Distributional Effects of a Wealth Tax under Lifetime-Dynastic Income Concepts

Elin Halvorsen and Thor O. Thoresen

The final authenticated version is available at:

Halvorsen, E. and Thoresen, T.O. (2020), Distributional Effects of a Wealth Tax under Lifetime-Dynastic Income Concepts. Scandinavian Journal of Economics Accepted Author Manuscript. https://doi.org/10.1111/sjoe.12392

Distributional Effects of a Wealth Tax under Lifetime-Dynastic Income Concepts*

Elin Halvorsen† and Thor O. Thoresen‡

Abstract

Annual wealth tax is back on the policy agenda, but the discussion on its effect is not well informed. When standard methodology is used and wealth tax burdens are measured against annual individual income, a large share of the tax burden is found to fall on people with low incomes. The present study uses rich Norwegian administrative data to discuss the distributional effects of wealth tax under several different income concepts, ultimately measuring income over the lifetime of family dynasties. When measured against lifetime income and lifetime income in dynasties, wealth tax is mostly borne by high-income taxpayers and is seen as clearly redistributive.

Keywords: Wealth tax, Redistribution, Life-cycle income, Dynastic income
JEL codes: D31; H24

*Financial support from the Norwegian Research Council (grant no 217423) is gratefully acknowledged. We thank Carol Romay for assisting the data work. We are grateful for helpful comments from Shafik Hebous and participants at Skatteforum 2016 (Halden, Norway), the Oslo Fiscal Studies internal seminar (2016), and the 2016 IIPF conference (Lake Tahoe, Nevada).

†Research Department, Statistics Norway, e-mail address: elin.halvorsen@ssb.no
‡Research Department, Statistics Norway, and Oslo Fiscal Studies (Department of Economics, University of Oslo), e-mail address: thor.olav.thoresen@ssb.no

1 Introduction

There is an ongoing debate across the world about how big the tax contribution of the wealthy should be and whether it should be increased. Over the past few decades, until the financial crisis, recurrent taxes on net wealth were in decline in many countries. Austria, Denmark, Finland, Germany, Luxembourg, and Sweden had all repealed such taxes (Förster et al., 2014). Some of the few countries that still keep a tax on net wealth are Norway, Spain and Switzerland (at the cantonal level). More recently, though, several OECD countries have either introduced or seriously debated introducing such taxes, as higher wealth taxes are discussed as tools to finance public debt. For example, both Iceland and Spain recently reintroduced wealth taxes as a temporary measure for fiscal consolidation purposes. Although wealth tax was abolished in Spain in 2009, it was reintroduced in 2012, and is still part of the tax schedule in 2018.[1]

The reintroduction of wealth taxation has been supported by important contributors in the field; see for example Piketty et al. (2013), Piketty (2014) and Atkinson (2015), who emphasize the role of wealth tax as a distributive backstop mechanism. However, it is acknowledged that there is little evidence as to how this type of taxation works (Kopczuk, 2013; Brülhart et al., 2017).[2]

The ambition of the present paper is to contribute to a more informed discussion on the distributional effects of this type of taxation. Our point of departure is that the redistributive properties of wealth tax are often measured against annual individual income, and the main message is that this practice provides inadequate information. The contribution of the paper is to provide descriptions of how annual wealth tax is distributed for a wide range of income concepts: annual household income, household income over time (as observed in data), imputed lifetime income

[1]Similarly, Iceland reintroduced a wealth tax schedule in 2010, which lasted for four years.

[2]Wealth taxation is often associated with negative effects on capital accumulation and with problematic compliance issues, as emphasized by Boadway et al. (2010) in their report for the Mirrlees Review. The standard results that capital should not be taxed at all (Atkinson and Stiglitz, 1976; Chamley, 1986; Judd, 1985) have recently been challenged, for example by several contributions under "new dynamic public finance", see Kocherlakota (2005), Albanesi and Sleet (2006), and Golosov et al. (2013). The results of Guvenen et al. (2018) are particularly relevant, given the present context, as they argue that, from an economic efficiency point of view, wealth taxation should replace capital income taxation, since the tax burden shifts from productive entrepreneurs to unproductive ones if the capital income tax were replaced with a wealth tax. It should also be noted that there seems to be a greater awareness of negative externalities coming from wealth accumulation and control of resources on fewer hands, which the annual wealth tax may counteract, as emphasized by Kopczuk (2013). For example, saving behavior of the wealthy is consistent with an interpretation of wealth as a source of utility in its own right (Carroll, 2000). However, power and status may be seen as ad hoc motives, and taxation on such grounds may not be easily defended (Boadway et al., 2010; Jacobs, 2013). See also discussions of wealth taxation in a Scandinavian perspective in Bastani and Waldenström (2018) and Jakobsen et al. (2018).

obtained by employing models of labor and capital income, and lifetime income in the family dynasty. We show how depictions of the distributive effects of wealth tax for different income concepts deviate from results obtained by using the conventional annual snapshot concept of income.

