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ABSTRACT

In this paper, the relationship between age and household net worth is examined. The empirical analysis is based on a time-series of four cross-sections of the Finnish household wealth survey. Two different schemes are employed to identify age, cohort and time effects. Time-of-birth is found to be an important determinant of asset accumulation. Contrary to the life-cycle model, net worth increases even after retirement age. The cohort effect is found to follow a concave pattern instead of increasing monotonously. However, the accumulation behaviour both over the life-cycle and across cohorts varies considerably by education.

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1. INTRODUCTION

Ageing of the population, increased longevity and more recently falling birth rate have raised concerns over the future generosity of the defined pension benefits in Finland. The replacement rate of social security determines incentives to save. According to the life-cycle model, retirement is the main motive to save. Assets are accumulated over the working life to finance consumption in retirement. Hence, the level of wealth follows a hump-shaped profile over the life-cycle of an individual. This theoretical prediction has been tested empirically in several studies including Shorrocks (1975), Jappelli (1999), Jappelli and Pistaferri (2000) and Kapteyn, Alessi and Lusardi (2005). However, the age-wealth profile of Finnish households has not been explored yet.

This study is aimed at finding out if Finnish households reduce their wealth holdings in old age as predicted by the life-cycle model. Seminal previous work on the saving behaviour of Finnish Households within the life-cycle framework includes Hämäläinen (1981) and Siimes (1994). Hämäläinen (1981) analyses the determinants of the saving rate using a single cross-section of survey data referring to the year 1969. Siimes (1994) explores the age distribution of the saving rate using cross-sections collected in three different decades. The latest dataset included in her study relates to year 1988. Each cross-section is analysed separately as they are comparable only to a limited degree due to the different data providers. The surveys used by Hämäläinen (1981) and Siimes (1994) were mostly conducted during the time financial markets were highly regulated, and hence incomplete, in Finland. This paper, on the other hand, focuses on the saving behaviour of the Finnish households during and after the liberalization of the financial markets in the late 1980s.

Both Hämäläinen (1981) and Siimes (1994) conduct a cross-sectional analysis of the implications of the life-cycle theory. In a single cross-section, it is possible to identify differences in the savings behaviour of different age groups in the population. As Shorrocks (1979) and Jappelli (1999) emphasize, differences between age-groups do not, however, necessarily describe the way the behaviour of an individual changes with age. Individuals surveyed in a single cross-section belong to different generations whose savings – that lead to accumulation of assets – vary because of productivity growth. The higher the productivity growth over time is, the larger the scale of the saving. Hence, younger generations who face higher productivity growth are better off than the previous generations were at the same age (see e.g. Deaton 1992, Jappelli 1999). Moreover, age, time-of-birth and calendar time are linearly dependent on each other. Using a single cross-section, it is impossible to identify separate effects for each of these three time variables. Cross-sectional analysis can thus lead to misleading conclusions on the behaviour of an individual over the lifetime.

In order to test the implications of the life-cycle hypothesis, panel data or a time-series of repeated cross-sections is needed. In this paper, 1987, 1994, 1998 and 2004 cross-sections of the household wealth survey conducted by Statistics Finland are used to test the hypothesis on the hump-shaped age-wealth profile. Even though the same household is only observed once, it is possible to follow a sample of the same cohort over the survey years. This approach is applied by Deaton and Paxson (1994, 2000), Attanasio (1998), Jappelli (1999), Jappelli and Pistaferri (2000), Jianakoplos and Bernasek (2006) and Lim and Zeng (2016) among others. Time series of cross-sections allows one to identify life-cycle patterns in households' saving behaviour in a more reliable fashion than the methods used in previous Finnish studies.

Even with a time-series of cross-sections, it is impossible to disentangle the effects of age, cohort and time on the wealth level. Additional identification restrictions are required. In this study, time effects are required to sum to zero and be orthogonal to a time trend. This normalization proposed by Deaton and Paxson (1994) is widely used in research on consumption, saving and investment behaviour including Attanasio (1998), Jappelli (1999), Jappelli and Pistaferri (2000), Jappelli and Modigliani (2005), Jianakoplos and Bernasek (2006) and Fernández-Villaverde and Krueger (2007). Schulhofer-Wohl (2018) provides an extensive survey on articles employing the Deaton and Paxson (1994) restriction.

The interpretation of the results of the empirical analysis depends on the identification restriction. The Deaton and Paxson (1994) normalization is based on the assumption of time effects averaging out over time. With the modest number of survey waves that span over a period of 18 years one cannot confidently assume that this underlying assumption is fulfilled. Hence, it is necessary to investigate if the popular scheme is a suitable strategy to identify separate effects for age, cohort and time. The identification restriction itself cannot be statistically tested. However, an alternative restriction is implied by the life-cycle model with homothetic preferences: cohort effects in wealth are equal to cohort effects in income. Therefore, regression for wealth-to-income ratio is used to confirm the validity of the conclusions drawn from the analysis based on the identification restriction proposed by Deaton and Paxson (1994).

2. LIFE-CYCLE MODEL WITH PRODUCTIVITY GROWTH

As in Jappelli (1999) and Jappelli and Modigliani (2005), the life-cycle model developed by Modigliani and Brumberg (2005, originally published in 1954) provides the theoretical framework for this study. In the life-cycle model, a representative agent maximizes utility from consumption subject to the lifetime resources, income and available assets. Consumption is smoothed across the lifespan L. Labour income is positive until retirement at age $N < L$ and zero afterwards. Since consumption and income paths over the life-cycle do not coincide, there is a need to accumulate assets that can be used to finance consumption in retirement.

In the simple version of the life-cycle model, preferences are assumed to be homothetic. Both the interest rate and the rate of time preference are zero. There is no uncertainty about the lifespan L or the labour income at age a of the representative agent belonging to generation c, $y_{a,c}$. Labour income is constant throughout the earnings span N. The representative agent does not receive inheritances or gifts at any point of life and leaves no bequest. In the absence of initial assets, lifetime resources are given by the identity $W_c = Ny_{a,c}$. Optimal consumption at age a is a constant fraction of lifetime resources, $c_{a,c} = W_c/L$. Following Jappelli's (1999) formulation, assets A accumulate through own saving until retirement according to

$$A_{a,c} = \frac{a}{N}\left(1 - \frac{N}{L}\right)W_c \text{ for } a = 0, \ldots, N-1.$$

In retirement, wealth is drawn down and eventually exhausted,

$$A_{a,c} = \left(1 - \frac{a}{L}\right)W_c \text{ for } a = N, \ldots, L.$$

These expressions imply that the evolution of assets over the life-cycle is independent of lifetime resources.

Lifetime resources determine the distance between the age-wealth profiles for different cohorts. The shape of the profiles, however, depends only on age. Thus the asset evolution equation can be suppressed to

(1) $$A_{a,c} = f(a)W_c.$$

where $f(a)$ is a concave function of age. Jappelli and Modigliani (2005) emphasize that dissaving after retirement is one of the central implications of the life-cycle model. More realistic assumptions about preferences and interest and time preference rates do not change this prediction. Even if assumptions concerning uncertainty and intergenerational transfers of assets are relaxed, wealth decumulation is expected near the end of life within the framework of the life-cycle model.

In Jappelli's (1999) formulation, productivity growth has an impact on wealth accumulation through the lifetime resources, such that $W_c = W_0 e^{\rho c}$. Here W_0 denotes initial resources common to all generations and ρ the growth rate of productivity. Each successive generation is more productive than the previous one. Within a generation c productivity, however, does not vary. In addition to the rate of productivity, individuals belonging to the same generation share preferences, mortality rates and institutional arrangements. Plugging the expression for lifetime resources into equation (1) and log-linearizing yields

(2) $$\ln(A_{a,c}) = \ln f(a) + \ln(W_0) + \rho c.$$

The shape of the age-wealth profile is not affected by the productivity growth. The position of the profile, however, changes across generations: productivity growth makes each successive generation wealthier than the previous one. In a similar fashion, initial resources W_0 have an impact on the level of the age-wealth profile but not on the shape of it.

3. ECONOMETRIC MODELLING AND IDENTIFICATION

In a single cross-section, an individual belonging to generation c is observed only once at a given age a but not at older ages. Therefore, it is not possible to observe differences in the behavior of different generations. As Shorrocks (1975) and Jappelli (1999) point out, estimation of equation (2) using cross-sectional data can, therefore, lead to misinterpretations about the evolution of household wealth over the life-cycle. (Ameriks and Zeldes (2004) provide an extensive illustration of this issue in their paper on the relationship between age and portfolio choice). In the absence of panel data, that follows the same individuals over time, repeated cross-sections can be used to elicit the impact of the time-of-birth on the outcome variable (see e.g. Deaton 1985). In repeated cross-sections, the observed individuals change from one survey year to the next. However, groups of individuals that share a common time-invariant feature, such as the year-of-birth, can be followed over time.

Estimation of equation (2) is based on the modified version of the specification presented by Jappelli (1999):

(3) $$\ln(A_{a,c}) = D^a\alpha + X\beta + D^c\gamma + d_t\delta + \varepsilon.$$

In this equation, D^a denotes a matrix of dummy variables for age. The estimated coefficients of age dummies allow one to assess if asset accumulation follows a hump-shaped path over the life-cycle as the theory predicts. X is a matrix of variables that determine the initial resources W_0 available to the household irrespective of the time-of-birth. These variables include sex, self-employment and educational attainment. D^c signifies a matrix of cohort dummies. The estimated coefficients of the cohort dummies reflect the growth in productivity from one generation to another. The coefficients d_t capture the effects of calendar time on wealth accumulation. These calendar year fixed effects capture the impact of uncertainty overlooked in the derivation of equation (3) on wealth accumulation. Households adjust their resources in response to unexpected changes in macroeconomic environment, that cause for example unemployment. The coefficients for the time effects also control for the effect of measurement error on the estimated wealth equation. Finally, ε denotes the error term.

