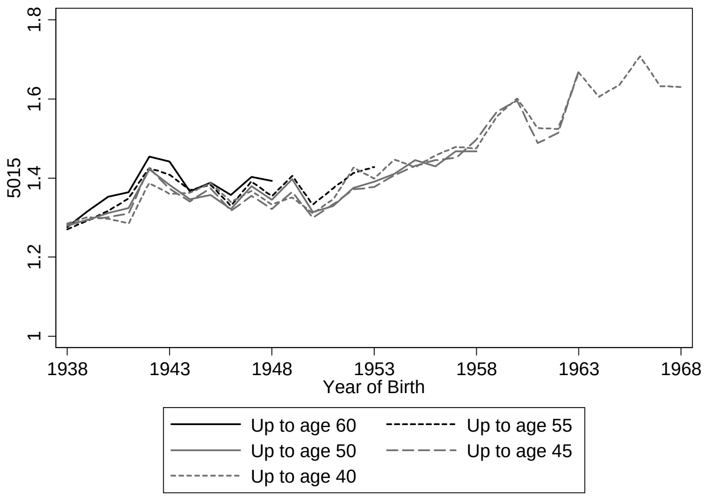
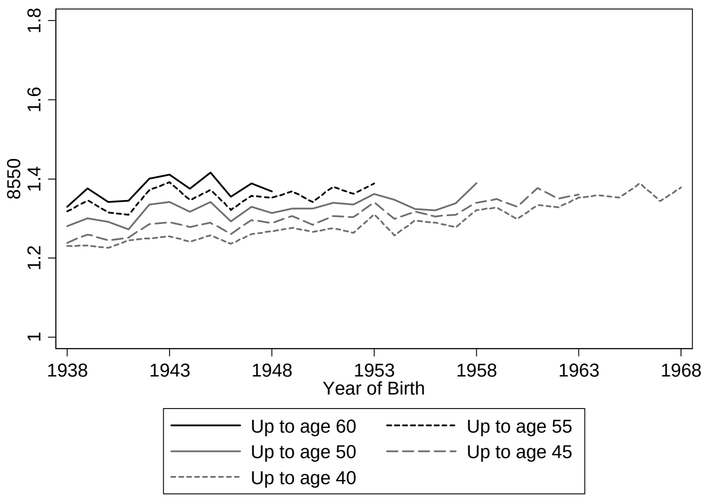


Figure 14: 85^{th} / 50^{th} ratio of UAX- earnings with federal bond discounting for cohorts 1938-1968.



While lifetime earnings inequality has increased both at the bottom and at the top of the distribution, the above Figures show that the increase has been stronger at the bottom of the distribution. As this may be driven by the rise of the incidence of unemployment for low-skill workers, it is instructive to disentangle the effect on inequality due to changes in the distribution of unemployment spells from the one due to changes in the wage structure.

Figures 15 and 16 below plot for each cohort the average number of months spent in employment, unemployment, and other ways during the life span that goes from age seventeen to age forty. The residual category includes civil and military service, periods of occupational disability, and college education. Within each cohort, individuals have been ranked into quartiles according to their lifetime earnings up to age forty, computed with Federal Bond discounting. Fig. 15 displays the quartiles in the bottom half of the cohort-specific distributions whereas Fig. 16 displays the upper half of the same distributions. Those Figures reveal a substantial increase of periods of unemployment for the bottom quartile, a moderate increase for the next quartile, and virtual stability for the upper half of the distribution. Individuals in the bottom quartile of the earnings distributions of cohorts born in the late 1930s spent on average about 5 months in unemployment before reaching age forty. By contrast, their statistical children born in the mid 1960s spent about 42 months in unemployment before reaching age forty. For individuals in the upper half of the distribution, no comparable rise of unemployment incidence for the younger cohorts can be observed. Interestingly, the same pattern arises if one only considers the employment records starting with age twenty-five, see Figures R 11 and R 12 in the Appendix.

Figure 15: Employment status up to age 40 in the first and second quartiles.

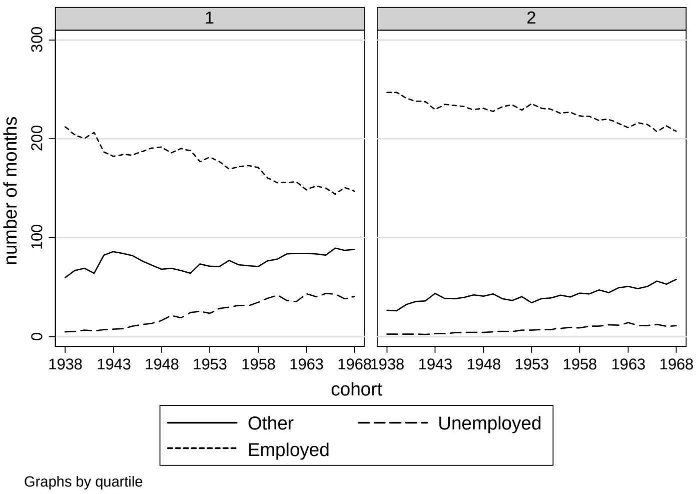


Figure 16: Employment status up to age 40 in the third and fourth quartiles.

The substantial increase of unemployment spells at the bottom of the intra-generational earnings distribution suggests that it may be a major driving factor behind the secular rise of lifetime earnings inequality in Germany. In order to quantify that effect, we simulate the evolution of lifetime inequality under the counterfactual of full employment. Based on the actual earning distribution, we construct a hypothetical scenario by imputing earnings when individuals are not recorded as employed. The imputed value for an individual is the last earning level observed for that individual.[16] Results for the hypothetical distributions of UAX are plotted in Figures 17 and 18. In Fig. 17, earnings have been imputed for all months in which an individual was not in employment. In Fig. 18, earnings have only been imputed for the months in which an individual was registered as unemployed.

[16] In cases where no previous individual earnings are observed, we impute retrospectively the first level of earnings observed for that individual.

Figure 17: Ginis of UAX- earnings with federal bond discounting for cohorts 1938-1968 with complete imputation.

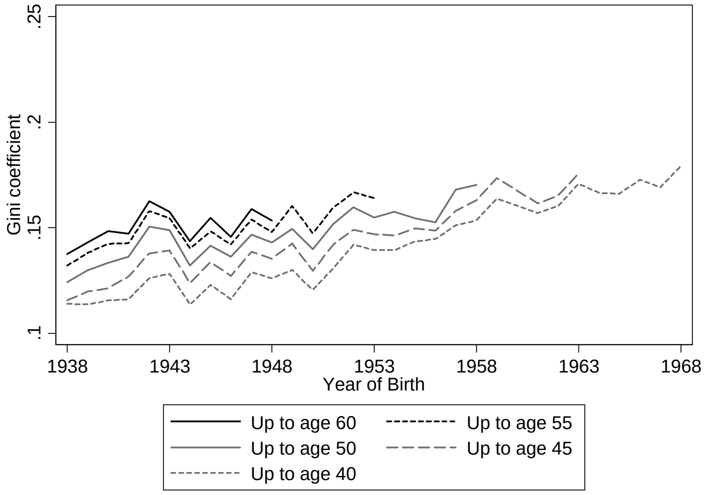
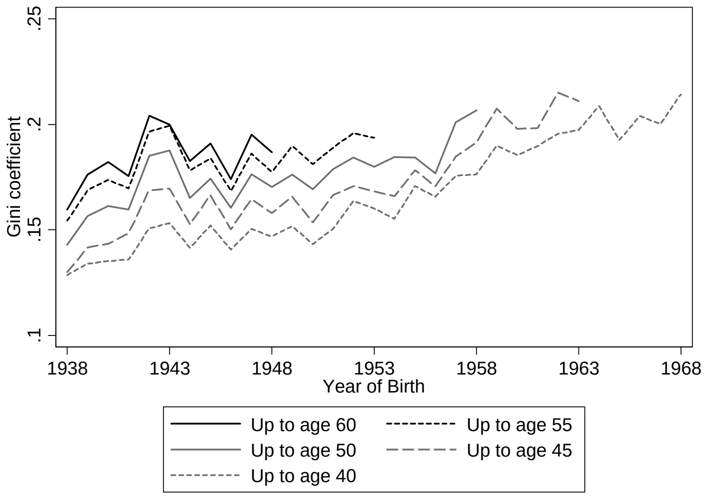


Figure 18: Ginis of UAX- earnings with federal bond discounting for cohorts 1938-1968 with imputation for unemployment only.



Comparing Figures 17 and 18 with Fig. 7 reveals that the unequal evolution of unemployment spells goes some way in explaining the rise of lifetime earnings inequality. To illustrate, consider again the cohort born in 1938 and the one of their statistical children born in 1963. In the scenario of complete imputation (Fig. 17), when the parents reached age forty-five their accumulated earnings were distributed with a Gini coefficient of about .115. At the same age, their children's generation was characterized by a distribution of accumulated earnings with a Gini coefficient of about .175, an increase of inequality by slightly more than 50 %. In the scenario of imputation for unemployment only (Fig. 18), the same comparison yields an increase of the Gini coefficient by slightly more than 60 %. In both cases, the Gini coefficient increases by considerably less than 80 %, the growth rate obtained from the data used for Fig. 7. This suggests that the unequal evolution of unemployment spells for individuals at different points of the earnings distribution contributes to explain some 30 to 40 percent of the secular rise of lifetime earnings inequality. The remaining 60 to 70 percent can be attributed to the evolution of wage inequality.

5 Conclusion

We have documented for the first time the magnitude, pattern, and evolution of lifetime earnings inequality in Germany. Based on a large sample of earning biographies from social security records, we have shown that the intra-generational distribution of lifetime earnings of male workers has a Gini coefficient around .2 for cohorts born in the late 1930s and early 1940s; this amounts to about 2/3 of the value of the Gini coefficient of annual earnings. Within cohorts, mobility in the distribution of yearly earnings is substantial at the beginning of the lifecycle, decreases afterwards and virtually vanishes after age forty. The main novel finding from this investigation is the one of a secular rise of intra-generational inequality in lifetime earnings: West-German men born in the early 1960s are likely to experience about 80 % more lifetime inequality than their fathers. Longer unemployment spells of workers at the bottom of the distribution of younger cohorts contribute to explain some 30 to 40 percent of the overall increase in lifetime earnings inequality. The remaining 60 to 70 percent is due to the increase of wage inequality.

The 80 % rise in lifetime earnings inequality that we observe when comparing the generations born around World War II with those of the baby boomers of the 1960s is large and unlikely to be offset by more progressive taxes and transfers. It is bound to have far-reaching repercussions for a number of policy issues, including the role of the welfare state, pension reform, and bequest taxation, as well as for how people relate to each other and see themselves as members of society.

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Appendix A: Descriptive statistics and alternative imputations

Table A1: Number of observations up to a certain age, unweighted.

Birth cohort	Up to 40	Up to 45	Up to 50	Up to 55	Up to 60
1938	1,033	1,018	1,004	992	987
1939	1,132	1,096	1,076	1,049	1,039
1940	1,074	1,051	1,043	1,045	1,040
1941	1,105	1,090	1,079	1,072	1,075
1942	1,125	1,104	1,110	1,089	1,086
1943	1,146	1,135	1,114	1,093	1,083
1944	1,144	1,109	1,089	1,059	1,057
1945	1,177	1,158	1,146	1,138	1,137
1946	1,214	1,167	1,144	1,124	1,103
1947	1,205	1,173	1,150	1,128	1,112
1948	1,190	1,152	1,127	1,115	1,085
1949	1,189	1,149	1,121	1,103	
1950	1,209	1,163	1,138	1,120	
1951	1,204	1,169	1,133	1,122	
1952	1,233	1,179	1,152	1,137	
1953	1,171	1,133	1,103	1,080	
1954	1,221	1,173	1,148		
1955	1,275	1,226	1,197		
1956	1,349	1,294	1,252		
1957	1,299	1,260	1,238		
1958	1,365	1,335	1,275		
1959	1,430	1,382			
1960	1,545	1,494			
1961	1,704	1,651			
1962	1,881	1,805			
1963	1,913	1,819			
1964	1,897				
1965	2,026				
1966	2,007				
1967	1,982				
1968	2,096				
	43,541	32,485	23,839	17,466	11,804

Table A2: Number of observations up to a certain age, weighted.

Birth cohort	Up to 40	Up to 45	Up to 50	Up to 55	Up to 60
1938	220,232	217,133	215,383	212,369	210,566
1939	248,090	239,754	234,731	228,828	226,207
1940	241,934	237,150	235,451	235,428	233,502
1941	223,777	221,106	218,880	217,072	217,911
1942	185,553	182,294	183,037	179,488	179,076
1943	189,304	187,452	184,261	180,665	179,451
1944	187,669	180,465	177,095	171,838	171,621
1945	148,087	145,490	143,321	141,886	141,534
1946	186,823	180,147	176,580	173,469	169,953
1947	202,736	198,089	194,473	190,454	187,583
1948	210,821	204,147	199,922	198,110	193,110
1949	224,189	216,556	211,653	208,567	
1950	229,461	221,167	216,950	213,633	
1951	213,650	208,678	202,316	199,721	
1952	220,289	210,641	204,772	202,641	
1953	204,980	199,173	193,775	190,055	
1954	225,753	217,265	212,062		
1955	227,899	220,669	214,523		
1956	244,608	234,339	226,798		
1957	243,499	236,167	231,693		
1958	249,580	244,416	233,676		
1959	269,384	262,298			
1960	276,926	267,851			
1961	281,291	273,518			
1962	297,397	287,350			
1963	299,297	286,464			
1964	305,386				
1965	307,182				
1966	307,047				
1967	310,611				
1968	297,228				
	7,480,683	5,779,779	4,311,352	3,144,224	2,110,514

Table A3: UAX Ginis for selected cohorts.