We find that the Norwegian wealth tax (which is akin to a tax on financial wealth only) has a distributional U-shape in annual income, as its burden falls disproportionately more on taxpayers with very low income and very high income, reflecting an unclear association between annual income and net worth. This is also seen in several other papers; see for example Banks et al. (2003), Jäntti et al. (2008) and Cowell et al. (2017). In such depictions wealth tax is therefore not seen as delivering the anticipated distributional effects, and similar findings may have contributed to the recent decline of this type of taxation in Europe.

Analysis of the distributional effects of wealth tax brings to the surface the deficiencies of using the annual income snapshot in studies of tax burden the distribution of tax burdens. For example, the capital owner may be positioned at the low end of the annual income distribution due to temporary business losses (a "bad year"). In such cases, taxation of wealth could be seen as an unacceptable burden for the asset owner since the assets do not generate sufficient income in a single year to enable the owner to pay an annual wealth tax on the capital (Boadway et al., 2010). Liquidity problems are also emphasized by Bastani and Waldenström (2018). However, this picture changes when we address household income over a longer period of time, and ultimately use lifetime income as the income concept: the burden of the wealth tax for low income levels diminishes and moves to the top end of the distribution.

Furthermore, ignoring inter-generational links may be misleading in the context of wealth tax distribution. Parents may transfer wealth to their children at an early stage of life, suggesting that wealth taxation falls on people with temporary low ability-to-pay, as noted by Atkinson and Harrison (1978). If we want to take a truly long-term view of wealth and income inequality, we need to employ the family dynasty as the unit of analysis (Becker and Tomes, 1979; Piketty, 2000; Cowell and Van Kerm, 2015; Kanbur and Stiglitz, 2016). We find that due to the relatively high degree of inter-generational mobility in Norway, overall inequality in dynastic-lifetime income, when measured across generations, is lower than lifetime income. However, the overall result is that extending lifetime income to family dynasty income does not change the depiction of the distributional effect of wealth tax much compared to what we see for lifetime income only.

Measures of income based on these methodological refinements are obtained by means of access to data for the whole Norwegian population aged over 19 years, from 1993 to 2011. These data are used to establish alternative income concepts. To measure income over time, we use information on observed income both directly and by employing the data to establish a measure of lifetime income by estimating models of the income generating process over the life-cycle, allowing lifetime labor income and lifetime capital income to be explained separately. Further, to discuss the effects of using the extended family (or the family dynasty) as the unit of analysis, we obtain measures that are approximations of "dynastic income", using two frameworks: one where inheritance is added to lifetime income and another where we aggregate income across generations.

The paper is organized as follows. In Section 2 we describe the distribution of the Norwegian annual wealth tax in the benchmark case – wealth tax burden measured against distribution of annual income. Section 3 presents the empirical framework for establishing different income concepts. In Section 4, the distributional effects of annual wealth tax are discussed with respect to the alternative income concepts, ultimately showing results for lifetime-dynastic income. Section 5 provides a conclusion for the paper.

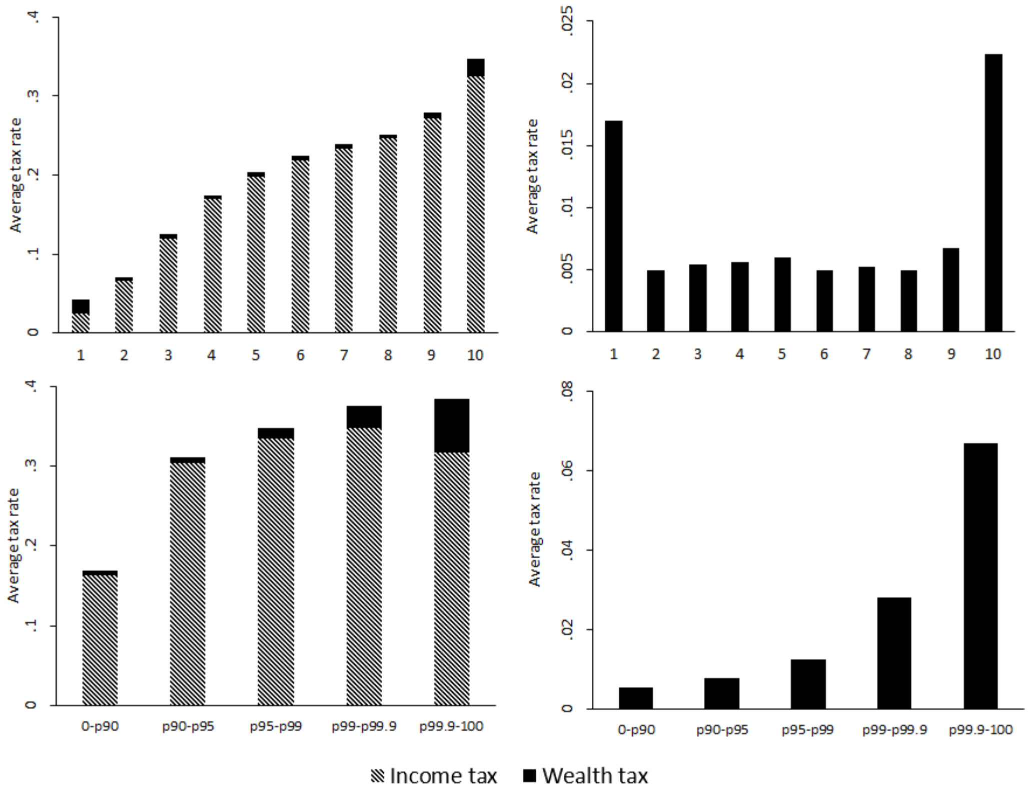
2 Limitations of annual income as a measure of well-being