In any empirical analysis of the life-cycle model, the issue of identifying separate effects for age, calendar time and year-of-birth needs to be addressed. It is impossible to simultaneously identify all of the three effects as they satisfy an exact linear relationship $a = t - c$: in period t, an individual born in year c is a years old. Repeated cross-sectional data allows one to identify two out of the three time dimensions (see e.g. Börsch-Supan 2001, Ameriks and Zeldes 2004).The third time effect can be recovered on the basis of the estimates of the other two. In order to disentangle the effects of age, time and year-of-birth, additional identifying assumptions need to be imposed. The simplest identification scheme within the literature on life-cycle model involves setting either cohort or time effects to zero. Time effects are assumed away, for instance, in the collection of articles on the household savings behaviour edited by Börsch-Supan (2001).

This paper adopts a popular identification restriction proposed by Deaton and Paxson (1994). In their normalization, year effects are required to sum to zero and to be orthogonal to a time trend:

$$\sum_{t=1}^{M} d_t = 0 \text{ and } \sum_{t=1}^{M} t \times d_t = 0$$

where Mdenotes the last survey. While allowing the simultaneous identification of age, cohort and time effects, this restriction should leave the predicted values of wealth unaffected.

In the Deaton and Paxson (1994) approach, the three time effects are divided into a trend and a cycle. The age and cohort effects together capture trends in the data. Calendar year fixed effects, in turn, reflect any unpredictable factors having an impact an asset accumulation, such as macroeconomic shocks and measurement errors discussed earlier. All interactions between age, cohort and calendar time are ruled out by this normalization (see e.g. Jappeli and Modigliani 2005; Kapteyn, Alessi and Lusardi 2005).

As explained by Schulhofer-Wohl (2018), another variant of the procedure proposed by Deaton and Paxson (1994) is to resort to external information to substitute for one of the three time effects. In their analysis of household wealth holdings over the life-cycle, Kapteyn, Alessi and Lusardi (2005) gauge the effect of year-of-birth by a cohort-specific index of gross national product per capita. Lim and Zeng (2016) use a similar macro variable based on GDP growth to identify time effects in their work on the association between consumption, income, wealth and age. Gourinchas and Parker (2002), in turn, supplant time effects with unemployment rate in their consumption regression. By replacing one of the time dimensions – age, cohort or calendar time – with out-of-sample data, it is possible to identify age, time and cohort effects simultaneously. The identification is achieved by breaking the additively-separate structure between the three time variables. For comparison, equation (3) will also be estimated using a very basic generation-specific GDP indicator.

McKenzie (2006) and Schulhofer-Wohl (2018) propose new methods to separate age, time and cohort effects in additive models like the one specified in this paper. Contrary to the standard approach, additional normalizations are not required. In the standard procedure, first derivatives of age, cohort and time effects are estimated. McKenzie's (2006) strategy to identify a life-cycle pattern in outcome variable, however, relies on estimating the second derivative of each of the three time effects. Schulhofer-Wohl's (2018) approach, on the other hand, utilizes second and higher derivatives. Since age and cohort enter the equation (3) as dummy variables, these new methods are not applicable to the analysis presented in this paper.

Conclusions drawn from the model that relies on the identification scheme of Deaton and Paxson (1994) are valid, if the data covers long enough a time period to include both a trend and a cycle. The four cross-sections of the Finnish household wealth survey are sparsely spaced within a period of 18 years. Therefore, one cannot confidently claim that the wealth survey meets the data conditions. Within the framework of the simplified life-cycle hypothesis it is, however, possible to verify if the inferences on asset accumulation relying on the Deaton and Paxson (1994) method are credible. Jappelli (1999) provides the foundation for the testing procedure applied in this paper: Under homothetic preferences and no uncertainty, income is proportional to lifetime resources, $Y_{a,c} = g(a)W_c$ (see Deaton and Paxson 2000). Since $\ln(Y_{a,c}) = \ln g(a) + \ln(W_c) = \ln g(a) + \ln(W_0) + \rho c$, cohort effects in income are equal to cohort effects in wealth (denoted by ρc). Subtracting the reduced form equation for the log of income from both sides of equation (3) implies another estimation equation:

(4) $$\ln\,(A_{a,c}/Y_{a.c}) = D^a\alpha + X\beta + d_t\delta + \nu$$

where ν denotes error term. Equation (5) can be estimated without imposing restrictions on time effects as it's based on the theoretical prediction that wealth-to-income ratio varies only with age and time.

In order to test if the cohort effects in wealth are equal to cohort effects in income, equation (4) is augmented with cohort dummies and the Deaton and Paxson (1994) restriction is imposed on time effects. Once this augmented regression is estimated, the joint hypothesis that the coefficients of the cohort dummies are equal to zero is tested. If consumption smoothing over the life-cycle leads to hump-shaped age-wealth profile, the shape of the estimated age-profile of wealth under the Deaton and Paxson (1994) identification restriction should be similar to the shape of the age-profile of wealth-to-income ratio derived under the assumption of equal cohort effects in wealth and income. This estimation procedure based on Jappelli (1999) thus allows one to test if the alternative identification restriction derived from the life-cycle model is valid. Moreover, it is possible to conclude if the data is consistent with the prediction on dissaving in old age.

4. THE DATA

The empirical analysis is based on the household wealth survey conducted by Statistics Finland. The wealth survey is a repeated cross-sectional survey of noninstitutionalized population aged 15 or over whose permanent residence is located in Finland. (A detailed description of the data is provided by Laiho 1998 and Säylä 1991, 1997, 2000, 2002, 2007.) The purpose of the survey is to describe the level and the composition of household wealth as well as capture changes in the financial position of Finnish households. Household refers to persons who live together, share meals or otherwise use their income together. The survey, which is representative of the total population, contains information on privately owned assets and personal liabilities. Hence, data on entrepreneurial assets and liabilities are excluded from the dataset. Social security wealth is also beyond the scope of the survey. In addition to data on asset holdings and liabilities, wealth survey contains information on household income and demographics.

In this study, 1987, 1994, 1998 and 2004 cross-sections are used to examine the age-wealth profile in Finland. These surveys cover 18,124 observations in total. During the selected survey years information was collected by interviewing sampled households. Survey responses obtained via interviews were supplemented with data from official registers. In 2009, wealth survey went through a significant redesign: interview-based data collection was replaced by a register-based method (Statistics Finland 2013). The data collection method and some variable definitions were further modified in 2013 and 2016. These changes have an impact on the comparability between the survey waves. The four early cross-sections used in this study provide the longest set of consistent data on household wealth in Finland.

Because of the sensitivity of the topic, participating households are likely to underreport the true level of their wealth in interviews. Thus the estimates of total wealth level are biased downwards in comparison to the alternative data sources (Laiho 1998). However, the wealth survey data provides a good description of the evolution of the financial position of Finnish households which is of interest in this paper.

Household wealth, also known as net worth, is defined as total assets net of private liabilities. Total assets include both financial and non-financial assets. Private liabilities refer to the sum of housing, consumer and student loans. Asset and liability values pertain to the end of the survey year except for the deposits whose value is determined by the time of the interview. The concept of net worth employed in this study reflects discretionary saving by households (e.g. Börsch-Supan 2001 and papers therein, Jappelli and Modigliani 2005). Discretionary saving accounts for the funds that households have a full control over themselves. Mandatory saving, on the other hand, consists of contributions to social security wealth that are beyond the supervision of households. Jappelli and Modigliani (2005) insist that in testing the implication of dissaving in old age the correct measure of net worth is comprised of both the discretionary funds and the assets accumulated mandatorily in a social security scheme. This notion has, however, been debated. For instance, Börsch-Supan (2001) asserts that households tend not to consider these two types of funds as equal even though mandatory saving may supplant households' personal efforts to save for retirement.

Following Börsch-Supan (2001) and Börsch-Supan et al. (2001) non-capital income is defined as the sum of earned income – wages, salaries and entrepreneurial income – and transfers received minus transfers paid. This definition of disposable income is closely related to the concept of discretionary saving underlying the measure of net worth captured by the Finnish household wealth survey. The measure is also consistent with the recommendations of the Canberra Group (2001). According to Canberra Group (2001) the income measure used here reflects the resources available for the consumption and services better than total non-capital income. Capital income is excluded since the interest rate is assumed to be zero in the specific version of the life-cycle model adopted by Jappelli (1999) and followed in this paper. Furthermore, capital income is inconsistently defined over the survey years.

The measure of income that matches Jappelli and Modigliani's (2005) definition of total household wealth treats receipts from the pension wealth in old age as dissaving instead of income. In this case, the appropriate interpretation of earned income is gross labour earnings net of taxes. Transfer income and contributions to social security schemes are ignored altogether. The closest construct of such an income measure feasible using the Finnish household wealth survey is the difference between the sum of labour income and all transfers paid. Taxes and other social security contributions cannot be separated from each other in all of the four cross-sections. Pursuing this avenue would lead the log of wealth-to-income ratio to be missing for 5,041 households out of the total of 18,124 observations. Such a significant truncation of the sample (28 %) might have a serious impact on the results of the empirical analysis (see e.g. OECD 2013). The use of the definition of the disposable (cash) income similar to Börsch-Supan (2001), Börsch-Supan et al. (2001) and De Nardi, French and Jones (2016), is therefore justified both by conceptual and statistical considerations.

Information on each household's wealth and income is the sum total of the corresponding items of each individual household member. All monetary variables have been deflated using the cost-of-living index so that the values correspond to 2004 price level. Cost-of-living index is used instead of the consumer price index as it is better suited for an analysis that covers a long time-period (see e.g. Säylä 2002).

Even though it is not possible to follow the same individuals over time in a time-series of cross-sections, it is feasible to follow groups of individuals who share the same time-invariant characteristic. In this paper, cohorts are defined by the year of birth of the household reference person, the member with the highest income. Birth year has been identified by subtracting the age of the reference person from the survey year. A 5 year-of-birth interval is selected to construct 9 cohorts. The oldest cohort is comprised of households born in 1923-1927. These households were 60-64 years old in 1987. The youngest generation considered in the analysis includes households born in 1963-1967. They were aged 20-29 years in 1987.