Cohort	Up to 40	Up to 45	Up to 50	Up to 55	Up to 60
1938	0.130	0.133	0.147	0.160	0.166
	(0.124; 0.138)	(0.126; 0.141)	(0.138; 0.157)	(0.149; 0.172)	(0.156; 0.180)
1943	0.158	0.175	0.196	0.211	0.215
	(0.149; 0.168)	(0.164; 0.188)	(0.184; 0.212)	(0.197; 0.228)	(0.202; 0.230)
1948	0.155	0.167	0.183	0.192	0.203
	(0.146; 0.166)	(0.157; 0.180)	(0.171; 0.197)	(0.180; 0.206)	(0.190; 0.218)
1953	0.173	0.184	0.196	0.211	
	(0.164; 0.184)	(0.173; 0.197)	(0.184; 0.211)	(0.199; 0.230)	
1958	0.196	0.213	0.228		
	(0.185; 0.208)	(0.202; 0.233)	(0.213; 0.250)		
1963	0.224	0.238			
	(0.214; 0.236)	(0.225; 0.251)			
1968	0.240				
	(0.229; 0.255)				

Note: Bias corrected and accelerated bootstrap confidence intervals at the 95%-level in brackets.

Figure 1 b: Comparison of Gini coefficients of fictitious populations, mean of cross sectional Ginis and the lifetime earnings. Assumption of maximal mobility, mean imputed earnings and not imputed earnings (in this order).

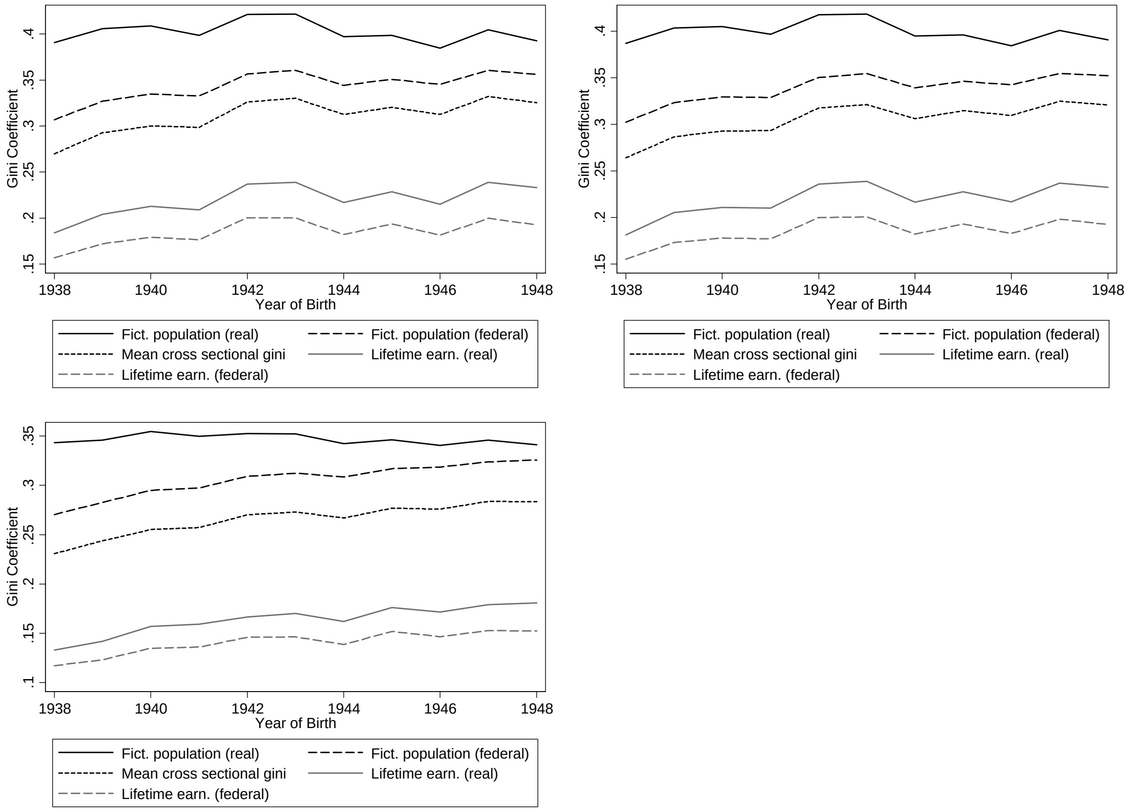


Figure 2 b: Annual Gini coefficients from 17 to 60 for cohorts 1938-1948. Assumption of maximal mobility, mean imputed earning and not imputed earning (in this order).

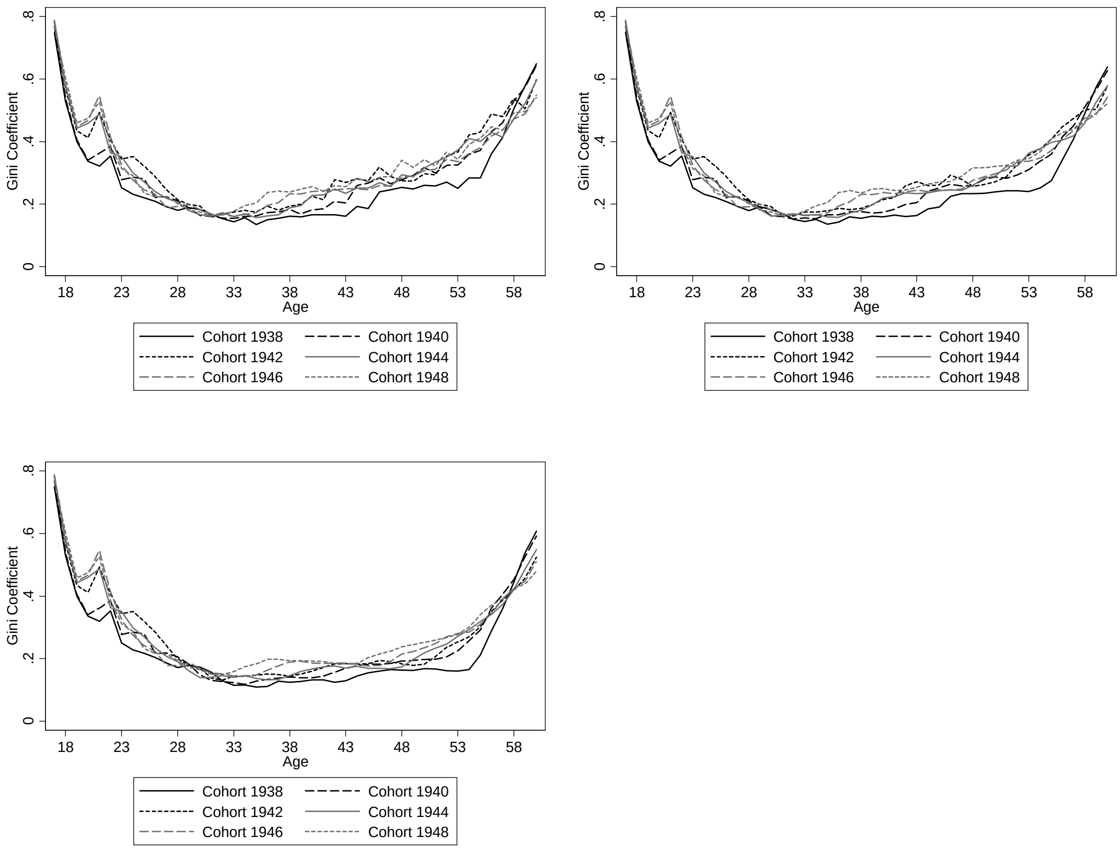


Figure 3b: Rank correlations of consecutive years for cohorts 1938-1948. Assumption of maximal mobility, mean imputed earning and not imputed earning (in this order).

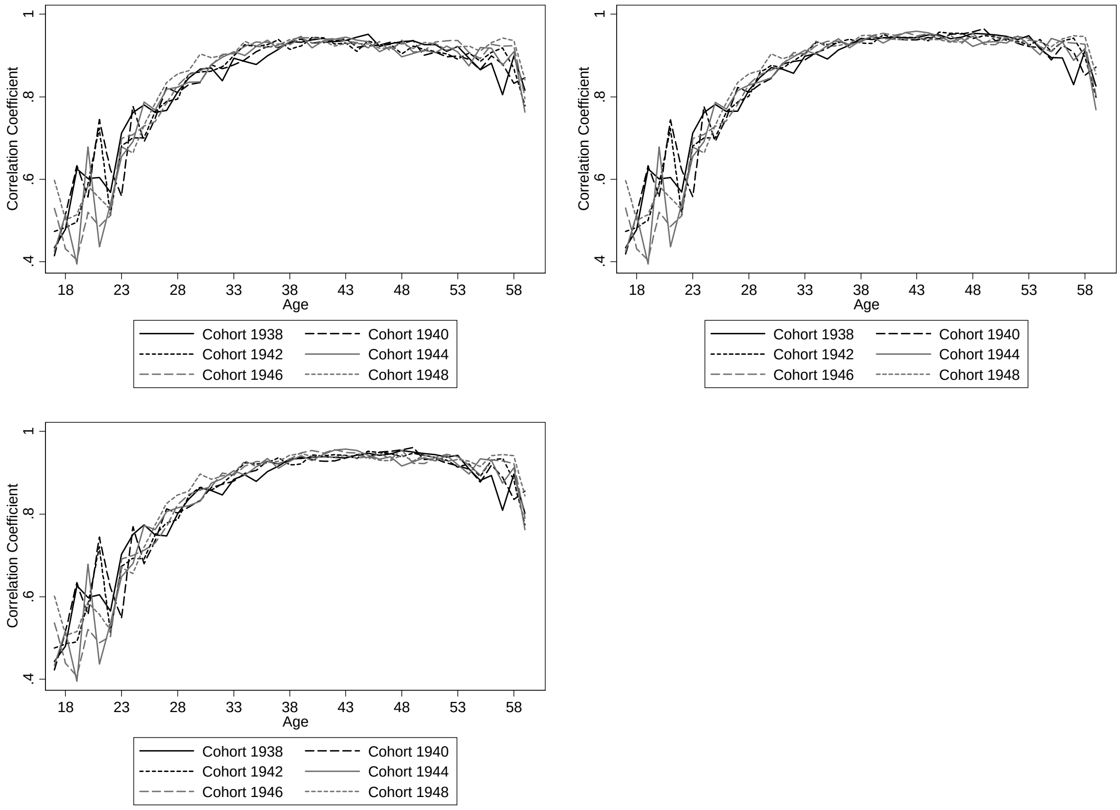


Figure 4b: Correlation coefficients of annual and lifetime earnings with federal bond discounting for cohorts 1938-1948. Assumption of maximal mobility, mean imputed earning and not imputed earning (in this order).

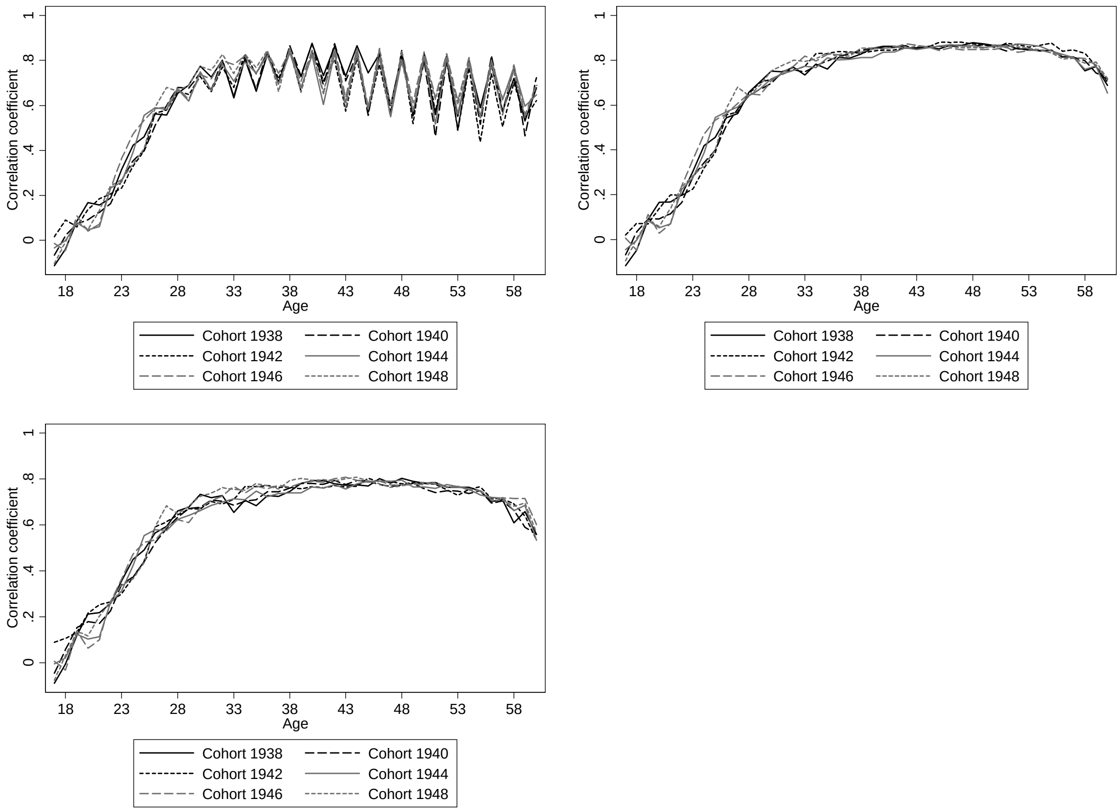


Figure 4c: Correlation coefficients of annual and lifetime earnings with real discounting for cohorts 1938-1948. Assumption of minimal mobility, maximal mobility, mean imputed earning and not imputed earning (in this order).