Taxation of wealth is usually treated as supplementing capital income taxation; see Boadway et al. (2010) and Keen (2015). Boadway et al. argue that in a dual income tax system, wealth taxation may be used as an additional policy instrument to achieve redistributive objectives. Further, as clearly illustrated by recent discussions on reform of the Norwegian schedule (Ministry of Finance, 2015), when there is a link between the corporate tax rate and personal capital income taxation (as in the Norwegian system), one may find additional downward pressure on capital income taxation.[3] Moreover, if, as in the Norwegian case, there is no tax on wealth transfers (inheritance tax was abolished in 2014), an annual wealth tax may be used to achieve redistribution in the tax schedule, a so-called "redistributive backstop" mechanism. Atkinson (2015), in particular, argues along these lines.

However, it may appear to fail in delivering the expected favorable distributional effects. The distribution of Norwegian wealth tax according to the schedule of 2011 illustrates that the burden of wealth tax is not necessarily borne by high-income individuals alone, see Figure 1. We use administrative income tax return data in the present study, which means that Figure 1 is based on information for the whole

[3]Fueled by a "race to the bottom" in terms of the corporate income tax.

Figure 1. Average tax as a fraction of average gross income, by quantiles of gross income 2011



adult population.[4] We see from the top diagrams in Figure 1 that the largest shares of wealth tax are borne by individuals with high and low income, in decile 1 and decile 10, whereas the rest of the tax burden is relatively uniformly distributed on deciles 2 to 9. The figure illustrates that a substantial wealth tax burden falls on the lowest income decile, when burdens are measured relative to annual gross income.[5]

When considering the distribution within decile 10 in more detail, as in the two lower diagrams in Figure 1, a more favorable distributional depiction emerges. The top permille (consisting of 3,856 individuals) actually pays less income tax as a fraction of their gross income than the rest of the top percentile, and the wealth tax seems to act as a backstop mechanism that ensures that the overall personal tax schedule (income tax plus wealth tax) is progressive at the very top. We also note that wealth tax shares in general are small, which is due to exemption and valuation rules. Less than 4 percent of the total tax revenue from personal income and wealth taxation came from wealth tax in 2011.

[4] We shall return to more information about the data in Section 3.

[5] To measure wealth tax and income tax burdens against gross income follows standard procedures of Norwegian governmental reports.

Throughout the paper we use the actual wealth tax levied on Norwegian households in 2011 (the tax exemption level has been increased since 2011 and the statutory tax rate has been lowered). The 2011 wealth tax schedule of Norway implies that wealth above NOK 700,000 is taxed at a rate of 1.1 percent. In 2011, NOK 700,000 was roughly equal to €90,000 or $125,000. By international standards, this threshold is rather low, which is also reflected in the empirical illustrations. The general rule is that different assets are valued at market values, but there are important exemptions: for example, the value of owner occupied housing is set at 25 percent of market value, and secondary housing at 40 percent. For most households, the tax value of housing and total debt balances out – or at least the net value rarely reaches the threshold limit – so that Norwegian wealth tax is in effect comparable to a tax on financial assets only.[6]

There are four main reasons that the lowest annual income decile shows a high wealth tax burden: the joint wealth of couples, life-cycle effects, transitory low returns (or losses), and inheritance. First, while income is easily attributed to the individual, and indeed taxed at individual level in the Norwegian system, wealth is a variable best measured at household level. In fact, although individual filing is the basic rule of the Norwegian personal tax schedule, taxation of wealth is reminiscent of joint taxation, as the tax base for each spouse is the total wealth of the couple divided by two. As a consequence, some wealth taxpayers may have low own income (often the wife) whereas the couple's joint income is much higher. A natural first improvement in the assessment of the redistributive effects of wealth tax is to rank people according to their (equivalized) household incomes rather than their individual incomes.

Second, accumulated wealth has a different lifetime profile than gross income. While individual income exhibits a hump shape over age, peaking at around age 50, accumulated wealth continues to grow over most of the life cycle, declining only after retirement. It follows that an old-age pensioner may be in a wealth tax position and at the same time receive a relatively low pension income. This is another reason for the wealth tax burden falling on low incomes.

Third, another group at the low end of income distribution that pays wealth tax consists of individuals with temporarily low income due to some transitory component, such as luck. Others are able to avoid tax by tax planning. Some of the wealthiest people in Norway consistently report no or very low income over long

[6]We have experimented with different alternative formulations of the wealth tax scheme, and in particular looked at the effects of valuing all houses at 100 percent of market value. In this case the wealth tax becomes more evenly spread out on all deciles. However, the relative higher tax rate in decile 1 and decile 10 remains.

periods,[7] and accordingly do not pay income tax, but only wealth tax.