The composition of the cohorts changes from one survey to another. As explained by Shorrocks (1975), Jappelli (1999) and Guillerm (2017), this variation distorts the sample estimates of household wealth. Particularly prone to changes are the cohorts composed of young and old households. New households enter young cohorts in increasing numbers as they reach the eligibility age of the survey. Young people also become new independent units of their own as they mature. Old cohorts, on the other hand, gradually decrease due to mortality and entry to retirement homes or other institutions providing long-term care. According to Shorrocks (1975), wealth and mortality are correlated. Wealthy households tend to live longer than poor ones. Since poor households exit the sample earlier, wealthy households represent a growing share of the population in old cohorts. These types of variations in the cohort composition result in increase in the average wealth of a cohort even if there had not been any accumulation of assets.

In order to control for the impact of entry to and exit from cohorts, the sample is truncated. Young adults less than 20 years of age are likely to be primary breadwinners and to live independently only under special circumstances. Therefore, 1,810 households whose reference person was born after 1967 (younger than 20 in 1987) are excluded. Households with a reference person born before 1923 (older than 64 in 1987) are also omitted from the sample. The number of these observations is 1,390. Due to the log-transformation of the variables of interest, further 1,716 households with zero or negative net worth or wealth-to-income ratio are excluded. The final sample includes 13,726 observations.

5. DESCRIPTIVE ANALYSIS

Table 1 reports summary statistics by cohort. First four columns record the year-of-birth intervals, age in the first and last survey and the average size for each cohort. Estimated means and standard errors of wealth are expressed in thousands of 2004 euros. Finnish households are not particularly wealthy. The average asset stock is only worth around 100,000 euros. Wealth holdings seem to follow a hump-shaped pattern across cohorts. However, this pattern is obscured by the linear dependence between age, cohort and time effects.

TABLE 1. Summary statistics by the year-of-birth of the household reference person

Year-of-birth	Age in 1987	Age in 2004	Average cell size	Mean wealth	S.E. mean wealth
1923-1927	60-64	77-81	215	88.57	3.67
1928-1932	55-59	72-76	281	107.57	4.14
1933-1937	50-54	67-71	314	114.43	4.01
1938-1942	45-49	62-66	401	120.33	3.56
1943-1947	40-44	57-61	540	122.96	3.22
1948-1952	35-39	52-56	550	105.80	2.83
1953-1957	30-34	47-51	469	91.57	2.92
1958-1962	25-29	42-46	383	77.41	3.32
1963-1967	20-24	37-41	308	65.85	2.88
All cohorts	20-69	37-81	404	99.96	1.08

Note: Wealth is expressed in thousands of 2004 euros. Means and standard errors are calculated using sample weights.

Figures 1 and 2 illustrate the identification problem associated with age, cohort and time effects. Figure 1 depicts average household wealth by age group for each survey year. The mean is presented at the center of each age group on x-axis (for instance, 22 for the age group 20-24). This figure compares different age groups with each other at a given point in time. Each of the age profiles follows a concave pattern with a peak before retirement at around 65 years of age. The behavior of Finnish households, therefore, seems to conform to the life-cycle hypothesis. However, the profiles displayed in Figure 1 are confounded by cohort effects: households belonging to different generations are compared with each other. In the life-cycle model, productivity growth causes the pattern of wealth accumulation to vary across generations. Intergenerational variation also arises from differences in preferences, macroeconomic conditions and institutional arrangements (see Jappelli 1999 and Kapteyn, Alessi and Lusardi 2005).

Figure 2 displays average household wealth by age and cohort. For ease of exposition, only the first year-of-birth out of five for each cohort is shown in the legend. Two different types of comparisons can be made on the basis of Figure 2. First option is to compare the wealth level of different cohorts with each other at the same, given age, that is examine the vertical distance between different cohort-specific profiles. The vertical distance reflects the combination of cohort and time effects. Whenever two profiles intersect, consecutive generations are equally wealthy. If one assumes away time effects, an older generation is wealthier than the successive one at several ages: at a given age, the profile of an older cohort is above the one for the next generation. This observation contradicts the life-cycle model. The implication that each consecutive generation is wealthier than the previous one at all ages seems only to hold for the three oldest cohorts. Within the framework of the simplified life-cycle model adopted in this paper, the observed differences in wealth between cohorts also translate to productivity growth. Under the assumption of no time effects, the productivity seems to first grow starting from the oldest generation but then decline among the youngest generations.

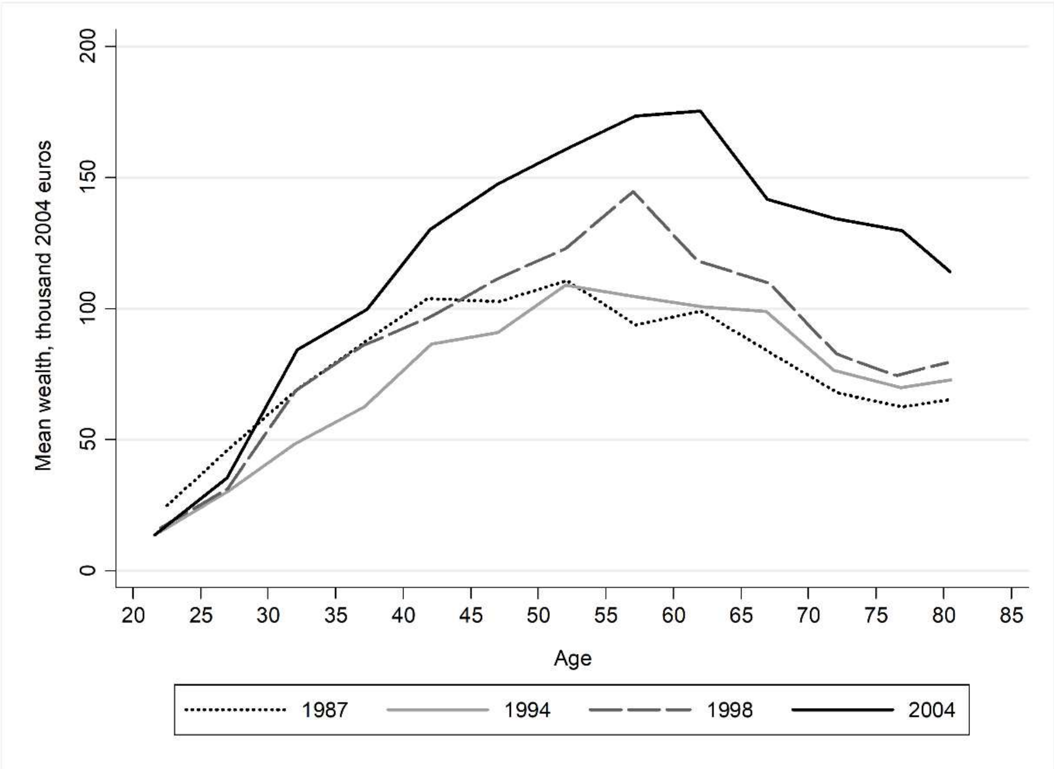


FIGURE 1. Average household wealth by age and survey year

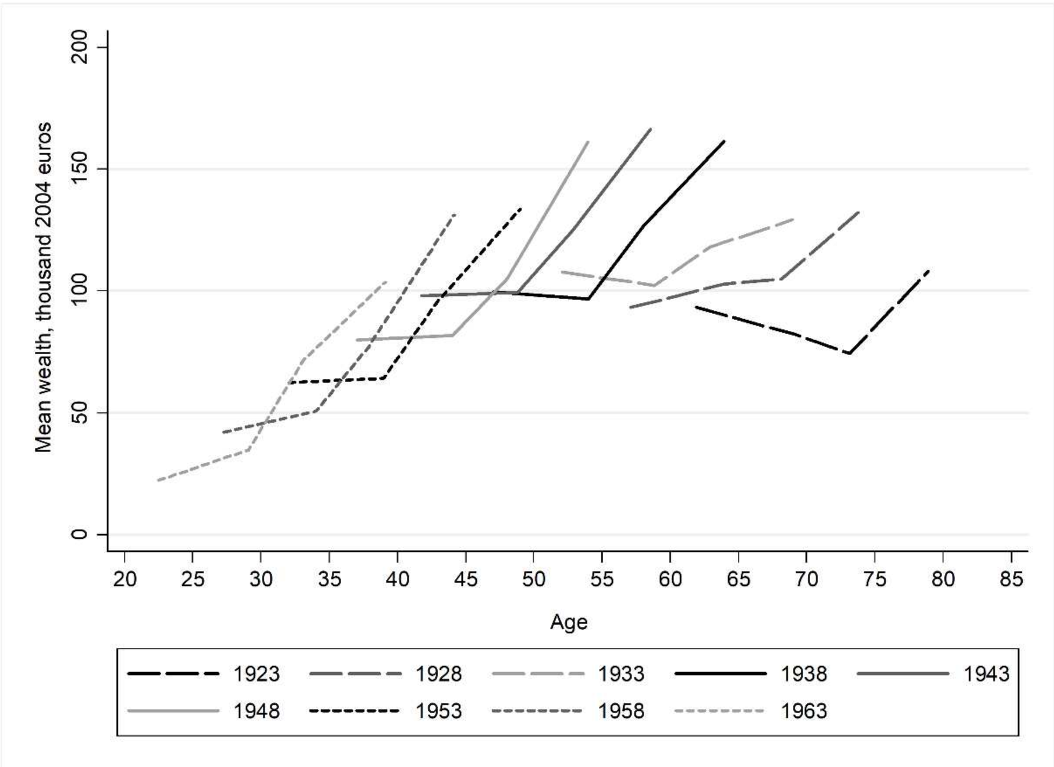


FIGURE 2. Average household wealth by age and cohort

Another way to interpret Figure 2 is to follow each cohort-specific profile individually. In this case, one studies the evolution of the wealth level of the same given cohort as it moves along the life-cycle. The difference along the same profile hence corresponds to the effect of both age and time. Young and middle-aged households accumulate the most wealth. Two noteworthy patterns emerge from Figure 2. First, in stark contrast to the image conveyed by Figure 1, household wealth keeps increasing even after retirement. Second, the cohort-specific wealth profiles are relatively uniformly shaped. After the year 1994 wealth has increased sharply in all cohorts. As explained by Jappelli (1999), this uniformity indicates that factors such as macroeconomic shocks, changes in preferences or measurement error, have a similar impact on the way different generations accumulate wealth. Hence, Figure 2 suggests that time effects are an important determinant of the age-wealth profile in Finland.