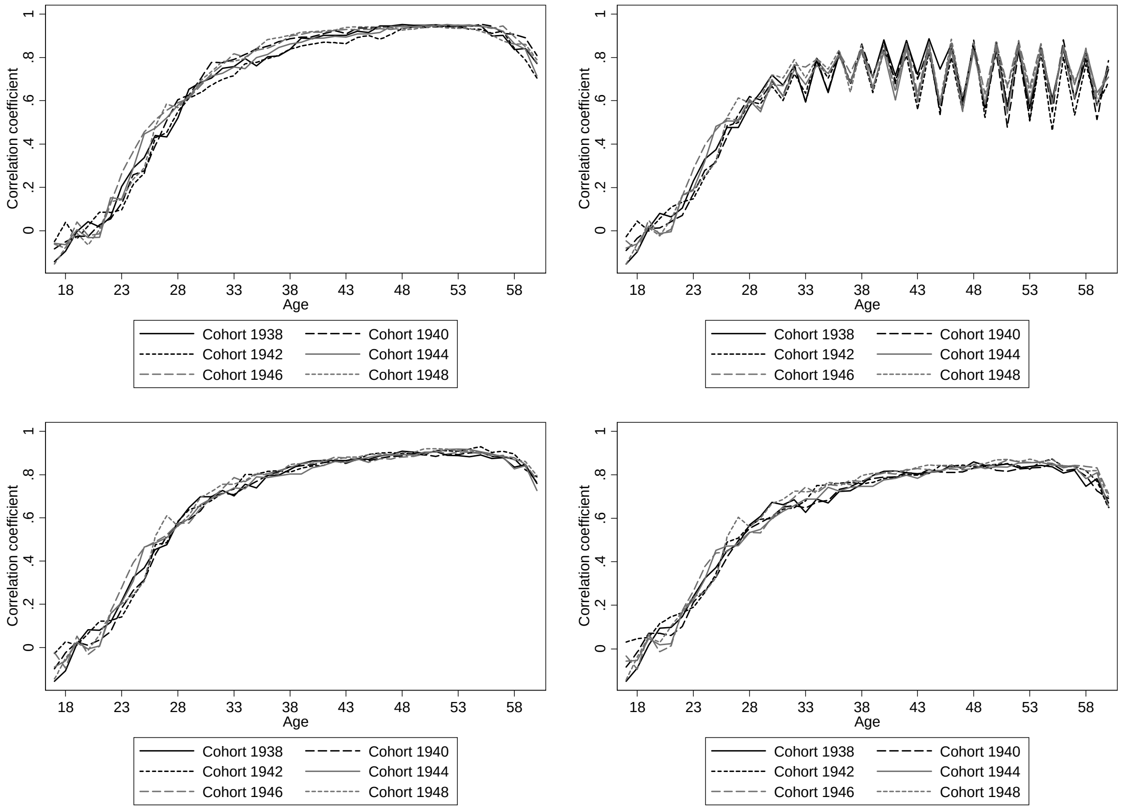


Figure 5b: Rank correlation of annual and lifetime earnings with federal bond discounting for cohorts 1938-1948. Assumption of maximal mobility, mean imputed earning and not imputed earning (in this order).

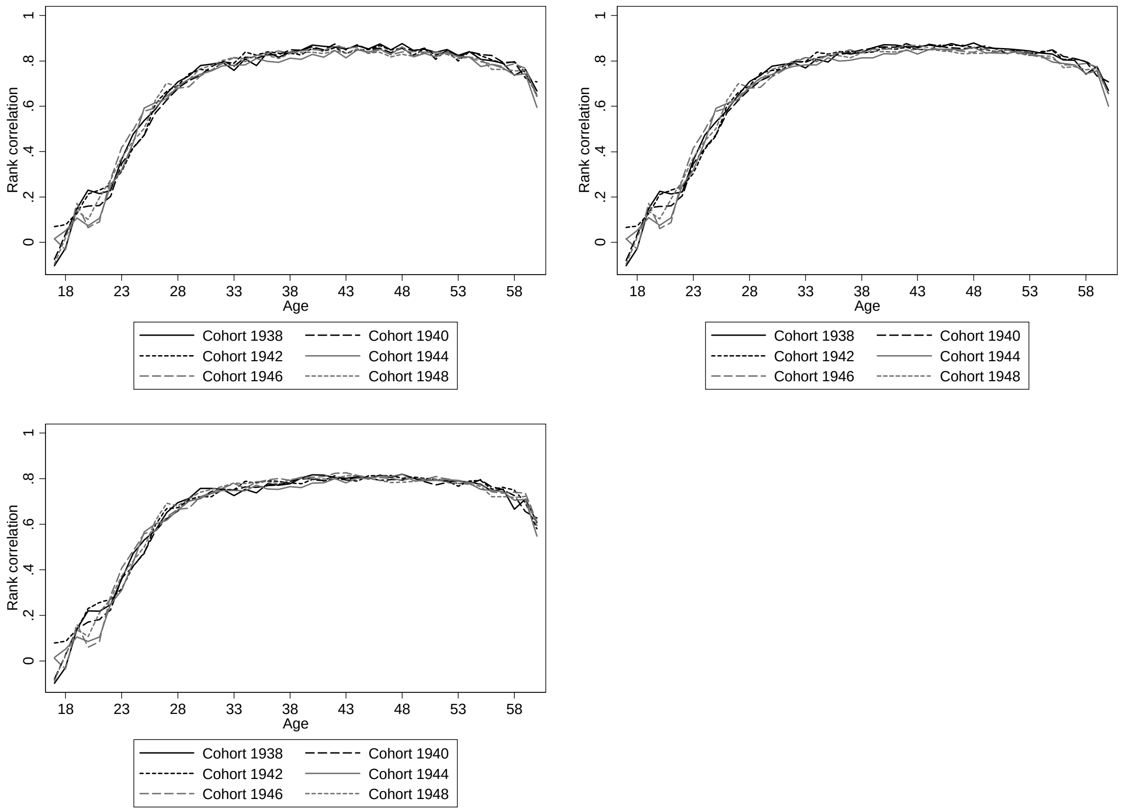


Figure 5c: Rank correlation of annual and lifetime earnings with real discounting for cohorts 1938-1948. Assumption of minimal mobility, maximal mobility, mean imputed earning and not imputed earning (in this order).

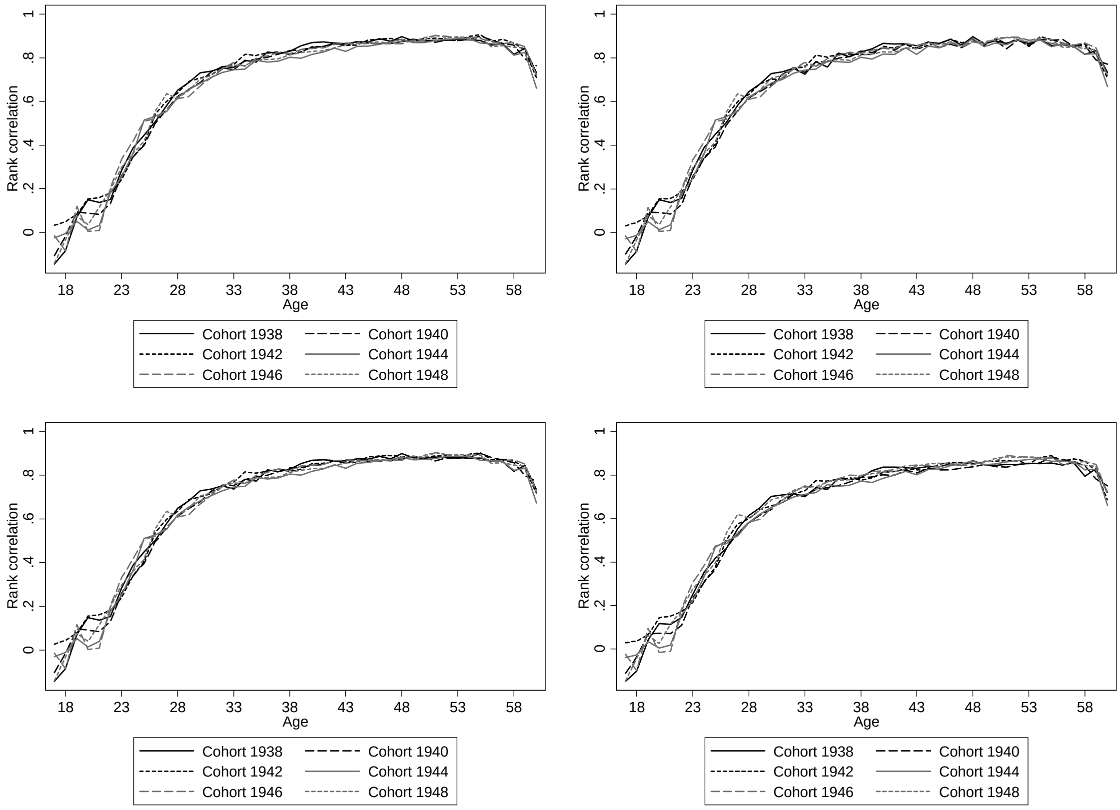


Figure 6b: Ginis of UAX- earnings with federal bond discounting for cohorts 1938-1968. Assumption of maximal mobility, mean imputed earning and not imputed earning (in this order)

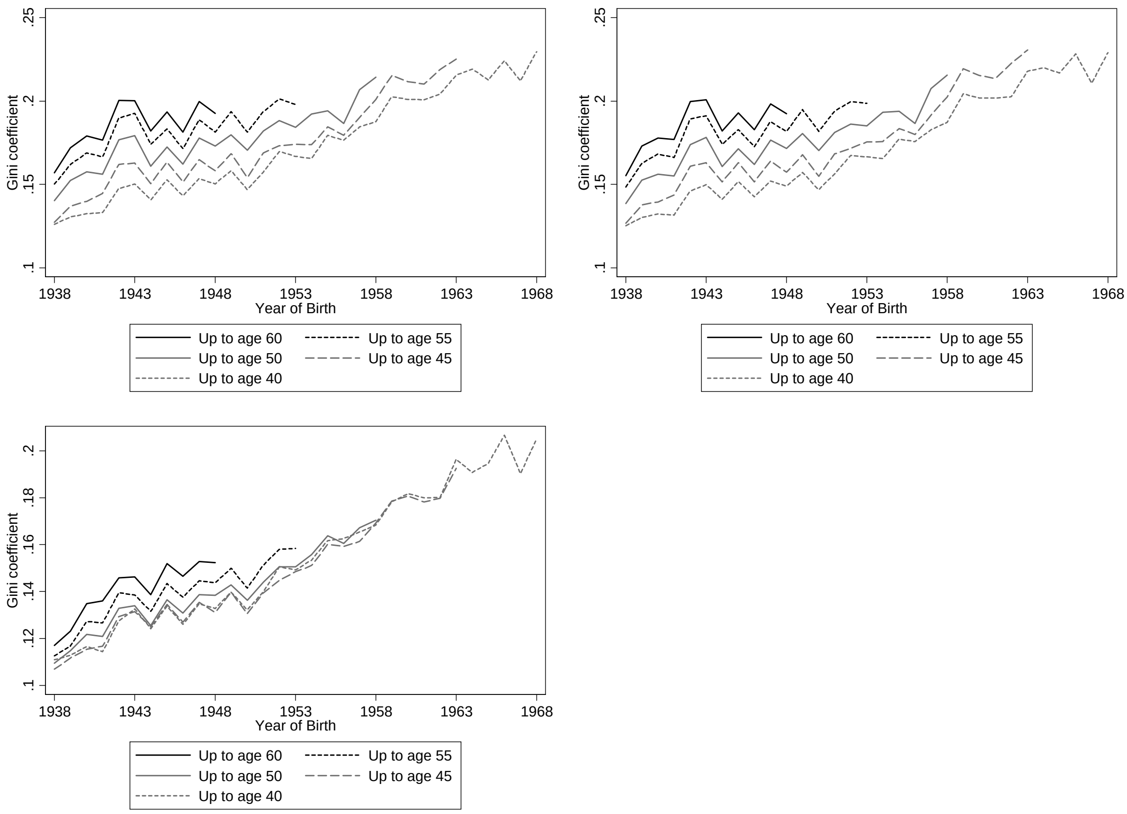


Figure 7b: Ginis of real UAX- earnings for cohorts 1938-1968. Assumption of maximal mobility, mean imputed earning and not imputed earning (in this order).