The presence of life-cycle effects and transitory low incomes (whether due to luck or tax planning) suggests that lifetime income is a better measure of the capacity to pay wealth tax. In fact, one may argue that annual income is a poor measure of ability-to-pay in general, and therefore gives a misleading picture of the distributional effects involved in taxation, as argued by Friedman (1962), Poterba (1989), Slemrod (1992), and Metcalf (1994).[8] Since the tax base, wealth, reflects the long run ability to accumulate savings and returns on wealth, it is reasonable that taxation be measured against the individual's long run income capacity.

However, wealth tax may still be regressive in lifetime capital income if some individuals have persistently higher returns on their wealth compared to others with the same amount of wealth, due to differences in so-called entrepreneurial spirit or ability. Several authors have shown that persistent heterogeneity in the returns on wealth is the key to explaining the long right-hand tail in the wealth distribution curve; see Quadrini (2000), Benhabib et al. (2011), and Benhabib and Bisin (2018). Fagereng et al. (2016b), using the same Norwegian register data as in this study, show not only that returns are heterogeneous, but also that they have a persistent component, both within and across generations.

Which brings us to the fourth and final reason; inheritance. Given that there is strong evidence of family inter-dependencies reaching beyond the nuclear family, a more complete picture of the distribution of resources in a society is obtained when the dynasty is used as the unit of analysis. Thus, we employ an income concept termed "dynastic income". Lifetime income may be closely associated with power or status, something that can be concentrated within families if certain endowments are inherited across generations. In other words, we take the argument that current income is a poor measure of well-being one step further, and argue that individual income may hide the pivotal role of the family dynasty as an engine for providing welfare. Several authors, such as Becker and Tomes (1979), Piketty (2000), Mare (2011), and Kanbur and Stiglitz (2016) suggest applying a multi-generational (dynastic) view of inequality.

[7]One may question how this is possible. In the Norwegian tax system, it means being paid in terms of capital income, but having deductions, for example from losses, to reduce taxable income down towards zero.

[8]Discussions of the correct definition of income dates back to the classical work of Schanz, Hicks and Simon, the so-called Schanz-Hicks-Simon income concept. The focus is then on the consumption possibilities obtained by income. Other authors argue that one should address distributive justice from completely different angles, see Sen (1997) and Kaplow and Shavell (2002) for different views.

3 From annual individual income to lifetime-dynastic income

3.1 Introduction to income concepts employed

This section introduces the different income concepts used to discuss the distributional impact of wealth tax. Note that for comparability purposes, we use measures of income that are defined in terms of annual income, irrespective of the time period during which the incomes are measured. Lifetime income is for example turned into an annual equivalent by normalizing and averaging over years.

A first extension to the individual perspective is to see how wealth taxes are distributed on household income. We calculate household income as equivalized income using information about spousal income, the number of children, and the so-called EU equivalence scale.[9] To simplify, we use the term "household income" in the following, although it refers to each adult in the data set being represented by their equivalent household income.

Next, many individuals with concurrent high levels of financial wealth and capital losses are most likely experiencing temporary losses and would be expected to reestablish a higher share of wealth tax to income in the longer run. There are several studies that discuss tax policy issues by utilizing information about income over a longer time period. For example, there are studies which use income data for an extended range of time directly, as in Slemrod (1992), Altshuler and Schwartz (1996), Poterba and Weisbenner (2001), Bengtsson et al. (2016), Bach et al. (2014), Heim et al. (2014), and Fullerton and Rao (2016), whereas others utilize the data to estimate economic models, which in turn are employed to simulate the effects of tax policy changes. In the first group of approaches one finds estimation of dynamic income process models, see the review in MaCurdy (2007), whereas the latter group includes the estimation and application of dynamic structural life-cycle models, as in Keane and Wolpin (1994).

In the following we shall use micro data to establish two types of income measures over a longer time perspective. First, we show the results of data time series, conditioned on observing individuals for at least 8 years. Second, we estimate and extrapolate (or impute) lifetime income profiles, by employing the micro data to estimate an income-generating process over the life cycle. Davies et al. (1984), Fullerton and Rogers (1991, 1993), Cameron and Creedy (1994) are examples of previous studies similar to this latter approach. It is well established that income mobility has an equalizing effect on the inequality among individuals, and lifetime income therefore exhibits less inequality than the annual snapshot; see Björklund

[9]Weight 1 to the first adult, weight 0.5 to other adults, and 0.3 to each child aged under 14.

(1993) and Creedy et al. (2013).

The method for imputing lifetime income is presented in detail in Appendix A. It can be described as taking the average and extrapolating it to each end of the lifespan, using a deterministic age-income profile conditioned on observed and fixed characteristics. More specifically, we estimate separate models for labor income and capital income, using fixed characteristics of the individual as explanatory variables: age, gender, and education. Number of children and marital status are time-varying variables and therefore not part of the model, but will obviously affect the shape of the age-income profile.[10] Thereafter we adjust levels by adding individual fixed effects, and finally we extrapolate the model over the entire adult lifespan. For the capital income model we allow for differentiated estimates for quintiles of the capital income distribution.