6. THE RESULTS

6.1. Baseline regression for wealth level

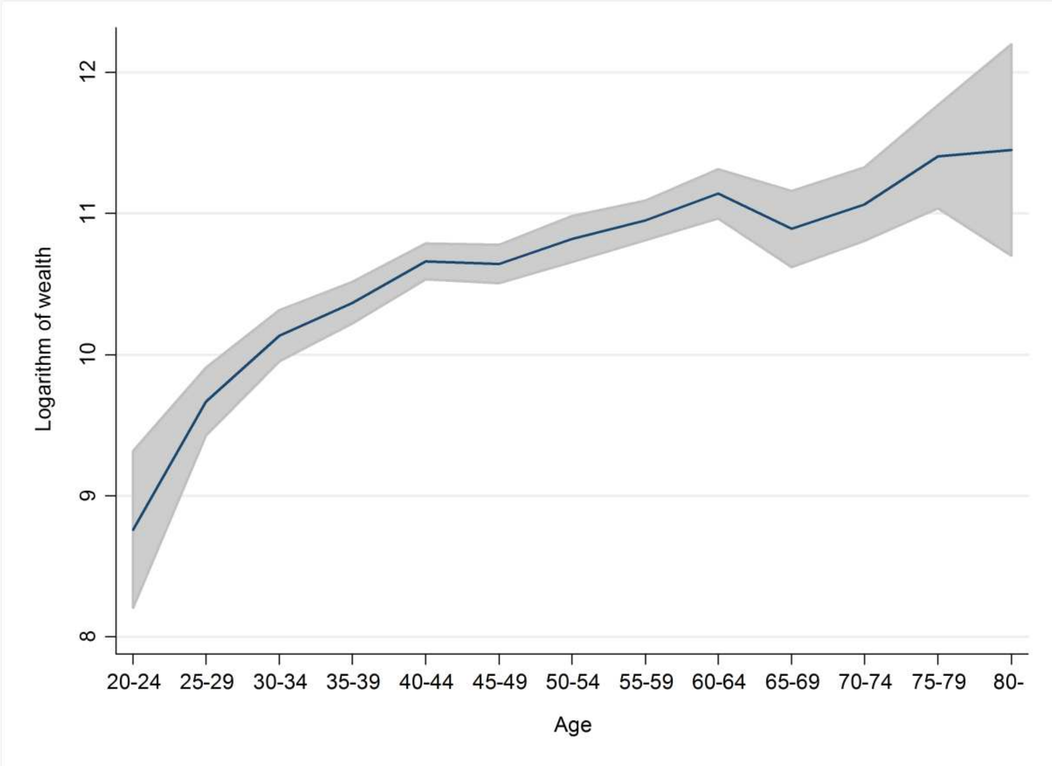
In the baseline specification of equation (3), log of wealth is regressed on age, cohort and restricted time dummies without additional controls. The estimation results are reported in column 1 of Table 2. The estimated cohort and time effects are presented in Appendix 2. The predicted age-wealth profile with associated 95 per cent confidence interval is depicted in panel A of Figure 3. Since there are no interactions in the baseline regression, the shape of this profile is constrained to be the same for all cohorts and all survey years, only the level of the curve varies. For comparison, panel B of Figure 3 displays the estimated age-wealth profile of a cross-sectional regression on age dummies using a pooled sample. Time and cohort effects are not controlled for in the cross-sectional regression.

The cross-sectional profile of panel B in Figure 1 follows a concave pattern. Wealth increases until retirement at the age of 60-64 and declines thereafter. Even though the decrease after retirement is not particularly pronounced, the shape of the profile resembles the one predicted by the life-cycle model (cf. Figure 1). In contrast, the baseline regression that controls for cohort effects implies that assets are steadily accumulated throughout the whole life. This result is inconsistent with the life-cycle model. The difference in the shape of the age-wealth profiles displayed in Figure 3 emphasizes the importance of time-of-birth as a determinant of asset accumulation. Therefore, it is necessary to control for cohort effects in a regression for wealth level.

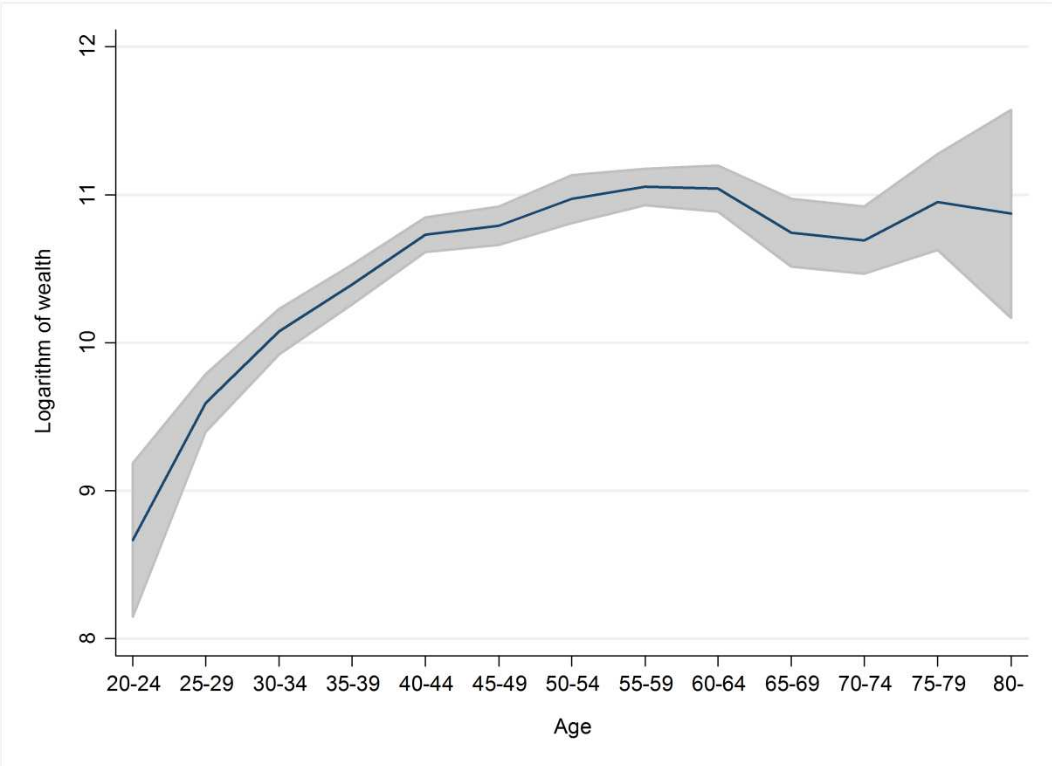
TABLE 2. Estimation results for the level of net worth

	(1)	(2)	(3)
Constant	8.668	5.903	8.469
	(0.265)	(1.14)	(0.263)
Age:			
25-29	0.905	0.971	0.644
	(0.294)	(0.297)	(0.29)
30-34	1.371	1.441	1.031
	(0.287)	(0.315)	(0.284)
35-39	1.605	1.649	1.308
	(0.289)	(0.343)	(0.284)
40-44	1.898	1.879	1.614
	(0.289)	(0.383)	(0.286)
45-49	1.88	1.856	1.64
	(0.295)	(0.428)	(0.291)
50-54	2.059	1.979	1.819
	(0.3)	(0.474)	(0.297)
55-59	2.189	2.068	2.005
	(0.298)	(0.532)	(0.296)
60-64	2.379	2.216	2.242
	(0.305)	(0.587)	(0.302)
65-69	2.128	1.996	2.046
	(0.325)	(0.646)	(0.322)
70-74	2.304	2.075	2.282
	(0.323)	(0.686)	(0.32)
75-79	2.642	2.279	2.616
	(0.349)	(0.746)	(0.345)
80-	2.687	2.215	2.777
	(0.483)	(0.851)	(0.47)
GDP		0.022	
		(0.006)	
GDP^2 / 1,000		-0.046	
		(0.012)	
GDP^3 / 10,000		0.0003	
		(0.00009)	
Female			-0.443
			(0.052)
Self-employed			0.84
			(0.044)
Secondary education			0.281
			(0.063)
Tertiary education			1.109
			(0.055)
F-test of overall significance	19.219	23.846	51.091
Model degrees of freedom	21	18	25
Residual degrees of freedom	13,675	13,675	13,675

Note: The model is estimated using sample weights. Standard errors are reported in parentheses. The regressions in columns 1 and 3 include eight cohort dummies and restricted time dummies. The regression in column 2 includes unrestricted time dummies. Reference group is the cohort born in 1963-1967 and aged 20-24 in 1987.