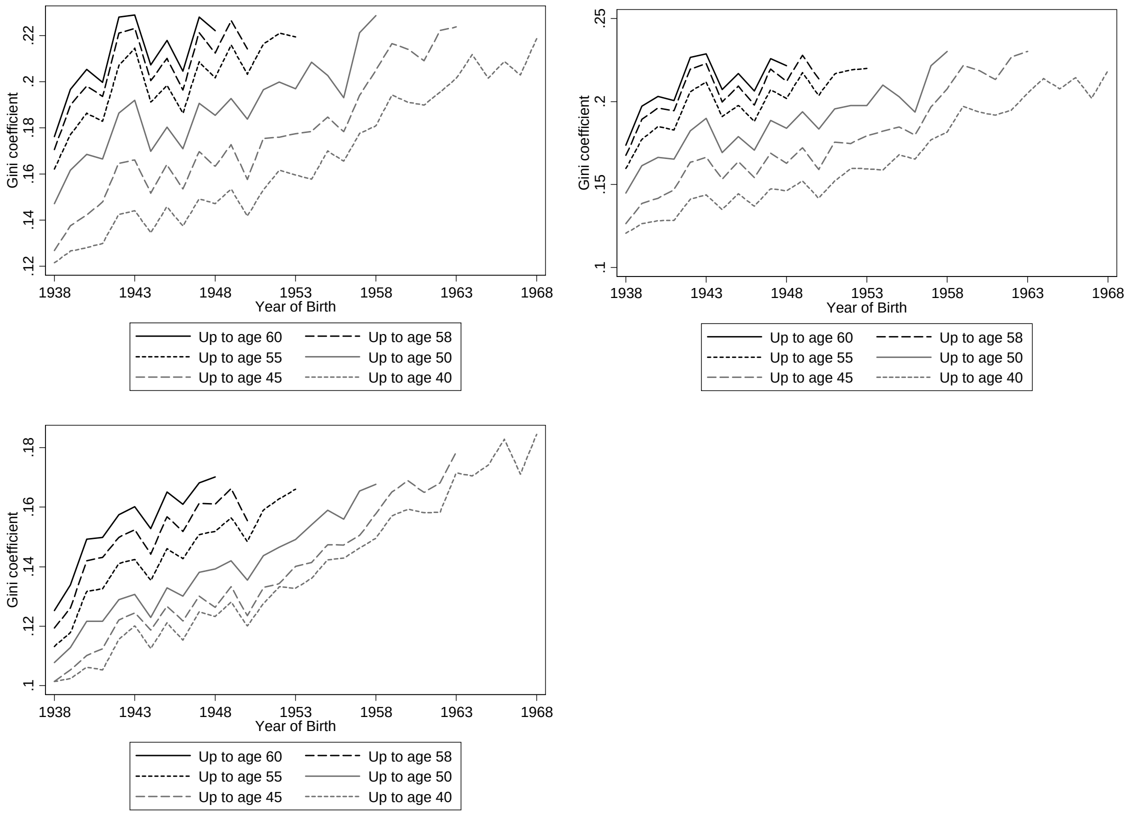


Figure 9b: 85[th] / 15[th] ratio of UAX- earnings with federal bond discounting for cohorts 1938-1968. Assumption of maximal mobility, mean imputed earning and not imputed earning (in this order).

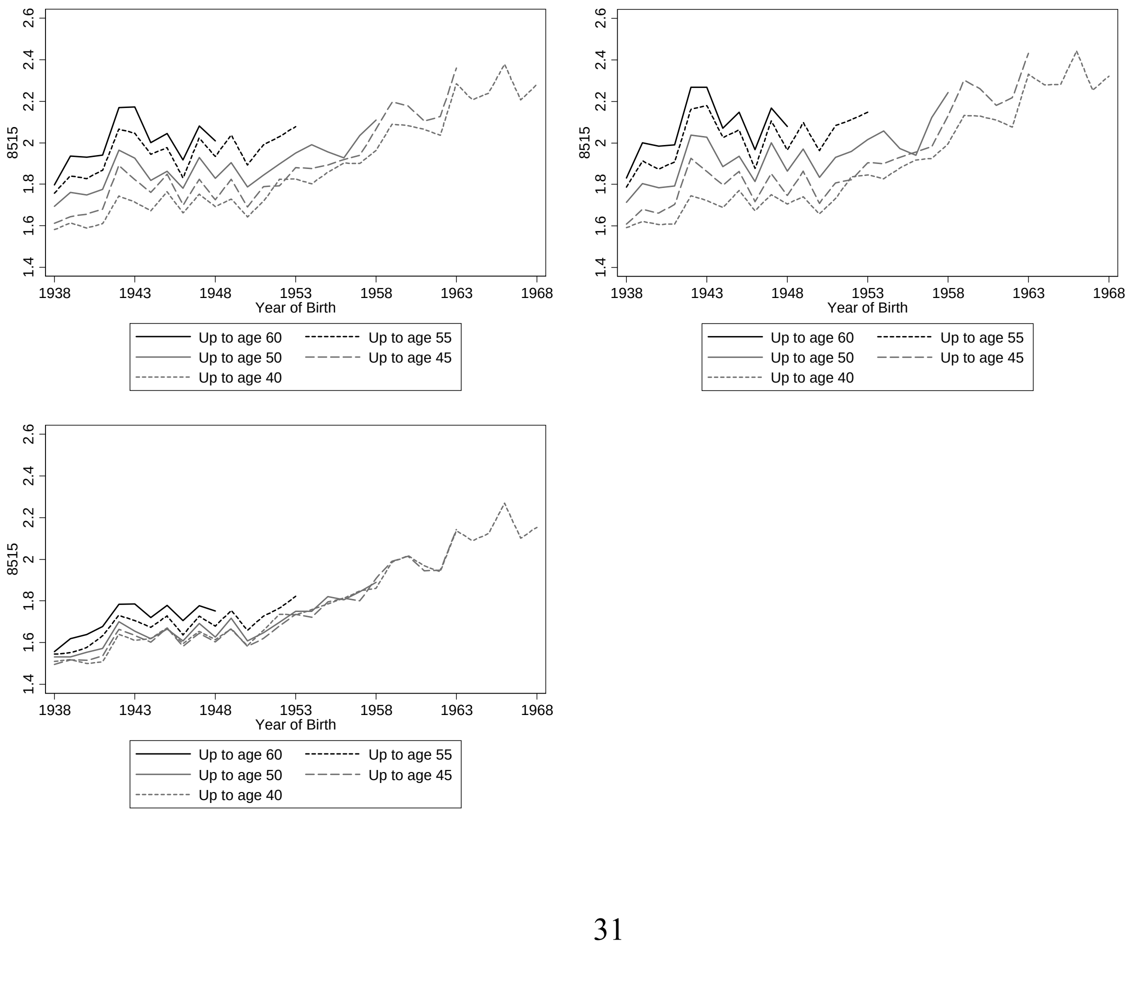


Figure 10b: 85^{th} / 15^{th} ratio of real UAX- earnings for cohorts 1938-1968. Assumption of maximal mobility, mean imputed earning and not imputed earning (in this order).

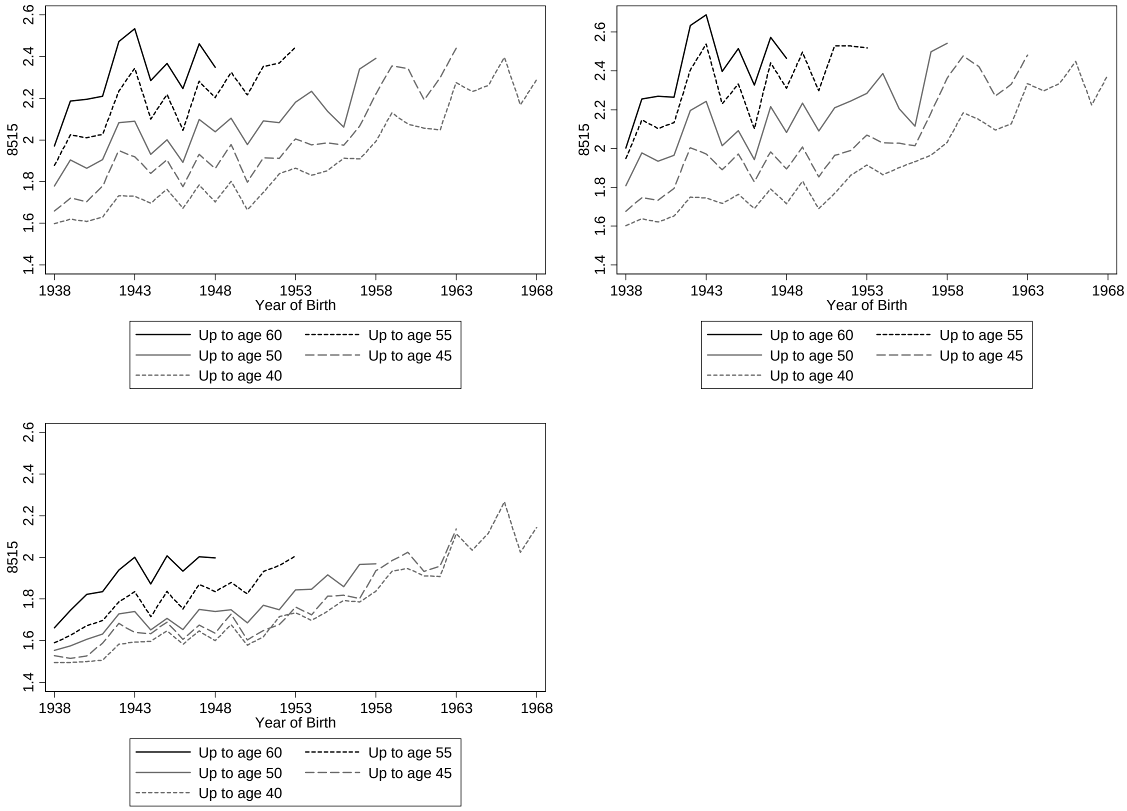


Figure 11b: Rank correlation UA-40 earnings with UAX earnings, federal bond discounting. Assumption of maximal mobility, mean imputed earning and not imputed earning (in this order).

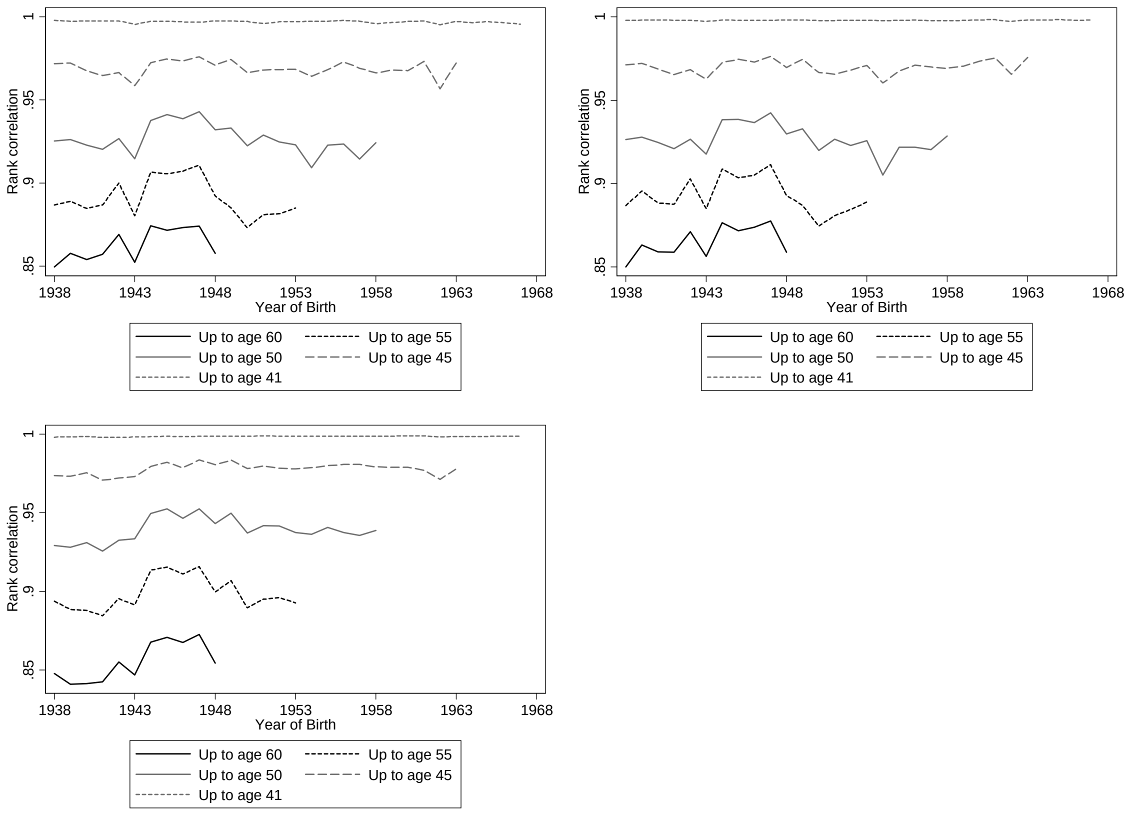


Figure 12c: Rank correlation real UA-40 earnings with real UAX earnings. Assumption of maximal mobility, mean imputed earning and not imputed earning (in this order).

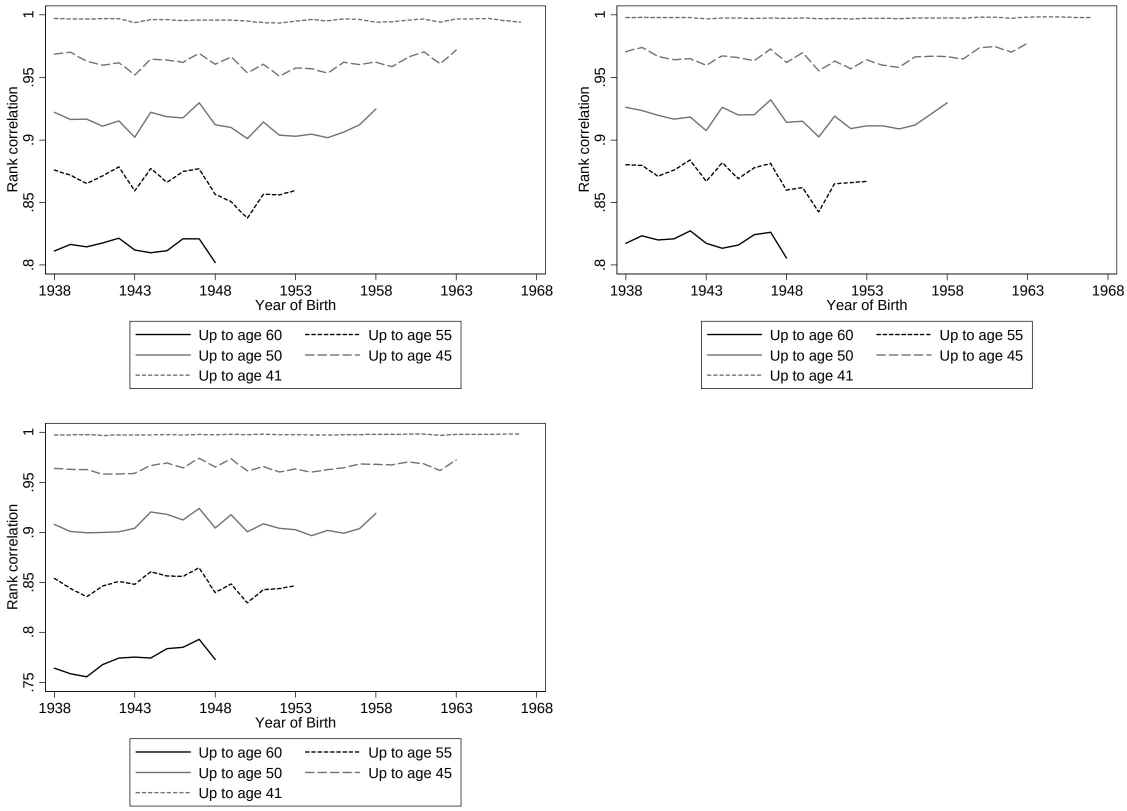


Figure 13b: 50th / 15th ratio of UAX- earnings with federal bond discounting for cohorts 1938-1968. Assumption of maximal mobility, mean imputed earnings and not imputed earnings (in this order).