Finally, we extend the empirical framework to account for members of the family dynasty. Taking account of inter-generational linkages is an appropriate empirical strategy in studies of income inequality in general, as argued by Becker and Tomes (1979), Piketty (2000), Mare (2011), Cowell and Van Kerm (2015), and Kanbur and Stiglitz (2016). For example, Björklund et al. (2012) find that for Sweden, inter-generational income transmission is remarkably strong at the top of the distribution. See also Boserup et al. (2018) for similar evidence for Denmark. Using the family dynasty as the unit of analysis controls for inter-generational transfer over the lifetime: distributional effects of wealth taxation can be sensitive to the time when parents transfer resources to the next generation, as emphasized by Atkinson and Harrison (1978).

We approach the calculation of dynastic income, or income that takes account of more than one generation, in two ways. The first is to add all previously received gifts and inheritances, plus all potential inheritances, to lifetime income. Potential inheritances are obtained using personal identifiers that enable us to link grown children to their parents. We proceed as follows: First, we identify living parents of the persons in our data set. Second, we estimate the overall age-wealth profile of these parents. Finally, for mothers[11] who have reached an age higher than their cohort's life expectancy, we use measures of parental joint wealth. For mothers younger than their cohort's life expectancy, we employ the age-wealth profiles to scale down the current joint parental wealth to the expected level, depending on the life expectancy age. In this manner we obtain measures that are approximations of

[10]For results on individual lifetime income, see a previous version of this paper, Halvorsen and Thoresen (2017).

[11]In the case when mothers outlive fathers. If the mother is missing in data or dead, and there is a living father, we use the father instead.

expected inheritance; in particular, capturing that there are differences in parents wealth level at high ages.

The second way of obtaining a measure of dynastic income is to sum lifetime income across generations and calculate the cohort-adjusted average of lifetime income in the family dynasty. Since our data set spans almost two decades, we aggregate income over two or three generations. With this alternative, we use information about individuals in order to follow dynastic linkages, instead of using the household as a unit, as the latter holds more than one family lineage. We let males who are born in the period 1933–1957 be the middle generation and add the lifetime income of their fathers (the grandparent-generation), and the lifetime income of their grown children. It is conventional in inter-generational mobility literature to focus on fathers and sons because of women's lower labor force participation. However, in this study we allow the youngest generation (the grown children) to be of both genders.

In the next section we describe in more detail the various income concepts used in this study: annual household income, household income observed over time (up to 19 years), model generated lifetime income, and two versions of lifetime-dynastic income. First we present the data used, and next we provide descriptive statistics on the various income concepts employed.

3.2 Data description

Data on income over the life cycle are rare. Here we use register data on income and wealth for the whole Norwegian population for 19 consecutive years, from 1993 to 2011, see Statistics Norway (2016).[12] Data are collected from annual tax records and other administrative registers, such as the one administered by the Norwegian Labor and Welfare Administration. Gross income is the sum of labor income, capital income and governmental transfers. Labor income consists of wages and salaries plus income from self-employment. Capital income consists of dividends, positive interest, plus realized capital gains and losses. Transfers include unemployment benefits, sickness benefits, paid parental leave, disability benefits and other social security payments. Taxable wealth consists of deposits, money market funds, stock

[12] Aaberge and Mogstad (2015) use Norwegian data for the whole individual lifespan; however, restricted to observations on labor income only, not on capital income and wealth.

market funds, bonds, stocks, other financial assets[13], and taxable real wealth.[14] It adds to the quality of these data that in Norway almost all incomes and financial assets are third-party reported. Employers, banks, brokers, insurance companies and other financial intermediaries are obliged to send, both to the individual and to the tax authority, information on earnings, the value of assets, and other types of information essential for the calculation of taxes. Consequently, the data set contains precise information about various income sources, wealth and taxes paid (including the tax paid on wealth). The data set also contains information on education, level and type, from the National Education Registry. Importantly, given our ambition to establish dynasties, detailed information on household family identifiers are included, enabling us to link a person to his or her grown children and parents.

We place restrictions on the data used in the analysis. First, as we utilize income information for each individual over several years, for example to obtain measures of income over time, we restrict the data to persons who are observed for at least 8 years[15], balancing the need to keep as many persons as possible in the data set, yet at the same time to have a sufficiently long period for income observations. Second, the model used to generate lifetime income is too computationally demanding to be used on the whole population. Thus, we select a 20 percent random sample of individuals. This sample forms the basis for establishing household income, adding the income of the spouse to the income of the selected individual. Finally, we also restrict the sample to individuals up to and including the age of 80. Again, this is motivated by the lifetime income imputation, which entails assigning a fixed lifespan to all individuals.[16]

[13]Pension rights through the National Insurance System or occupational pension schemes are not subject to wealth taxation and therefore not reported in the tax registry. It is possible to set aside savings in tax-exempt individual pension savings (IPS). However, the benefits from IPS are so small that the scheme is rarely used. Only 1 percent of Norwegian households save in IPS (4 percent of households close to retirement), and the amounts invested are small. The same applies to the cash value of life insurance, another asset category that is insignificant in the Norwegian context. Statistics Norway is currently collecting data on pension wealth for all pension types and for the entire population. Unfortunately, these data are not yet available, but are likely to be published by the end of 2019.

[14]While housing wealth is represented by market values through hedonic value imputations, values of holiday homes and other real assets are less accurately measured. Furthermore, the valuation of shares in unlisted companies is a challenge that carries over to the valuations of different portfolios in the present analysis. It would require more detailed knowledge on the companies' balances and market position to obtain more correct values, information that we do not possess.