(A) Cohort-adjusted profile and 95% confidence interval



(B) Cross-sectional profile and 95% confidence interval

FIGURE 3. Estimated age-wealth profiles

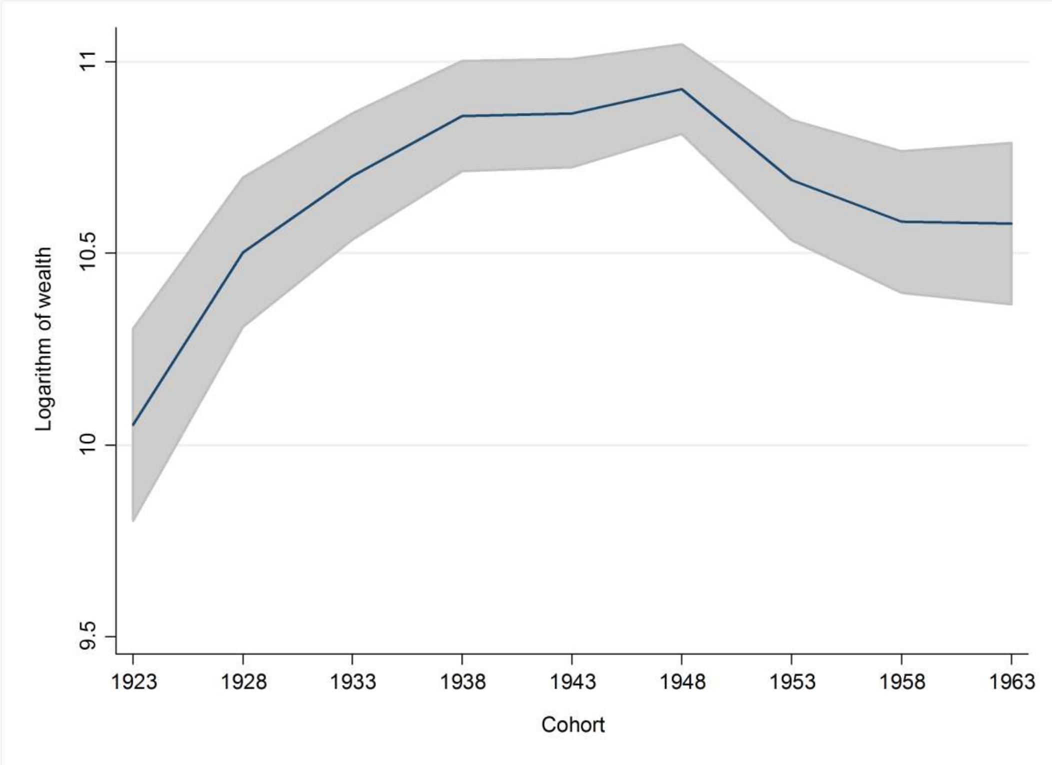


FIGURE 4. Estimated cohort-profile of wealth

Figure 4 displays the estimated level of wealth by cohort. For brevity, only the first year of birth is displayed for each cohort on x-axis. Wealth grows from the oldest generation to the generation born between 1948 and 1952 but declines thereafter. Thus the impression of young generations being poorer than their predecessors conveyed by Figure 2 is confirmed by the regression analysis. In terms of the productivity, this result translates to younger generations being less productive than the older ones. However, according to the life-cycle model, the cohort effect should increase monotonously.

In order to get an insight into the contradicting evidence, cohort dummies are replaced by a very basic cohort-specific indicator of productivity growth in the baseline regression for wealth level. The time series of gross domestic product per capita used to construct the indicator is provided by Statistics Finland (2018). For each cohort, the indicator equals the arithmetic average of GDP per capita over the years the household reference person entered the labour market. Labour market entry is assumed to take place at the age of 25. A similar comparison between cohort dummies and a proxy for the productivity of a generation is presented in Jappelli (1999) and Kapteyn, Alessi and Lusardi (2005).

In addition to age dummies and unrestricted time dummies, the preferred specification of the alternative wealth regression includes a cubic of the productivity growth index. The estimates are reported in column 2 of Table 2. The estimated coefficients of the GDP indicator imply a concave relationship between wealth level and cohort-specific index of productivity growth. This result suggests that lower wealth levels of younger generations are caused by a decline in the growth rate of productivity.

A test if the productivity growth indicator explains intergenerational differences in wealth level is performed following the procedure described in Kapteyn, Alessi and Lusardi (2005). Four arbitrary cohort dummies are included in the model along with the indicator of productivity growth. Typically, one dummy variable needs to be excluded from the model. An additional cohort dummy needs to be omitted due to the collinearity between age, year-of-birth and calendar time. In this case, the model also includes three other cohort-specific variables. Therefore, three more cohort dummies need to be left out. The adjusted Wald test statistic for the joint null hypothesis that the cohort dummies are zero is 0.95 which is not statistically significant at the 5 percent level. Hence, the differences in the estimated wealth level across cohorts depicted in Figure 4 seem to be fully explained by variations in productivity growth. This conclusion is in line with the implications of the simple life-cycle model. Figure 5 displays the average growth rate of the gross domestic product per capita by cohort. It supports the hypothesis that the decline in cohort effect reflects slowdown in productivity.

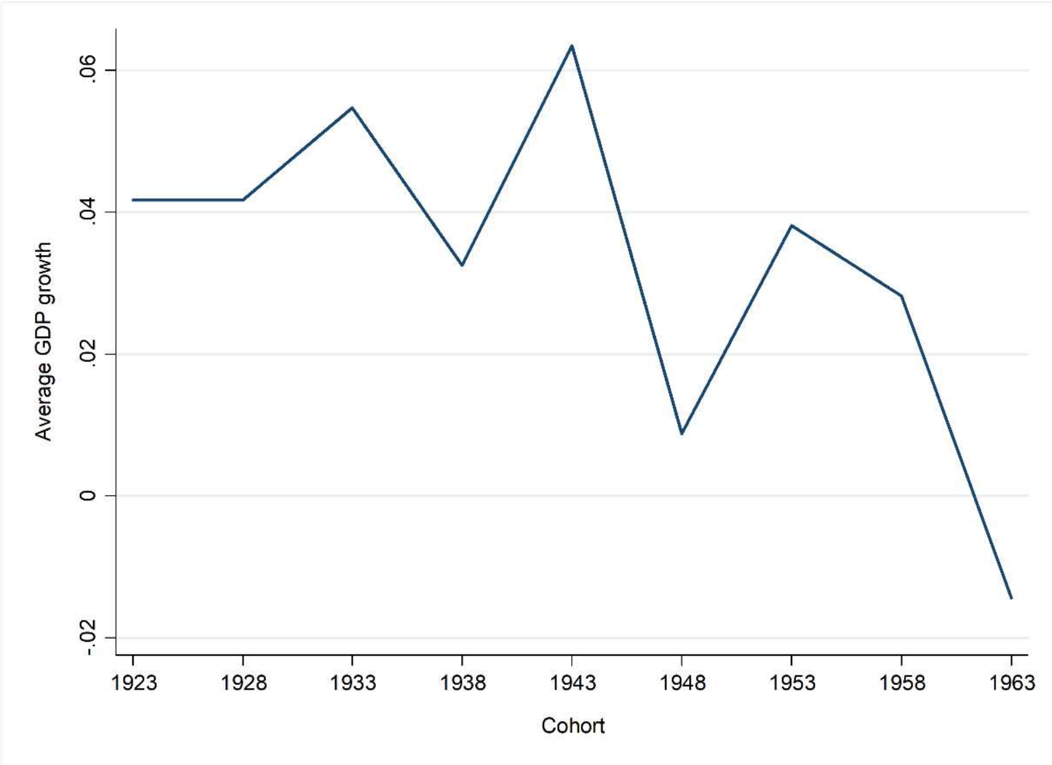
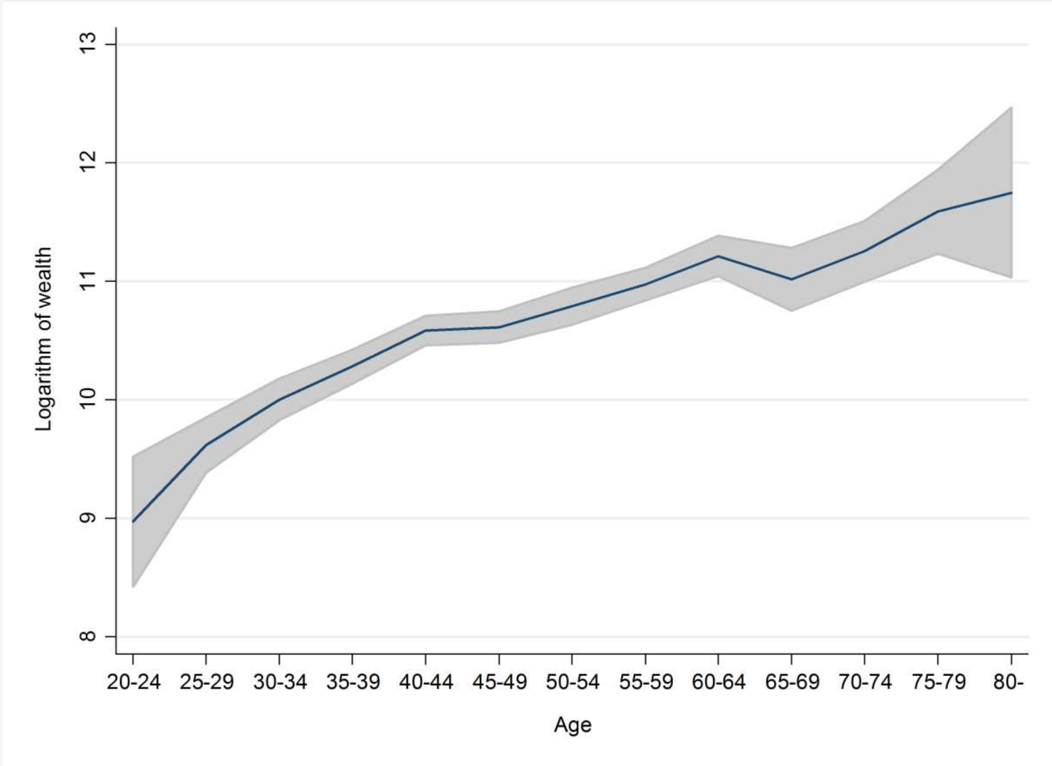