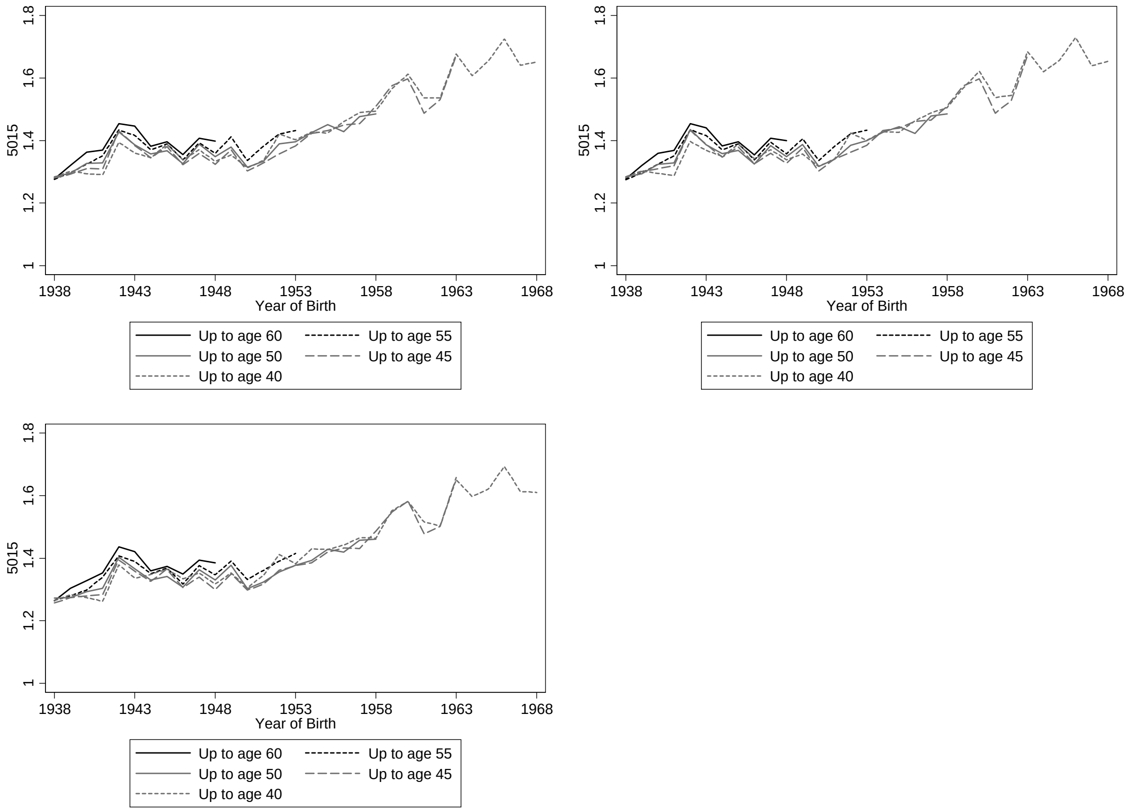
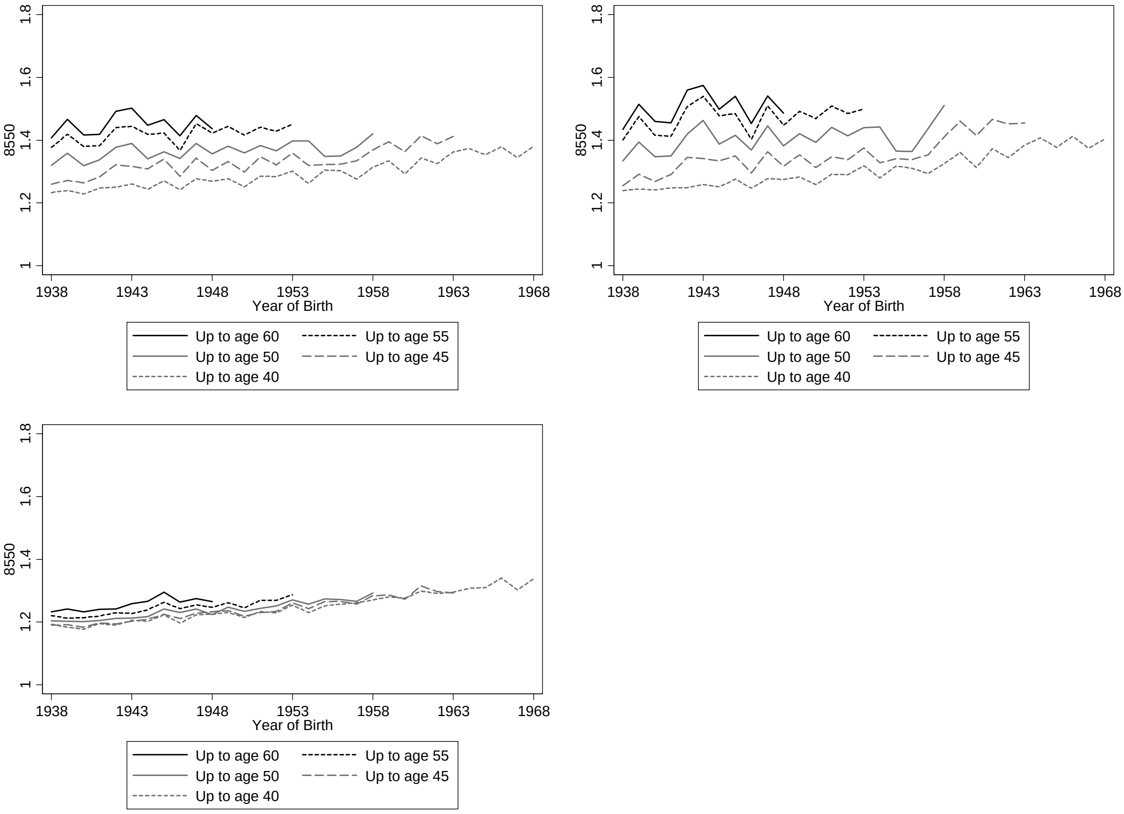


Figure 14b: 85th / 50th ratio of UAX- earnings with federal bond discounting for cohorts 1938-1968. Assumption of maximal mobility, mean imputed earnings and not imputed earnings (in this order).



Appendix B: Generalized entropy measures

Figure B 1: GE[0] (Mean logarithmic deviation) of UAX- earnings with federal bond discounting for cohorts 1938-1968. Assumption of minimal mobility, maximal mobility, mean imputed earnings and not imputed earnings (in this order).

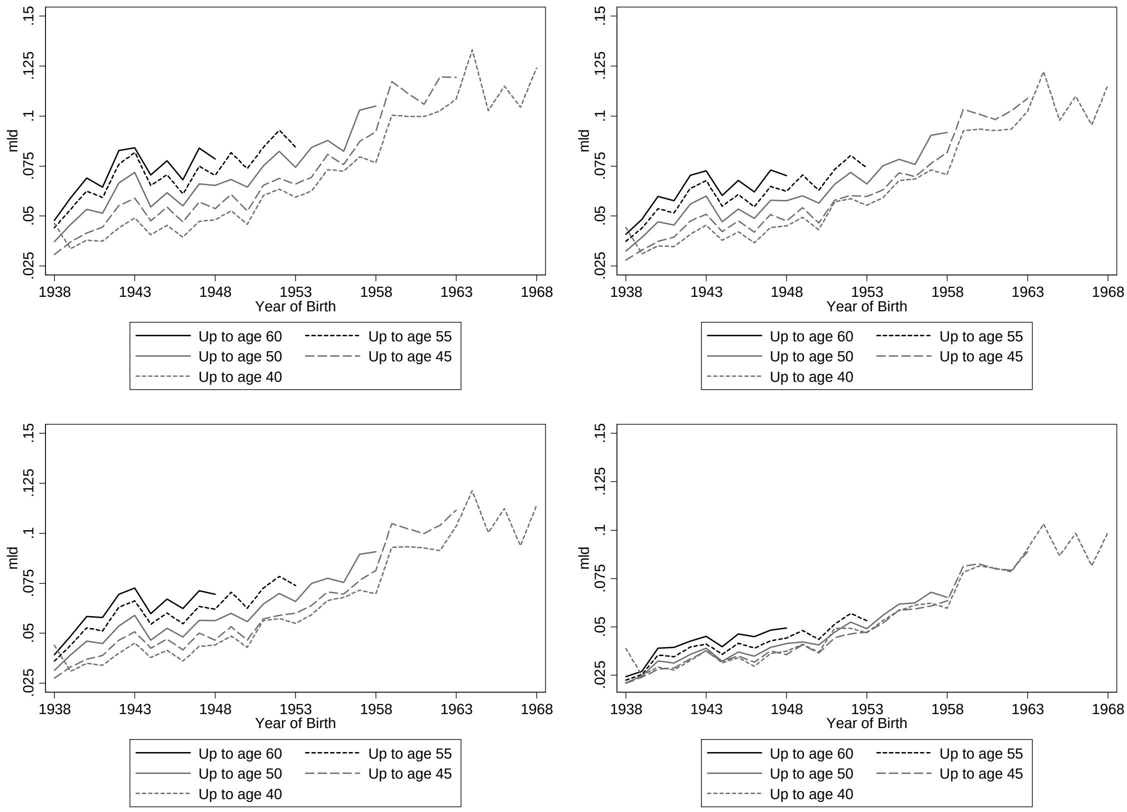


Figure B 2: GE[0] (Mean logarithmic deviation) of real UAX- earnings for cohorts 1938-1968. Assumption of minimal mobility, maximal mobility, mean imputed earnings and not imputed earnings (in this order)

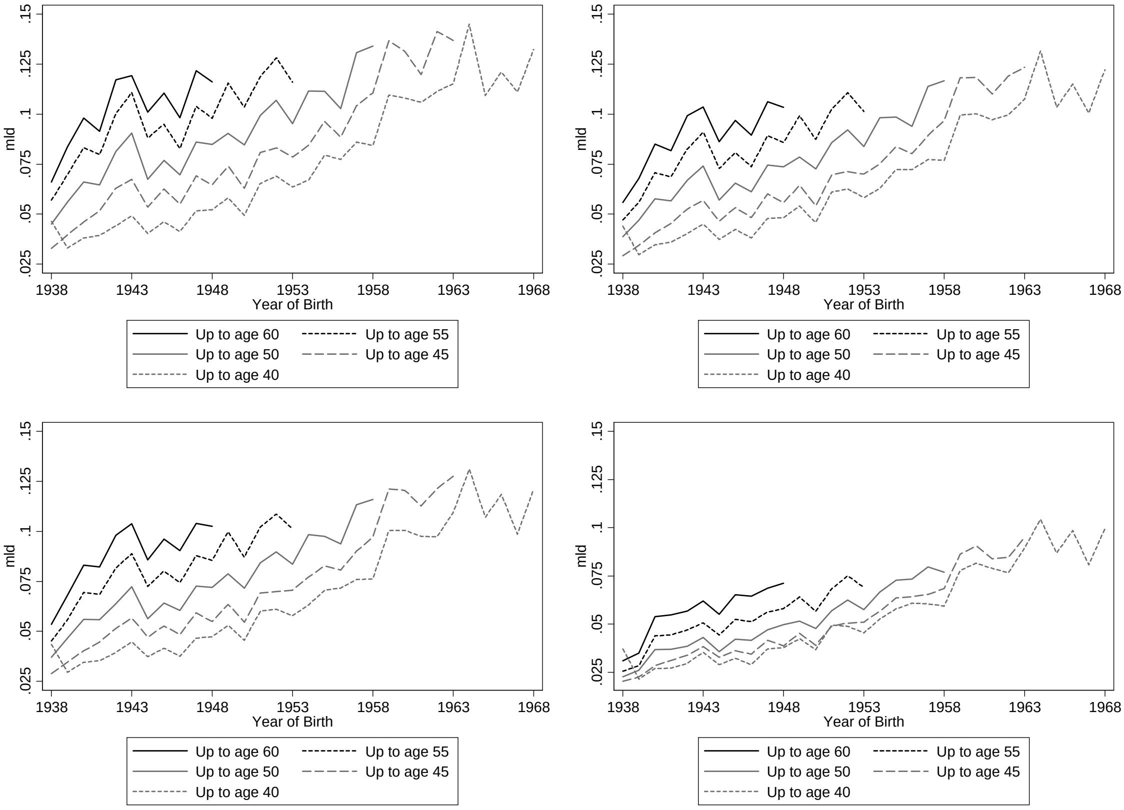


Figure B 3: GE[1] (Theil index) of UAX- earnings with federal bond discounting for cohorts 1938-1968. Assumption of minimal mobility, maximal mobility, mean imputed earnings and not imputed earnings (in this order).