[15]In Appendix B we show results for alternative assumptions regarding the time span – 3 and 5 years. We also show results when restricting to individuals being observed over all 19 years.

[16]This is obviously a choice that can be questioned. A more realistic alternative would be to assign differential mortality based on socio-demographic characteristics, like gender and education. However, differential mortality affects the sum of lifetime income more than average lifetime income, and the focus here is on average lifetime income.

The construction of one of the concepts for dynastic income relies on information on inheritances. We obtain all previously received gifts and inheritances from a data set on all gifts and inheritances reported to the tax authorities in the period 1997–2011 (Statistics Norway, 2015).[17] The other income concept used to measure income in the family dynasty, the one based on aggregating income across generations, is based on a specific sample with information on (extended) families of two or three generations; see Appendix C for further details.

3.3 Descriptive statistics for various income concepts

Descriptive statistics for different income concepts are presented in Table 1. The present study employs two different data sets. The upper part of the table shows implications with respect to descriptive statistics of moving from annual individual income to lifetime household income. In the lower part of the table, results for the separately established data set for obtaining results for the lifetime-dynastic income concept are compared to the annual individual income benchmark. The pattern

Table 1. Descriptive statistics for different income concepts

	Mean	Std	Gini coeff.	Atkinson index	P90 /P10
Main data set					
Annual individual income	447	665	.328	.212	4.04
Individual income over time	427	483	.312	.168	3.76
Annual household income	488	434	.281	.145	3.33
Household income over time[a]	464	385	.260	.117	3.02
Household lifetime income[b]	458	284	.205	.073	2.32
Lifetime income + inheritance[b]	474	297	.209	.075	2.39
Dynasty dataset					
Annual individual income	478	599	.331	.183	3.41
Individual lifetime income[b]	431	515	.304	.152	3.02
Lifetime-dynastic income[b]	428	444	.262	.110	2.72

Notes: The "Main data set" is based on a 20 percent sample of the whole population, 1993–2011, minimum 8 years of observations. All incomes in thousand NOK based on 2011 income levels. The "Dynasty dataset" is based on information about 160,000 dynasties, where males born between 1933–1957 are linked to their parents and their children. The Atkinson index is reported for the inequality aversion parameter set at 1.
[a]Based on observed income for 8–19 years.
[b]Based on income generated by models for labor and capital income; see Appendix A.

[17]The register is an administrative register for inheritance tax filers (the tax was abolished in 2014). Gifts and inheritances from parents are difficult to distinguish from transfers from others, as we do not have information about donors. Although smaller transfers not liable to inheritance tax are reported because of the mandatory estate settlement, not all gifts are. Thus, gifts are likely under-reported.

revealed by the table is relatively clear. First, as expected, using an income concept based on (equivalized) household income brings down income inequality, as measured by the Gini coefficient, the Atkinson index and the P90/P10 range, compared to inequality measured with respect to individual income. Second, employing information over a longer period of time also decreases inequality, as shown by the results for the income concept denoted "Household income over time". This income concept is average income over 8–19 years of observed income. Moreover, the inequality is further reduced by employing an income concept based on (full) lifetime income ("Household lifetime income"). Third, the final extension, to let the the family dynasty be the unit of analysis, has more modest effects. Adding inheritance to lifetime income increases income inequality, but not by much. The average inheritance (already received or expected) is around NOK 1 million in 2011 prices. However, when distributed evenly across a lifespan of 62 years, it is reduced to an annual amount of about NOK 16,130, which is only 3.5 percent of annual lifetime income. In contrast, according to the results for the "Dynasty data set", there is a reduction in income inequality when the average income of the family dynasty is considered, compared to the annual individual income benchmark.