FIGURE 5. Average growth rate of gross domestic product by cohort

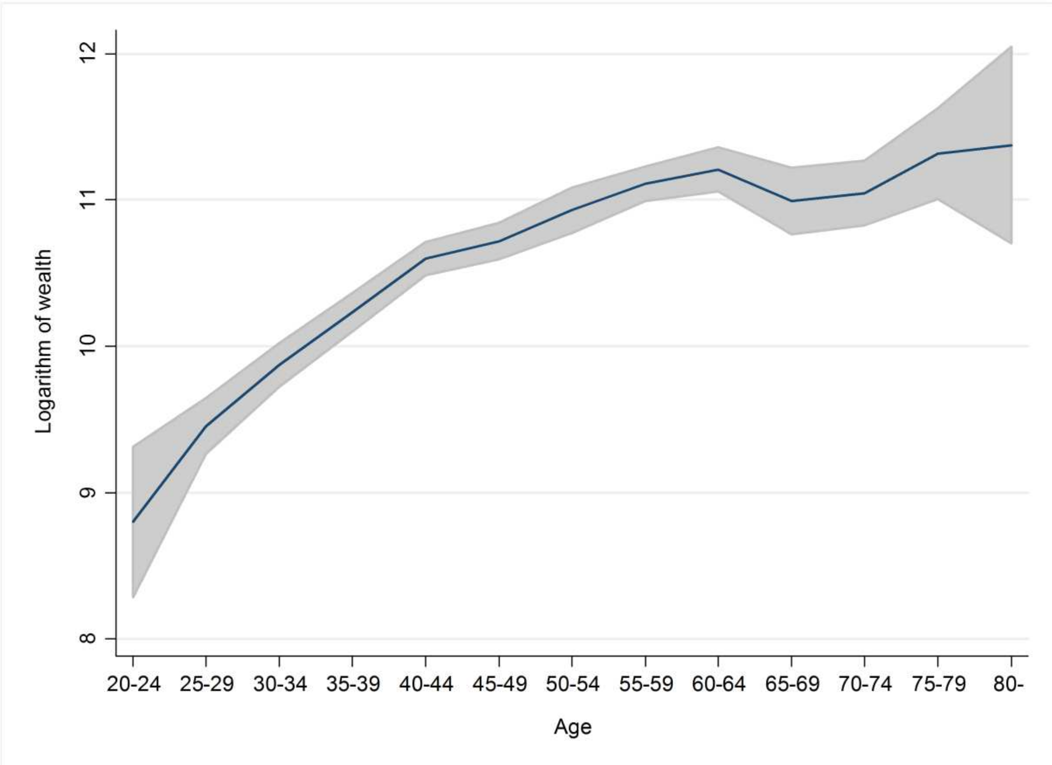
6.2. Augmented regressions for wealth level

The determinants of the age-wealth profile are further explored by adding demographic controls to the regression model. These controls include dummies for female reference person, self-employment and educational attainment. Column 3 in table 2 and panel A in Figure 6 present the results. The estimated age-wealth profile for cross-sectional model is displayed in panel B of Figure 6 for comparison. Results for the cohort effect are only reported in Appendix 2 since wealth level by cohort follows a pattern similar to the one presented in Figure 4 but on a higher level.

The dummies for female reference person and self-employment have an impact only on the level of the age-wealth profile. The coefficient of the self-employed dummy is positive and quantitatively large. Self-employment tends to be associated with greater income risk compared to paid employment (see



(A) Cohort-adjusted profile with demographic controls and 95% confidence interval



(B) Cross-sectional profile with demographic controls and 95% confidence interval

FIGURE 6. Estimated age-wealth profiles with demographic controls

Carrington, McCue and Pierce 1996, Parker 2003 and Parker, Belghitar and Barmby 2005). Carroll and Samwick (1997) showed that wealth holdings and income uncertainty are positively correlated. Cagetti (2003) further proved that income volatility gives rise to precautionary motive to save: assets are accumulated in order to protect consumption against fluctuations in income. Hence, the estimated effect of self-employment is consistent with these findings.

Dummies for education make the estimated age-wealth profile flatter compared to the one presented in panel A of Figure 3. The coefficients are positive and increase with the level of schooling reflecting the positive correlation between education and income. Most importantly, adding demographic controls highlights the absence of decumulation in retirement years. According to the cohort adjusted regression, wealth keeps increasing until the end of lifespan.

Poterba, Venti and Wise (2011, 2018) and De Nardi, French and Jones (2016) point out that non-financial wealth comprises an important component of the total net worth until late in life since elderly are reluctant to liquidate their housing equity. Households are likely to run their financial wealth down faster than their housing equity. Consequently, the trajectories of total net wealth and financial net wealth over the life cycle may differ. Results of the unreported regressions for net financial wealth, however, do not qualitatively differ from the ones for total net wealth. Households are inclined to accrue more assets in advanced ages.

In order to better understand the wealth accumulation behaviour of Finnish households, next it will be analysed if the trajectory of asset accumulation over the life course varies by education. Previously the age profiles of wealth were assumed to be similar in shape for all educational groups. As explained by Jappelli (1999), underlying possible variations in asset accumulation are differences in earnings profiles, ages of labour market entry and exit, mortality rates and replacement rates of social security. In a life-cycle framework that incorporates uncertainty, attitude towards risk provides another channel through which education has an impact on asset accumulation. Highly educated are more likely to invest in risky assets which generate capital income (see e.g. Wachter and Yogo 2010, Cooper and Zhu 2016 and Lusardi and Mitchell 2014).

First, a model which allows all of the right-hand side variables of the previous model, including demographic controls, to be education-specific is estimated. The null hypothesis that the coefficient for female reference person varies by education is rejected at the 5 percent level (the adjusted Wald test statistic is 0.28 with 2 and 13,674 degrees of freedom). Once this interaction term is omitted from the estimated model, the differences between the coefficients of all of the other right-hand side variables by education turn out to be statistically significant at the 5 percent level. Results for this model that includes interactions of education with age, cohort, time and self-employment dummy and the main effect for the female reference person are reported graphically. To save space, the coefficient estimates are not displayed.

The interaction of age and education is statistically significant at the 5 percent level: the adjusted Wald test statistic is 1.57 with 24 and 13,652 degrees of freedom. Figure 7 displays the estimated age profiles of wealth by education. Confidence intervals are omitted for clarity. The age-wealth profiles for households with primary and secondary education resemble the profile in panel A of Figure 6. Assets are accumulated relatively monotonously throughout the whole lifespan. In contrast, the profile for highly educated households is concave in accordance with the life-cycle model. Within the life-cycle model framework, heterogeneity in accumulation behaviour by education constitutes a puzzle. Even if the age-wealth profiles were not uniformly shaped, saving should be negative in old age regardless of educational attainment.

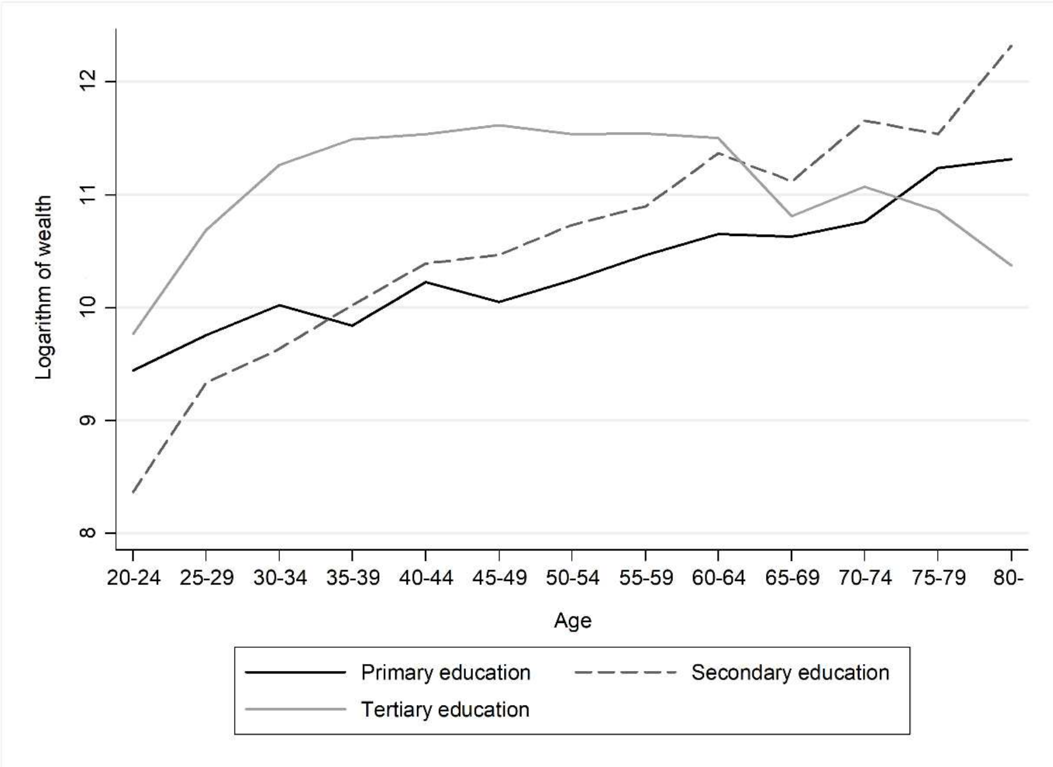


FIGURE 7. Age-wealth profiles by education

There is a large literature addressing the low rate of dissaving near the end of life. Recent results showing lack of decumulation among the elderly in the USA are presented in Poterba, Venti and Wise (2018) and in De Nardi, French and Jones (2016). Niimi and Horioka (2019) analyse the slow dissaving of retired Japanese. Börsch-Supan (2001) and Börsch-Supan et al. (2001), in turn, explore the saving puzzle using German data.

Jappelli and Modigiani (2005) attribute nonnegative saving in old age to measurement error. According to them, the appropriate measure of total net worth includes pension wealth in addition to discretionary wealth. Increase in discretionary wealth after retirement is an indication of households saving out of pension benefits. Pensions received are essentially equal to withdrawals from mandatory savings. Such resaving behaviour is suggestive of a desire to leave a bequest. However, it is not possible to confirm the presence of bequest motives within the reduced-form framework applied in this study (see Jappelli 1999). The identification is also limited by data issues reviewed by Jappelli and Modigliani (2005) and Modigliani and Brumberg (2005). Receipts of gifts and bequests are documented in some of the cross-sections used in this study. However, this data is just as uninformative of the donor's plans as the level of the wealth at various ages. Furthermore, in a life-cycle model that allows for uncertainty the impact of bequest motive on asset stock is confounded by precautionary savings motive. Because of uncertain lifespan and health hazards, it is never optimal for a risk-averse household to deplete all assets. As a result, it may leave behind an unintentional bequest.