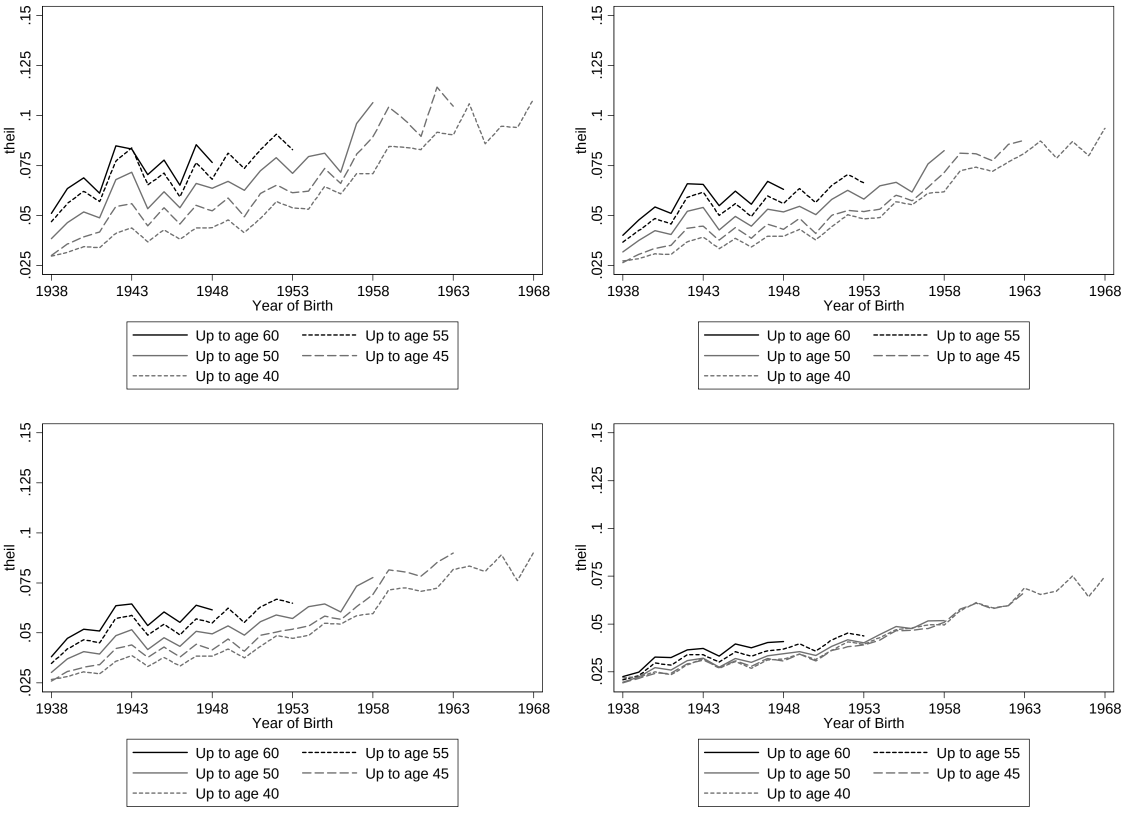


Figure B 4: GE[1] (Theil index) of real UAX- earnings for cohorts 1938-1968. Assumption of minimal mobility, maximal mobility, mean imputed earnings and not imputed earnings (in this order).

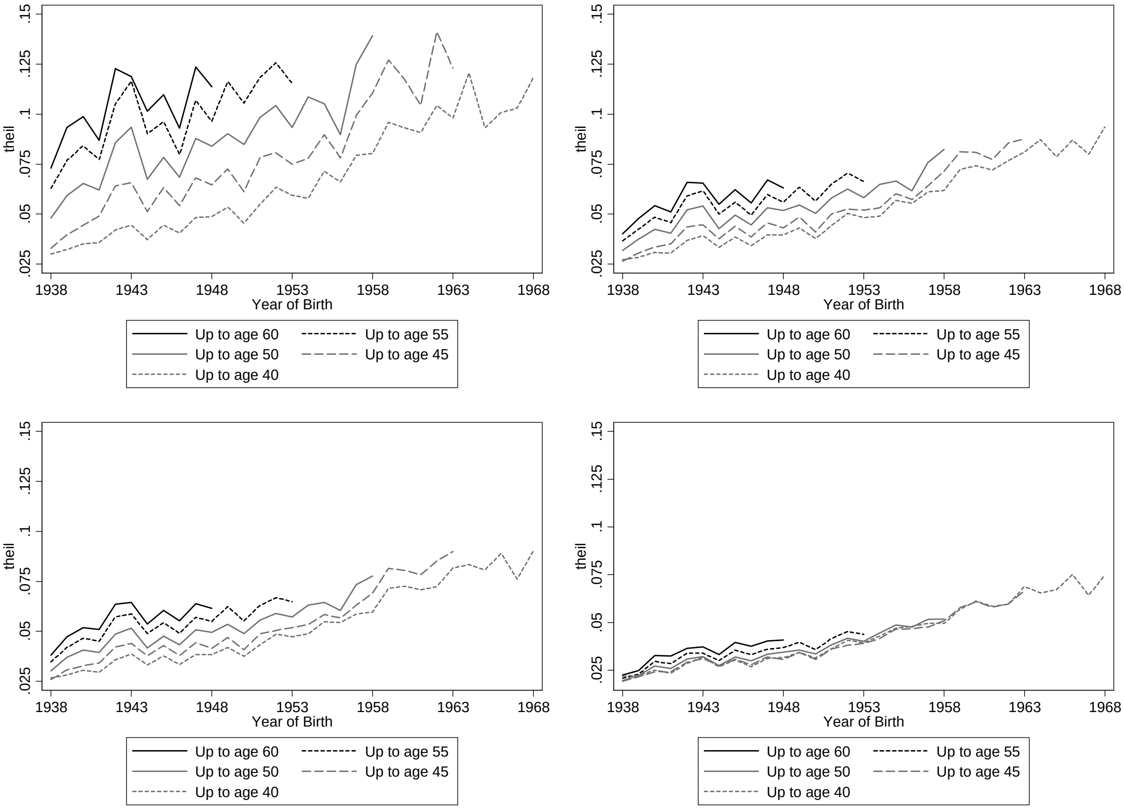


Figure B 5: GE[2] (Half the square of the coefficient of variation) of UAX- earnings with federal bond discounting for cohorts 1938-1968. Assumption of minimal mobility, maximal mobility, mean imputed earnings and not imputed earnings (in this order).

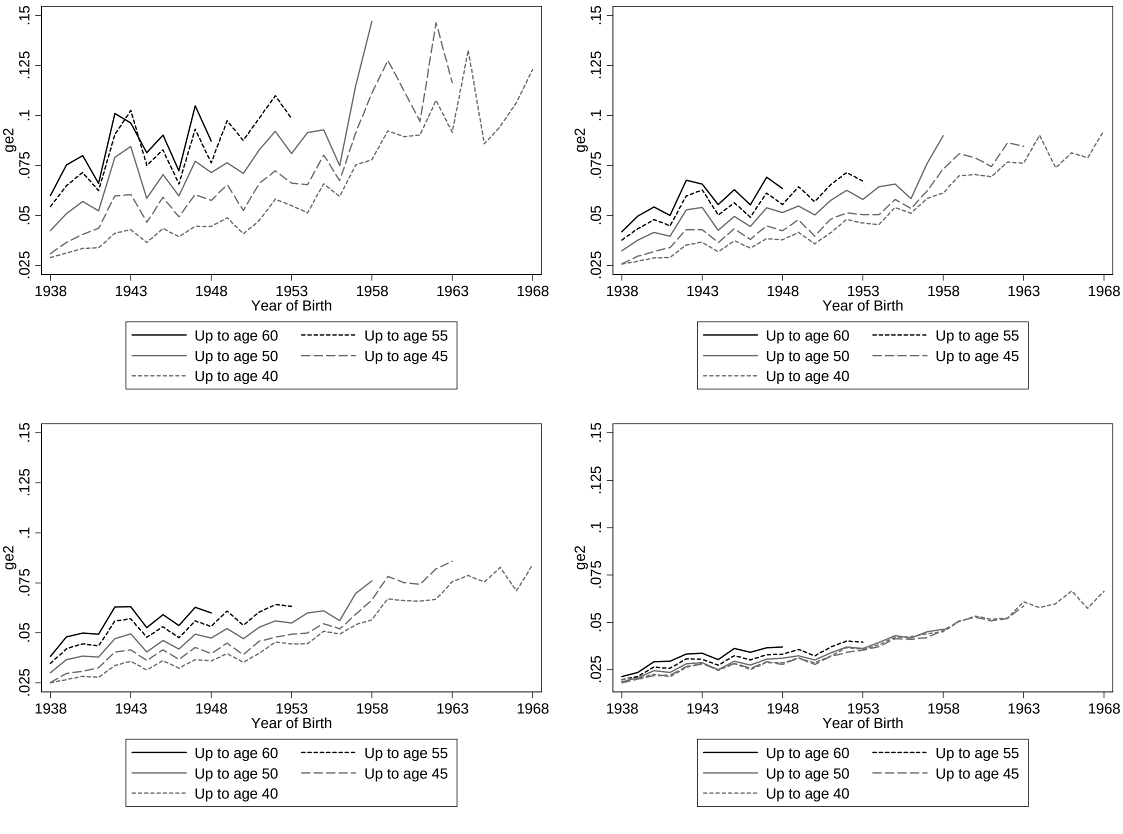
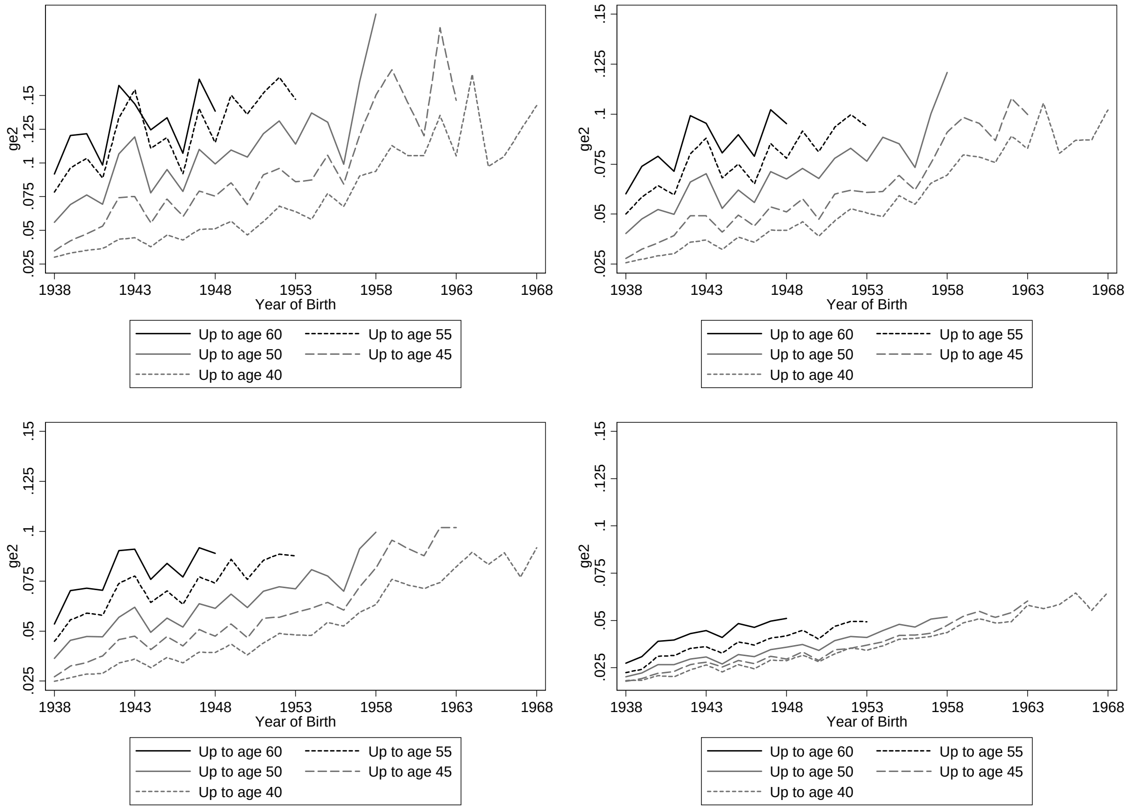


Figure B 6: GE[2] (Half the square of the coefficient of variation) of real UAX- earnings for cohorts 1938-1968. Assumption of minimal mobility, maximal mobility, mean imputed earnings and not imputed earnings (in this order)



Appendix C: Robustness, NPV from 25 to X

Figure R 1 b: Comparison of the Gini coefficients of the artificial/fictive population, the means of the cross sectional Gini and the lifetime earnings from 25-60 with real earnings and federal bond discounted earnings for cohorts 1938-1948. Assumption of minimal mobility, maximal mobility, mean imputed earnings and not imputed earnings (in this order)

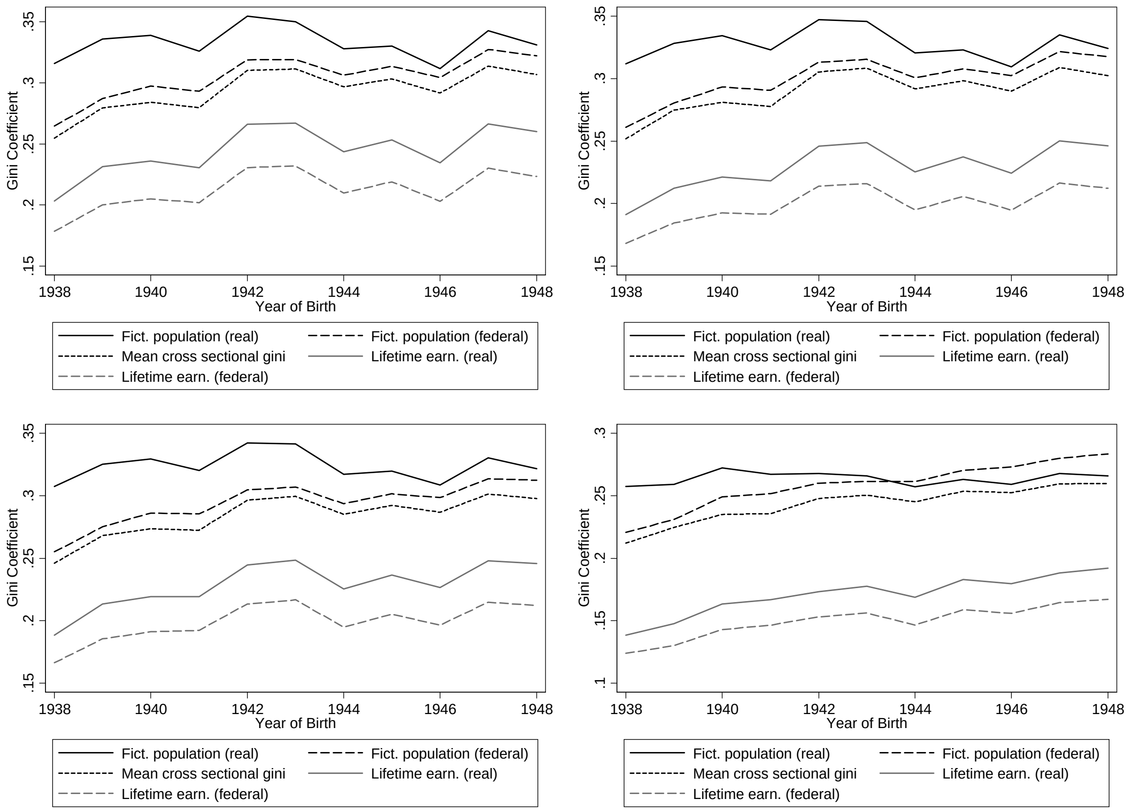


Figure R 4b: Correlation coefficients of annual and lifetime earnings with federal bond discounting for cohorts 1938-1948. Assumption of minimal mobility, maximal mobility, mean imputed earnings and not imputed earnings (in this order).

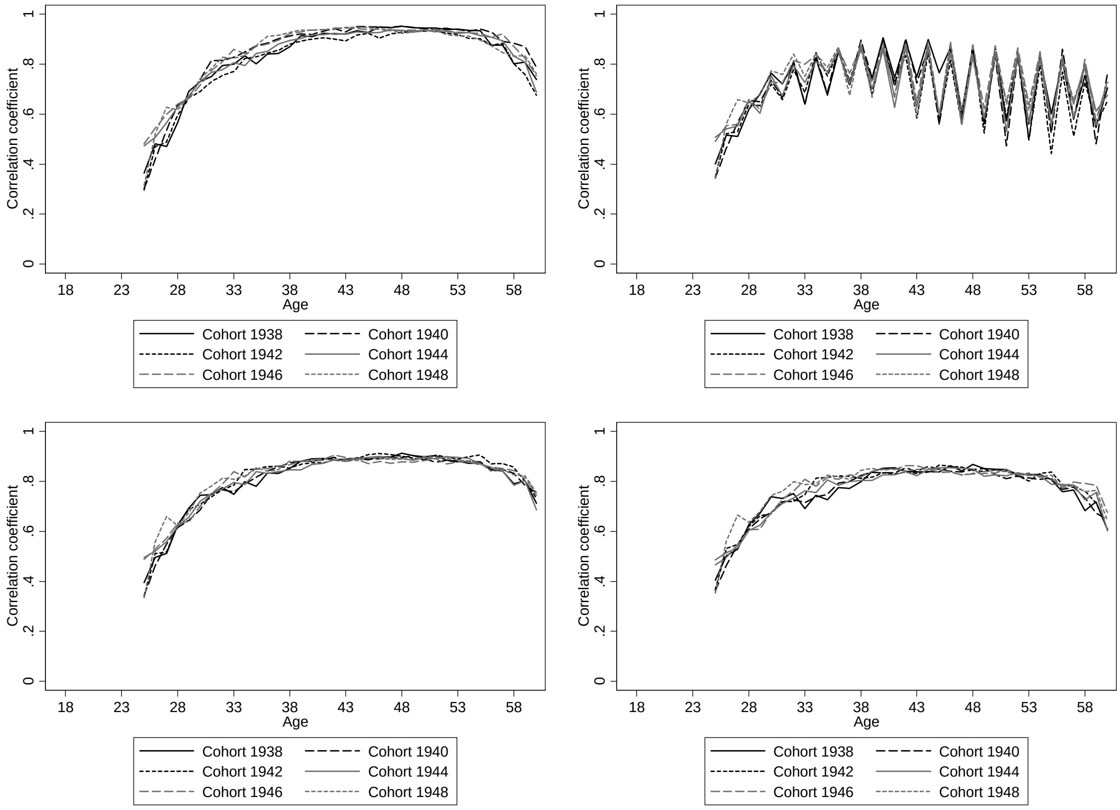


Figure R 4c: Correlation coefficients of annual and lifetime earnings with real discounting for cohorts 1938-1948. Assumption of minimal mobility, maximal mobility, mean imputed earnings and not imputed earnings (in this order).

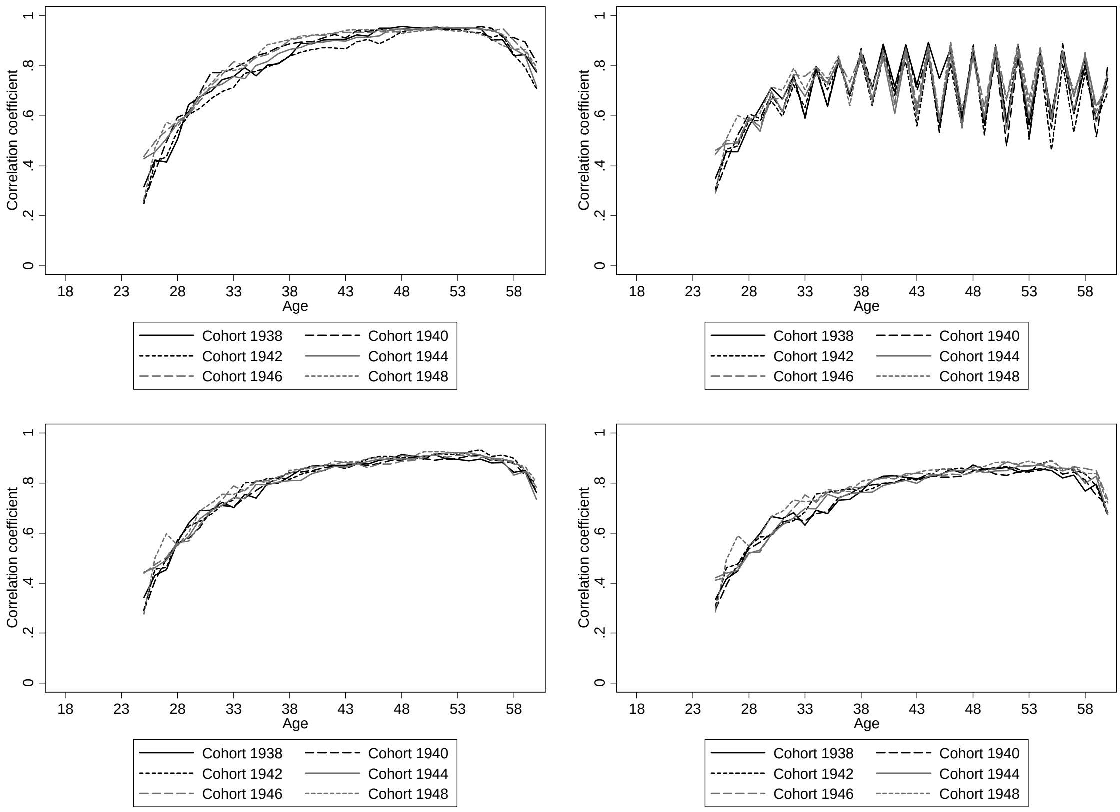


Figure R 5b: Rank correlation of annual and lifetime earnings with federal bond discounting for cohorts 1938-1948. Assumption of minimal mobility, maximal mobility, mean imputed earnings and not imputed earnings (in this order).

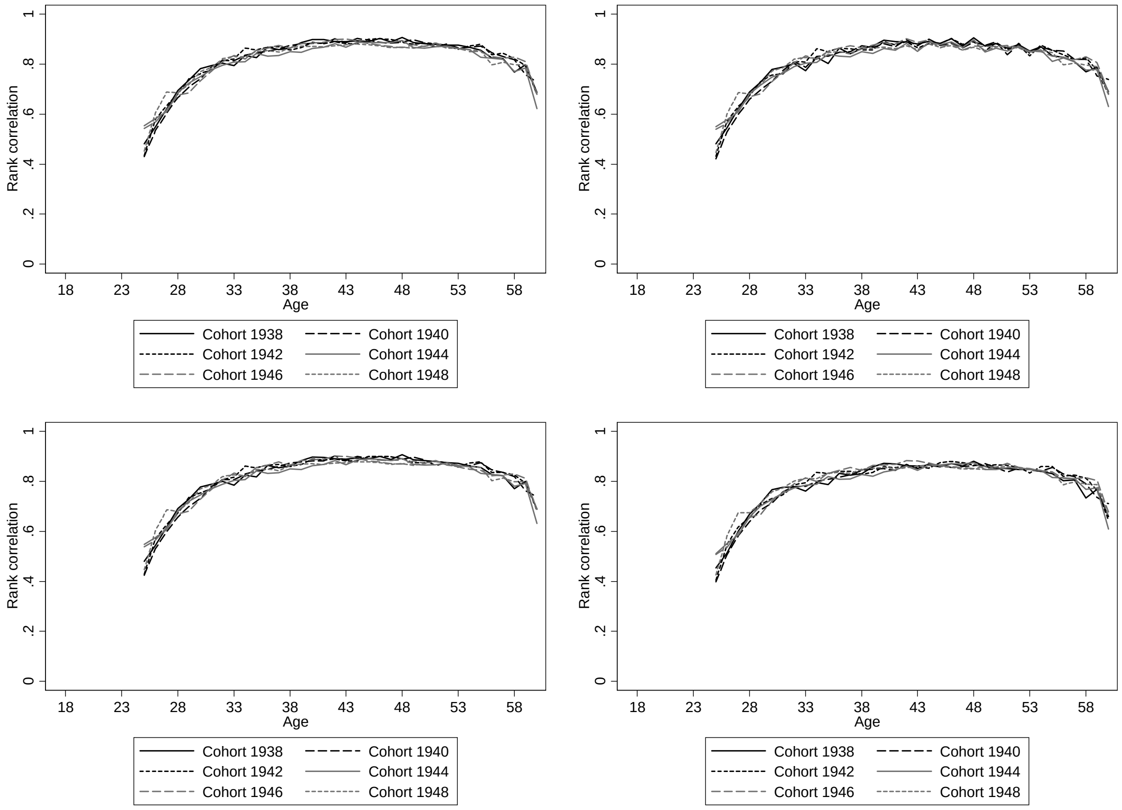


Figure R 5c: Rank correlation of annual and lifetime earnings with real discounting for cohorts 1938-1948. Assumption of minimal mobility, maximal mobility, mean imputed earnings and not imputed earnings (in this order).

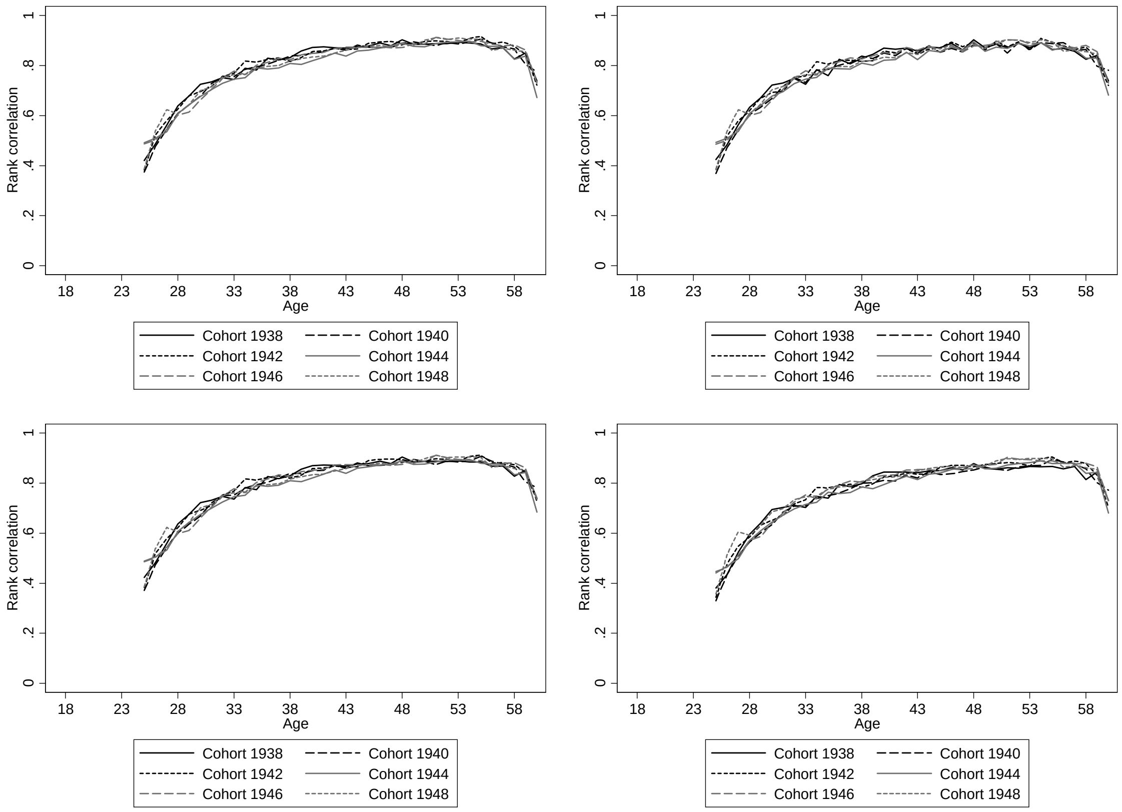


Figure R 6b: Ginis of UAX- earnings with federal bond discounting for cohorts 1938-1968. Assumption of minimal mob, maximal mobility, mean imputed earnings and not imputed earnings (in this order).