As De Nardi, French and Jones (2016) explain, information on preference parameters is required to determine the relative importance of bequest and precautionary saving motives. The cross-sections of the Finnish household wealth survey used in this study do not contain information that allows one to elicit saving preferences. However, a recent survey conducted by Danske Bank (2019) is suggestive of the significance of the precautionary motive among Finnish households: 48 percent of all the respondents aged 18 or over said they would save for unexpected expenses if they had 100 euros of extra income per month. The second most popular use for extra income was investing with 17 percent of respondents choosing this alternative. The reasons for investing were not surveyed though. Only 7 percent of the sample would explicitly want to save for retirement. Although the survey did not directly address plans to leave a bequest, it seems that the precautionary motive has a stronger effect on the savings behaviour of Finnish households than the bequest motive. Niimi and Horioka (2019) conclude using Japanese data that the slow decumulation of assets in old age is more likely explained by the precautionary savings motive than the bequest motive.

On the other hand, the absence of decumulation may be attributable to the bias associated with the target population of the Finnish household wealth survey. Old people in institutions are excluded from the sample. According to Poterba, Venti and Wise (2011) elderly tend to exhaust their housing equity mainly when they face a health shock that requires them to move to a facility providing long-term care. Börsch-Supan et al. (2001) remind, that in this case, the regression results are representative of the wealth accumulation behaviour of those who are likely to dissave at a slow pace.

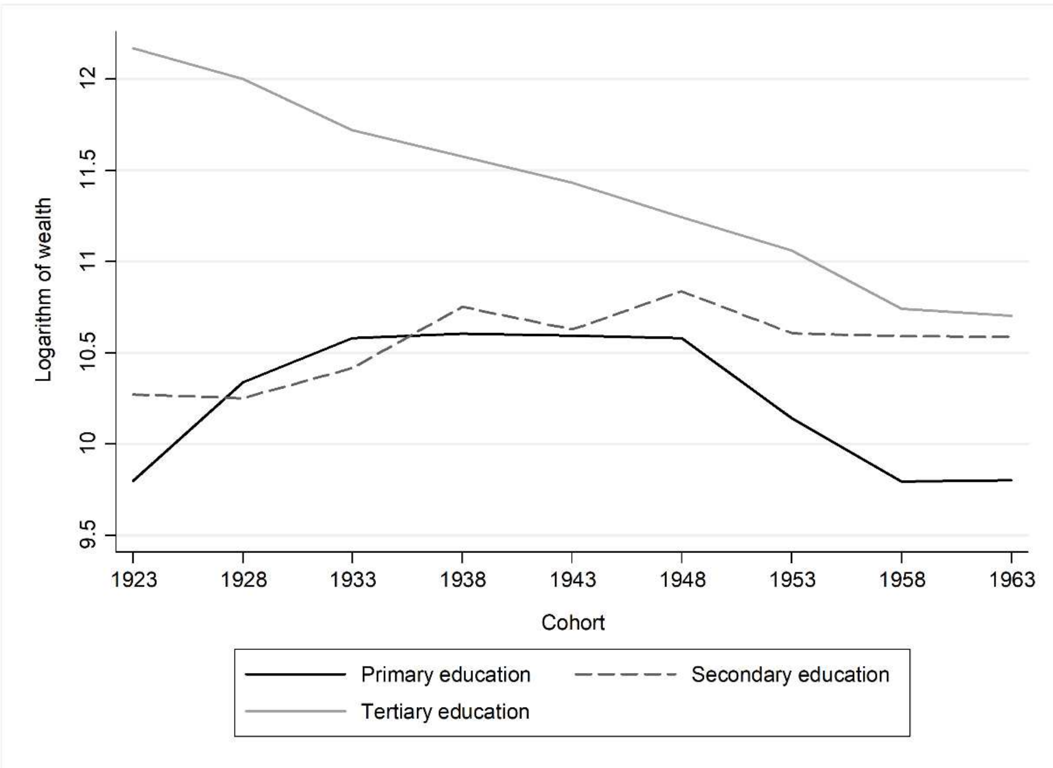


FIGURE 8. Estimated cohort effect of wealth by education

Differences in cohort effect by education are statistically significant at the 5 percent level. The adjusted Wald statistic is 2.05 with 16 and 13,660 degrees of freedom. The estimated cohort effects, without the confidence intervals, are depicted in Figure 8. The estimated effect for households with primary education resembles the one for the whole population in Figure 4. First, log of wealth increases with the year of birth and then stagnates. The three youngest generations with primary education are successively less wealthy than the previous generations. Households with secondary education, on the other hand, are closest to exhibiting the kind of generational differences in wealth level that the life-cycle model implies. Almost every consecutive generation is wealthier than the previous one until the generations born in 1953 or after. The three youngest generations of households with secondary education are equally wealthy. The estimated cohort effect for the households with tertiary education, in turn, exhibits an interesting pattern. Contrary to the prediction of the model, the wealth level of highly educated households decreases almost linearly with the year of birth. According to the earlier regression results, differences in productivity across generations explain the concave pattern of cohort effect at the level of the whole population. The analysis by educational attainment, however, implies that productivity differences alone do not cause the intergenerational variation in wealth among households with secondary and tertiary education. Changes in other macroeconomic circumstances or differences in preferences may have an effect on the wealth level in these two educational groups.

6.3. Empirical results for wealth-to-income ratio

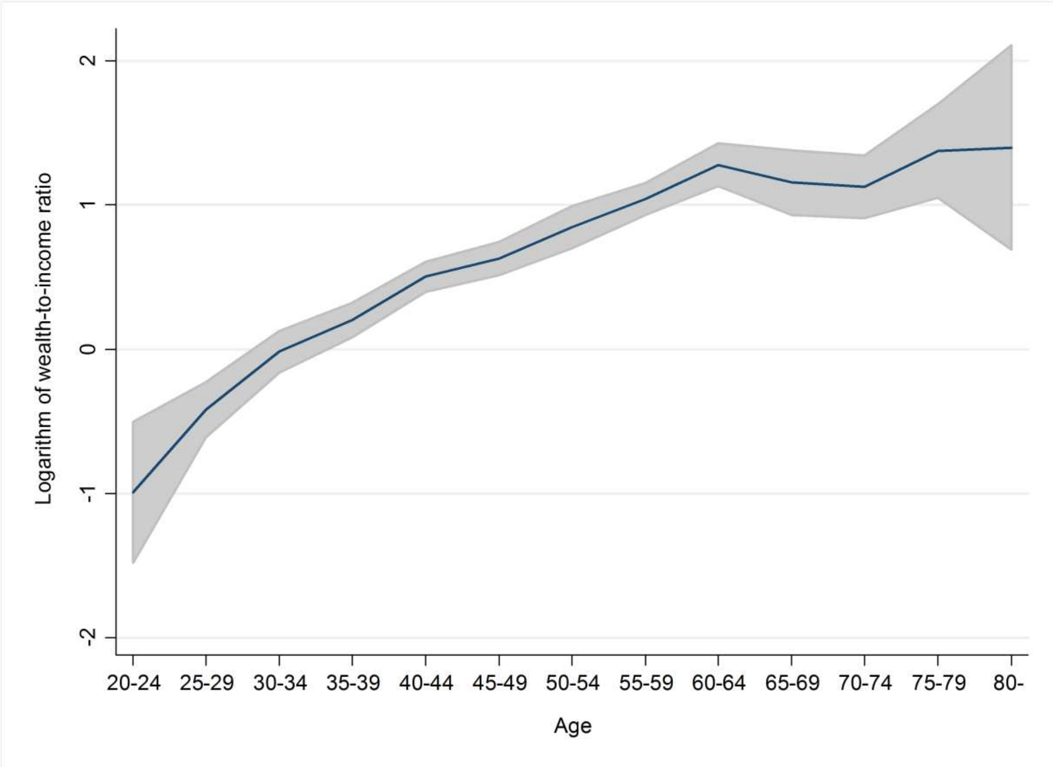
In the econometric analysis of wealth-to-income ratio, it is assumed for simplicity that the interest rate is zero. The results for the regressions of logarithm of wealth-to-income ratio on age and unrestricted time effects are reported in Table 3. Column 1 displays the coefficient estimates for the baseline model without demographic controls and column 2 for the model augmented with demographic controls. Estimated time effects are reported in Appendix 3. The estimated age-profiles are depicted in Figure 9. Regardless of the model specification, the logarithm of wealth-to-income ratio increases with age across the whole lifespan (cf. Figure 6, panel A). This result verifies the implications of the regressions for the wealth level: assets accumulated during the working life are not exhausted in retirement.

The equality of cohort effects in wealth and income are tested by regressing logarithm of wealth-to-income ratio on age, cohort and restricted time effects. Most of the cohort dummies are statistically significant in both models without and with demographic controls which points to the time of birth having an impact on wealth accumulation. A joint test on cohort dummies provides a more formal procedure to determine if the hypothesis of no cohort effects can be rejected. The adjusted Wald statistic given 8 and 13,668 degrees of freedom is 5.74 for the baseline model and 5.77 for the model that includes demographic controls too. Both of these test statistics are statistically significant at the 1 percent level. Thus the identification restriction derived from the life-cycle model is rejected. Time of birth has an impact on the evolution of wealth-to-income ratio. Therefore, cohort effect is an important determinant of asset accumulation in Finland. Two conclusions can be drawn on the basis of this result. First, the wealth accumulation behaviour of Finnish households does not accord with the predictions of the life-cycle hypothesis. As pointed out by Jappelli (1999), this conclusion is quite obvious since the testing strategy is based on a stylized version of the life-cycle hypothesis. Second, the identification restriction proposed by Deaton and Paxson (1994) is an appropriate method to identify separate effects of age, birth-year and time in the analysis presented in this paper.