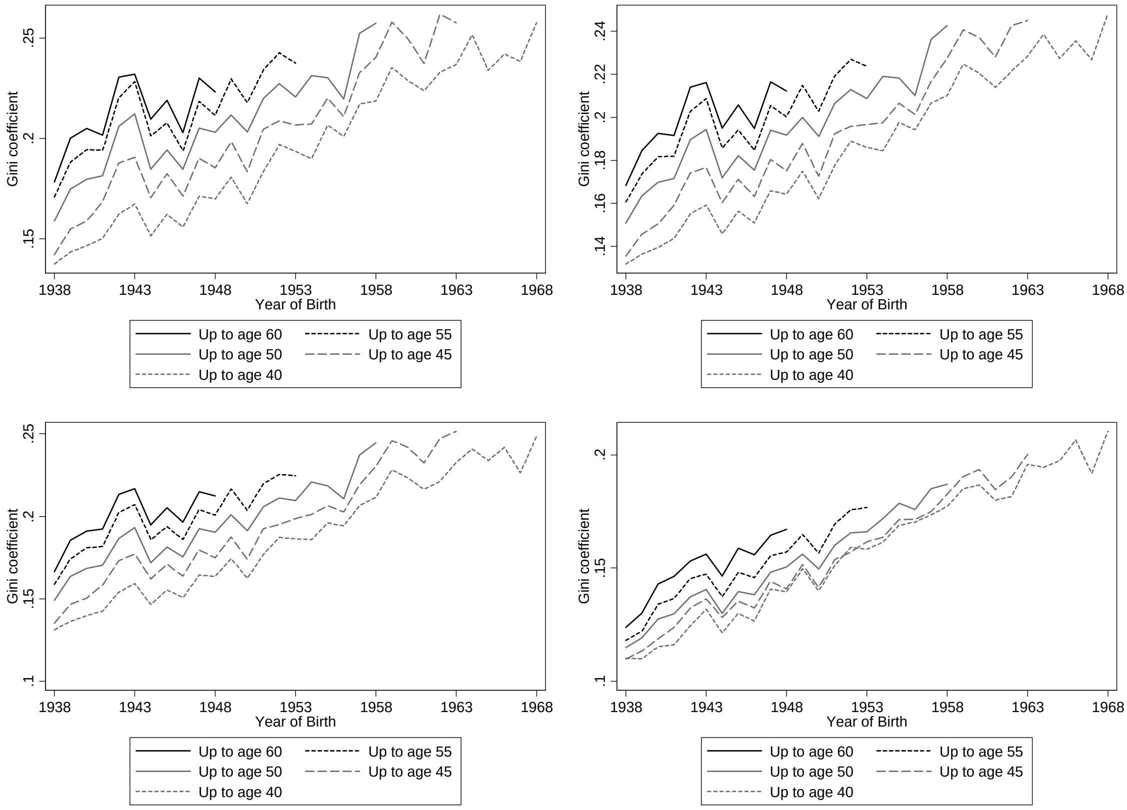


Figure R 7b: Ginis of real UAX- earnings for cohorts 1938-1968. Assumption of maximal mobility, mean imputed earnings and not imputed earnings (in this order).

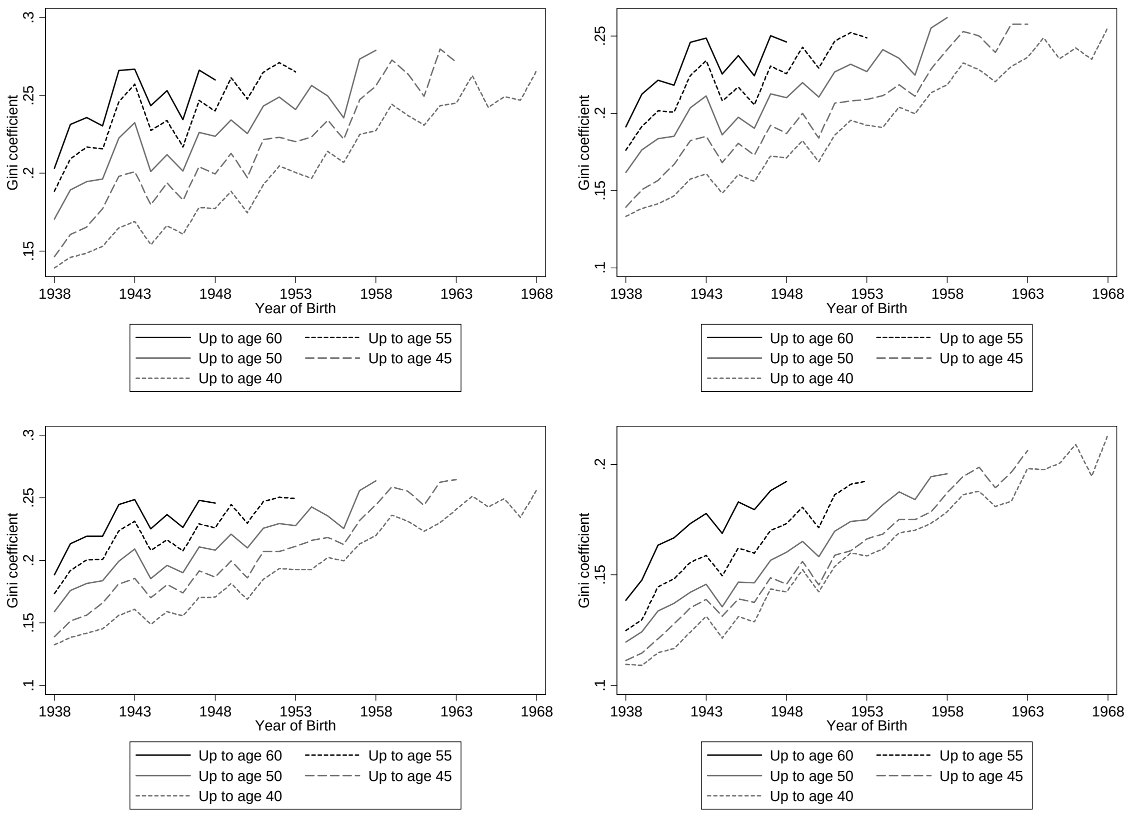


Figure R 8b: Rank correlation of UA-40 earnings with UAX earnings, federal bond discounting. Assumption of minimal mobility, maximal mobility, mean imputed earnings and not imputed earnings (in this order).

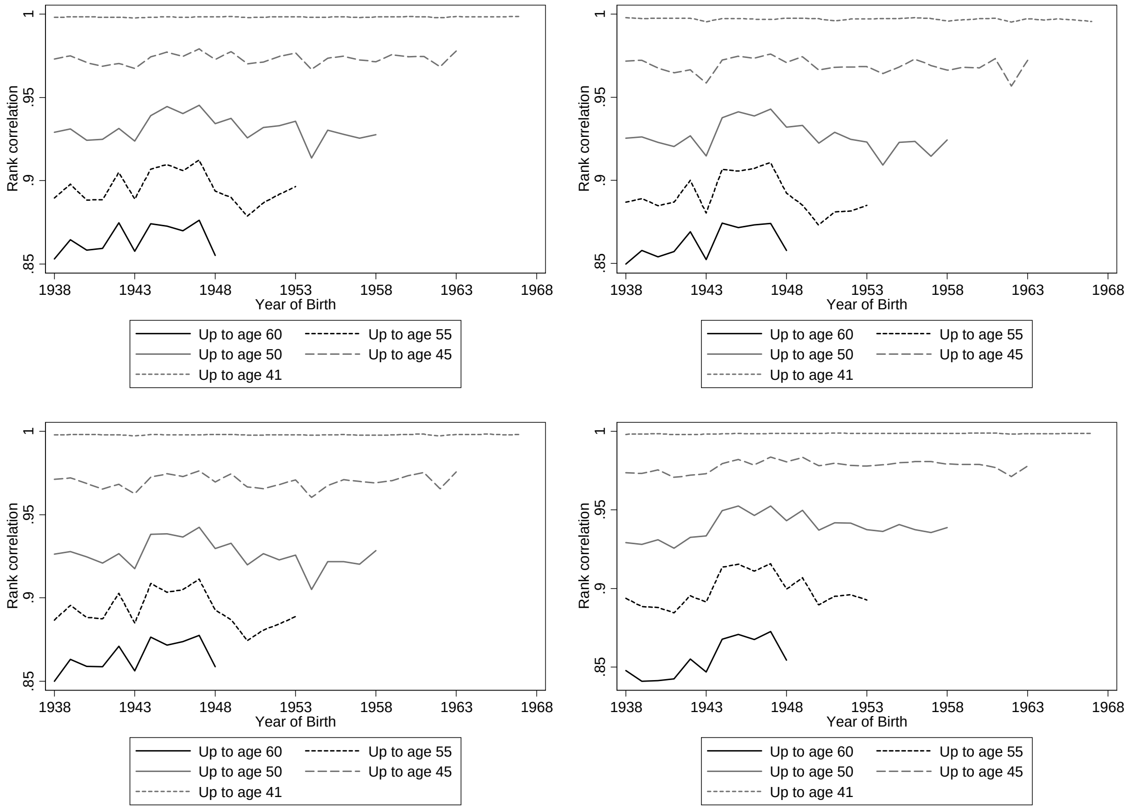


Figure R 8c: Rank correlation real UA-40 earnings with real UAX earnings. Assumption of minimal mobility, maximal mobility, mean imputed earnings and not imputed earnings (in this order).

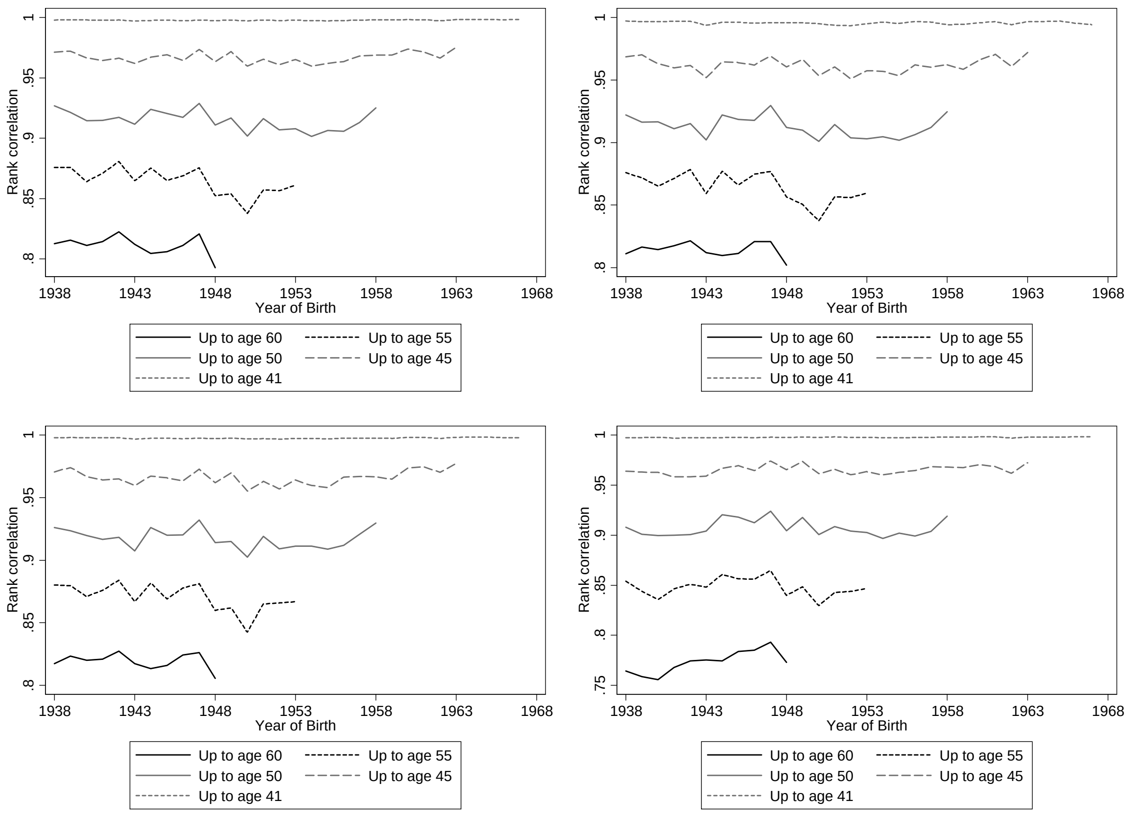


Figure R 11: Employment status up to age 40 in the 1st and 2nd quartile.

Figure R 12: Employment status up to age 40 in the 3rd and 4th quartile.