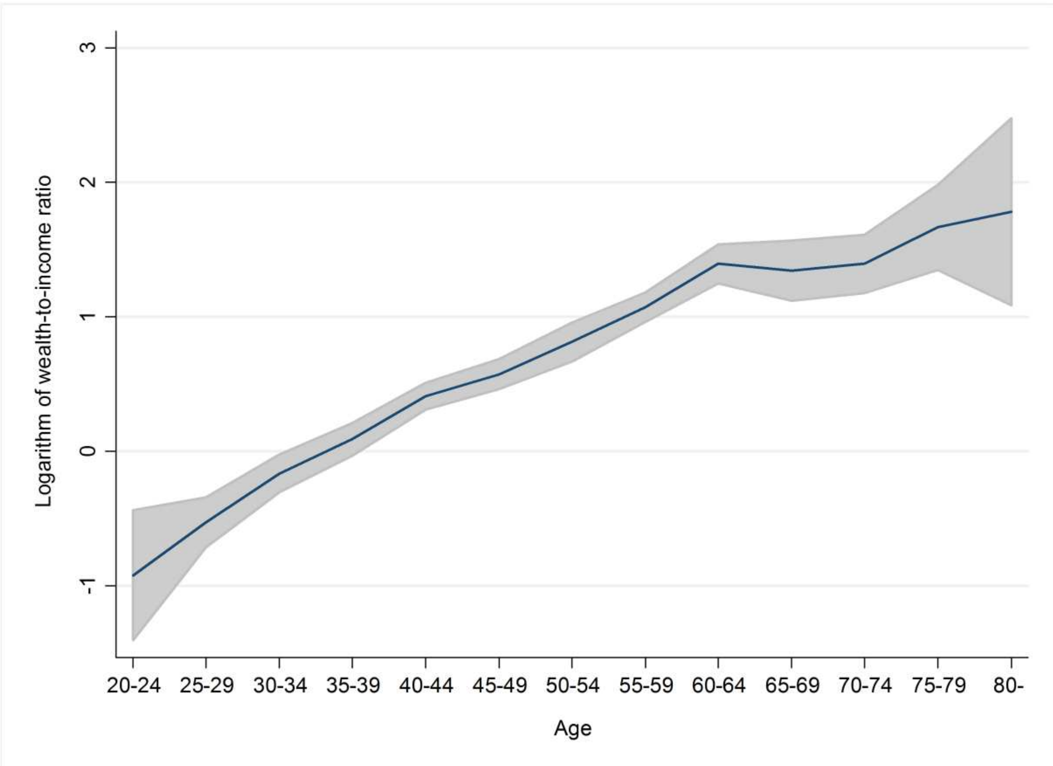
TABLE 3. Estimation results for wealth-to-income ratio

	(1)	(2)
Constant	-0.858	-1.077
	(0.246)	(0.245)
Age:		
25-29	0.573	0.394
	(0.264)	(0.261)
30-34	0.976	0.758
	(0.257)	(0.255)
35-39	1.194	1.012
	(0.254)	(0.252)
40-44	1.495	1.331
	(0.253)	(0.251)
45-49	1.62	1.496
	(0.255)	(0.252)
50-54	1.839	1.736
	(0.258)	(0.257)
55-59	2.034	1.993
	(0.255)	(0.254)
60-64	2.27	2.316
	(0.262)	(0.26)
65-69	2.147	2.266
	(0.275)	(0.273)
70-74	2.118	2.317
	(0.274)	(0.272)
75-79	2.367	2.589
	(0.3)	(0.298)
80-	2.39	2.703
	(0.44)	(0.434)
Female		-0.185
		(0.049)
Self-employed		0.86
		(0.043)
Secondary education		0.227
		(0.059)
Tertiary education		0.724
		(0.051)
F-test of overall significance	34.079	59.874
Model degrees of freedom	15	19
Residual degrees of freedom	13,675	13,675

Note: The model is estimated using sample weights. Standard errors are reported in parentheses. The regressions include three unrestricted time dummies. Reference group is households aged 20-24 in 1987.



(A) Age-profile without demographics



(B) Age-profile with demographic controls

FIGURE 9. Estimated age-profile of wealth-to-income ratio

7. CONCLUSIONS

In this paper, the wealth accumulation behaviour of Finnish households was explored using a time-series of four independent cross-sections. Previous evidence on the relationship between age and savings in Finland is based on cross-sectional analysis which may lead to misinterpretations since it is not possible to account for the impact of the time-of-birth. The econometric analysis confirmed that the time-of-birth is an important determinant of wealth accumulation in Finland.

The cohort-adjusted age-profiles of wealth imply that the saving behavior of Finnish households contradicts the predictions of the life-cycle model. There is no draw down of assets in old age. Instead, Finnish households keep accumulating assets even after retirement. A closer inspection of different educational groups revealed that the evolution of asset stock varies over the life course. The age-wealth profiles of households with primary and secondary education increase monotonously through the whole lifespan. The asset stock of households with tertiary education, on the other hand, follows a hump-shaped pattern predicted by the life-cycle model. The absence of dissaving in old age and heterogeneity in the accumulation behaviour by education pose a challenge to the life-cycle hypothesis. Wealth holdings should follow a concave pattern over the lifespan regardless of the education.

Decumulation of wealth in old age is an implication unique to the life-cycle model. Alternative models of saving might provide a better description of the savings behaviour of Finnish households. Increases in asset stock after retirement have been attributed to a desire to leave a bequest. However, given life's uncertainties the bequest motive is indistinguishable from the precautionary motive to save. In order to determine the relative importance of the different saving motives, information on preference parameters is needed.

An alternative explanation for the monotonously increasing age-profile of wealth is provided by bias associated with the target population of the survey. Since elderly in institutions providing long-term care are excluded from the dataset, average wealth may increase in old age because only the wealthy households who are reluctant to decumulate assets are represented.

At the level of the whole population, young generations seem to be poorer than older ones. According to the life-cycle model, wealth level should increase monotonously with year-of-birth due to the productivity growth. Despite the absence of the linear relationship between the wealth level and the time-of-birth, regression results using a cohort-specific indicator of gross domestic product indicated that the cohort effects reflect slowdown in productivity. This correlation between the wealth level of different cohorts and the productivity implies that the asset accumulation in Finland follows the predictions of the life-cycle model to some degree when all demographic groups are analysed together.

Inspection of the cohort effect by educational attainment, however, reveals variation in the cohort-profiles of wealth across generations. Among the households with primary education, the relationship between the wealth level and time-of-birth follows a similar pattern as in the whole population. Among households with secondary education, wealth primarily increases with the time-of-birth. In the group with tertiary education assets, in turn, decline monotonously across cohorts. These differential patterns suggest that intergenerational differences in wealth among the two highest educated groups are not explained by variation in productivity alone. Other macroeconomic factors, differences in preferences and motives to save, institutional arrangements, life-expectancy and demographic changes are thus likely to play a role in the asset accumulation behaviour of Finnish households.

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APPENDIX 1. Survey methodology

The participating households in 1987 household wealth survey were selected by sampling with probabilities proportional to size. Two-staged stratified sampling, on the other hand, was used to select households in 1994, 1998 and 2004 data sets. The Finnish Tax Administration records were used to group the target population into the following primary strata: salaried employees, farmers, other self-employed persons, pensioners and others. An additional stratum was formed of those households whose income information could not be obtained from the tax records. In order to improve the efficiency of the population estimates of aggregate assets, high-income households, farmers and other self-employed households are over-represented in survey samples. The data files contain sample weights that can be used to reduce the effect of over-sampling on the efficiency of the estimation. The weights also correct for the effect of the bias caused by survey non-response. Thus the results of the analysis are representative of the total population.

Property in the form of land and forest as well as durable consumption goods have been excluded from the definition of household wealth. In contrast, the definition includes vehicles, such as cars, motorcycles, trailers and boats excluding rowing boats. A significant part of household resources may be comprised of items like antiques, works of art, jewelry and precious metals. However, these items have been omitted from the survey due to valuation problems. In 1994 private pensions, apartments owned for investment purposes, and so-called secondary free-time residences were added to the concept of household wealth.

TABLE A1. Composition of household wealth and liabilities

Non-financial wealth	
Permanent dwelling	
Free-time residence, proper	
Vehicles	
Financial wealth	
Deposits	
	Current accounts
	Term deposits and investment accounts
	Accounts, unspecified
Securities	
	Listed shares and mutual funds
	Other shares
	Share certificates
	Bonds and debentures
Other financial assets	
	Savings and deposit insurances
	Voluntary pension insurance savings
	Loan receivables
	Cash funds
Private liabilities	
Housing loans	
Other loans	
	Consumer loans
	Student loans

APPENDIX 2. Regressions for wealth level, cohort and time effects

TABLE A2. Estimated cohort and time effects by model specification

	Model		
	(1)	(2)	(3)
Cohort:			
1923-1927	-0.525		-0.252
	(0.184)		(0.18)
1928-1932	-0.074		0.142
	(0.163)		(0.159)
1933-1937	0.123		0.292
	(0.149)		(0.146)
1938-1942	0.281		0.372
	(0.137)		(0.131)
1943-1947	0.288		0.33
	(0.129)		(0.124)
1948-1952	0.351		0.369
	(0.119)		(0.112)
1953-1957	0.114		0.141
	(0.115)		(0.109)
1958-1962	0.005		-0.003
	(0.118)		(0.112)
Year:			
1994	0.042	-0.21	0.04
	(0.022)	(0.104)	(0.021)
1998	-0.083	-0.167	-0.081
	(0.044)	(0.153)	(0.043)
2004	0.042	0.145	0.04
	(0.022)	(0.223)	(0.021)

Note: The model is estimated using sample weights. Standard errors are reported in parentheses. The reference group is the cohort born in 1963-1967 and aged 20-24 in 1987

APPENDIX 3. Regressions for wealth-to-income ratio, time effects

TABLE A2. Estimated time effects by model specification

	Model	
	(1)	(2)
Year:		
1994	-0.215	-0.202
	(0.052)	(0.051)
1998	-0.244	-0.26
	(0.066)	(0.065)
2004	-0.064	-0.121
	(0.065)	(0.064)

Note: The model is estimated using sample weights. Standard errors are reported in parentheses. The reference group is households aged 20-24 in 1987.

The **Aboa Centre for Economics (ACE)** is a joint initiative of the economics departments of the Turku School of Economics at the University of Turku and the School of Business and Economics at Åbo Akademi University. ACE was founded in 1998. The aim of the Centre is to coordinate research and education related to economics.

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