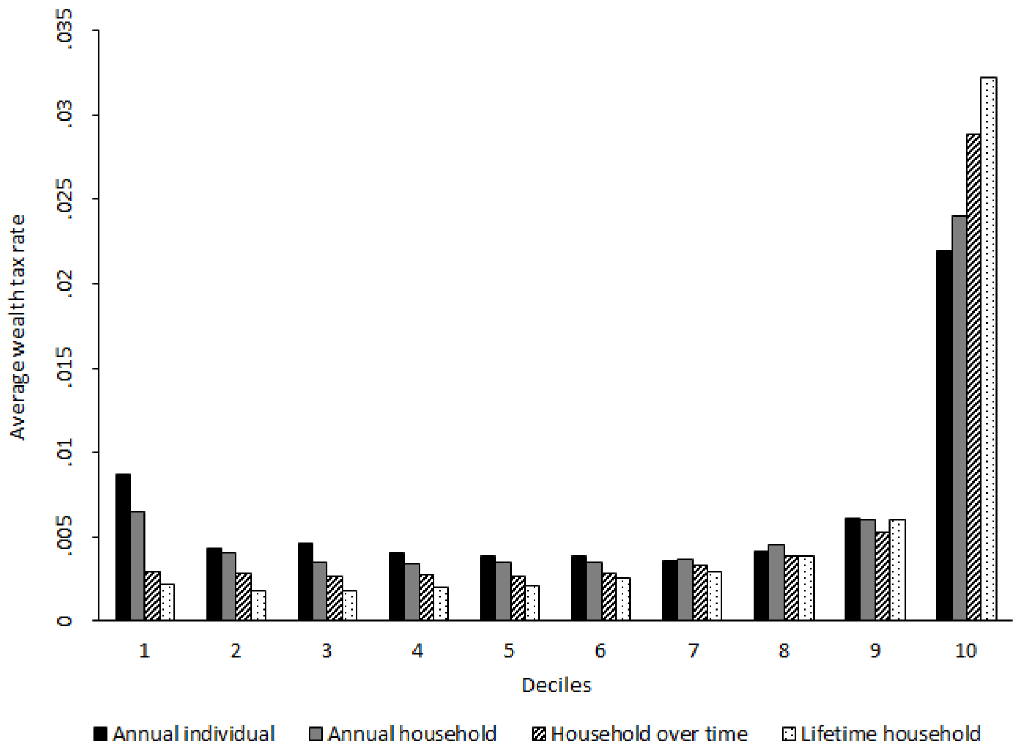
4 Distribution of wealth tax

4.1 Distribution of wealth tax on household income

In this section we discuss how the depiction of the distribution of (annual) wealth tax depends on the income concept against which the tax burdens are measured. First, Figure 2 shows wealth tax shares by deciles for four different income concepts: annual individual income, annual household income, household income over time (8–19 years) and lifetime income. The figure shows a clear pattern. Moving from individual to household income reduces the tax burden of the wealth tax in the lower part of the income distribution, increases it in the top decile, and leaves deciles 7–9 largely unaffected. The shift from annual household income to average income over a longer period of time (8–19 years) reduces the tax burden in decile 1 in particular. Finally, using lifetime household income as an income concept implies that there is a high tax concentration in the upper part of the income distribution.

In Section 2 we listed four main reasons for finding high wealth tax burdens for low annual income: joint wealth of couples, life-cycle effects, transitory low returns (or losses), and inheritances. In order to evaluate how the different income concepts may potentially mitigate these measurement factors, in Table 2 we look more closely at the characteristics of the wealth taxpayers in the lowest decile. With respect to

Figure 2. Annual wealth tax as a share of income, for rankings (in deciles) by different income concepts



the first reason, under annual individual income, the table shows that 75 percent of the individuals paying wealth tax and belonging to the lowest decile are married females. These are females in couples who share high joint wealth with their male partners, but have little own income. Consequently, these taxpayers to a large extent move out of decile 1 when income concepts based on household income are employed.

According to Table 2, there is no over-representation of old-age pensioners (statutory retirement age is age 67 in Norway) among taxpayers when we sort by annual individual income. Instead (not shown in the table) they are found to be in decile 2. However, when we sort by household income, we find that old-age pensioners account for almost half of the taxpayers in decile 1, and furthermore, that this does not change even when household income is measured over time.

Another notable characteristic of low-income wealth taxpayers for the income concept based on annual individual income is the relatively large share of young people. Further inspection of the data tells us that a substantial share of this group has inherited in preceding years. The second main explanation is that many of the taxpayers have temporarily low income, and accordingly, when sorted by lifetime income, there are hardly any young individuals left in the lowest decile. Since

Table 2. Characteristics of wealth taxpayers in the lowest decile, ranked by different income concepts

	Annual		Over time	Lifetime
	Individual	Household	Household	Household
Shares				
Age 20-29	0.11	0.02	0.08	0.00
Age 30-39	0.07	0.03	0.09	0.01
Age 40-49	0.15	0.07	0.06	0.08
Age 50-59	0.27	0.13	0.12	0.28
Age 60-69	0.36	0.24	0.18	0.38
Age 70-80	0.03	0.45	0.46	0.25
Losses	0.07	0.05	0.05	0.05
Married female	0.75	0.11	0.11	0.11
Stock-owner	0.46	0.25	0.20	0.23
Average in NOK 1000				
Annual capital income	9.2	13.5	22.6	22.8
Lifetime capital income	97.5	41.8	17.8	11.4
Lifetime earnings	395	275	229	219
Financial wealth	3,788	1,360	1,035	1,028
Housing wealth	3,352	2,256	1,988	2,164
Debt	612	270	213	183
No of taxpayers	9,104	6,630	3,166	6,238

lifetime income is almost completely age-independent, the distribution of wealth tax closely follows the age-wealth profile.

Transitory losses and low returns is the third type of explanation. The share of taxpayers that report capital losses or business losses is larger for low individual income, compared to what is observed for the other income concepts. If capital income, or more precisely the rate of return, varies among individuals with the same level of wealth, it follows almost by construction that the wealth tax burden will be higher on low incomes than on high incomes. By definition, if there are no labor earnings, average wealth tax is constant across capital income as long as a) the assets in the wealth tax base are the same as the assets that generate capital income, and b) the rate of return is constant across individuals. Consider the average wealth tax for individual i at age t:

$$awtr_{it} = \frac{\tau_w W_{it}}{r_t W_{it} + E_{it}}, \tag{1}$$

where τ_w is the wealth tax rate, W_{it} is wealth at age t, E_{it} is labor income earnings, and r_t is the average rate of return on investments. For the sake of argument, consider the case with no earnings, $E = 0$. Then the average wealth tax rate can be seen as: $awtr_{it} = \tau_w / r_t$, i.e., as long as the rate of return is the same for all individuals, the average wealth tax rate is the same for all, irrespective of wealth level and wealth distribution. In other words, when wealth tax is proportional to wealth and the rate of return is homogeneous, the wealth tax rate will be constant and equal for all. Next, if the rate of return, r_t, differs across individuals, as seen in Fagereng et al. (2016a), Fagereng et al. (2016b), and Bach et al. (2017), for example because some individuals are more productive than others, then the average tax rate will be low for productive owners because the denominator in (1) increases. Alternatively, the rate of return may differ because of the asset composition, so that owners of unproductive capital will have a higher tax burden than owners of productive capital. Generally, the average wealth tax rate declines with the individual rate of return, and for those with a rate of return close to zero, the wealth tax rate becomes infinitely high.[18] The regressivity of wealth tax on (realized) capital income increases at the top end of the distribution if productive assets or assets with high returns are undervalued in the wealth tax.

We therefore turn our attention to the top end of the distribution. Table 3 provides information about how the wealth tax burden is distributed on the top incomes: the table provides information on the internal distribution of income and wealth tax payments within the tenth decile, sorting incomes by decreasing fractions of top incomes. In the table, the first column shows wealth tax in NOK, the second column the share paying wealth tax, and the third and fourth columns report wealth tax and income tax shares (measured against income), respectively.[19]

Table 3 shows that the role of wealth tax as a supplement to income tax is seen as more advantageous in terms of lifetime income than annual income. With reference to the discussion in Section 2, where we established that there will often be a close correspondence between the numerator and the denominator of Equation (1), the results in Table 3 indicate that the wealth accumulation rate is higher than the rate of return on investments at the very top of the income distribution. We may speculate that unrealized capital gains is the main explanation, as these are becoming increasingly important as we move closer to the top of the income distribution. However, it is also clear from Table 3 that the amount of tax paid and the share paying tax at the very top is high when we sort by household income over

[18] As seen in Equation (1), adding earnings, $E_{it} > 0$, makes the result less clear, but if labor income is correlated to capital income, the result still holds.

[19] Table 3 also shows that the results of Figure 2, with lower tax burdens at low income for over time household income and lifetime household income, are explained by fewer people paying the tax; see results for decile 1.

Table 3. Distribution of wealth tax across income deciles, zooming in on the top. Different income concepts

Annual individual income	Wealth tax in NOK	Share paying	Wealth tax rate	Income tax rate	Annual household income	Wealth tax in NOK	Share paying	Wealth tax rate	Income tax rate
0–p10	1,008	0.15	0.009	0.050	0–p10	1,068	0.11	0.006	0.103
p10–p50	1,205	0.17	0.004	0.169	p10–p50	1,208	0.15	0.004	0.183
p50–p90	2,304	0.17	0.005	0.253	p50–p90	2,515	0.19	0.005	0.232
p90–p95	6,648	0.27	0.008	0.309	p90–p95	6,469	0.31	0.008	0.266
p95–p99	15,968	0.36	0.014	0.338	p95–p99	17,385	0.42	0.016	0.286
p99–p99.9	74,479	0.58	0.033	0.343	p99–p99.9	95,873	0.65	0.047	0.293
p99.9–p100	879,027	0.87	0.092	0.300	p99.9–p100	525,881	0.84	0.072	0.289
Household income over time (8–19 years)	Wealth tax in NOK	Share paying	Wealth tax rate	Income tax rate	**Lifetime household income**	Wealth tax in NOK	Share paying	Wealth tax rate	Income tax rate
0–p10	507	0.05	0.003	0.208	0–p10	482	0.10	0.002	0.129
p10–p50	664	0.11	0.002	0.218	p10–p50	978	0.14	0.003	0.195
p50–p90	2,097	0.22	0.004	0.236	p50–p90	1,985	0.19	0.004	0.247
p90–p95	7,010	0.42	0.009	0.271	p90–p95	5,561	0.31	0.008	0.311
p95–p99	16,204	0.56	0.016	0.288	p95–p99	15,514	0.46	0.018	0.353
p99–p99.9	84,708	0.78	0.046	0.264	p99–p99.9	82,291	0.74	0.056	0.343
p99.9–p100	1,111,882	0.93	0.153	0.151	p99.9–p100	1,125,771	0.92	0.197	0.203

Notes: Based on information on 600,276 individuals, up to age 80. Minimum 8 years of observations.

time or lifetime income.

Table 4. Estimates of tax progressivity and redistributive effects of wealth tax

	Annual		Over time	Lifetime
	Individual	Household	Household	Household
Pre-tax inequality (Gini)	0.328	0.281	0.260	0.205
Post-tax inequality (Gini)	0.326	0.279	0.256	0.202
Reynolds-Smolensky index	0.002	0.002	0.003	0.004
Kakwani progressivity index	0.285	0.306	0.470	0.484

Note: See Reynolds and Smolensky (1977) and Kakwani (1977) for further details about the indexes employed.

To further illustrate the impact of using different income concepts, we present estimates of the progressivity of wealth tax and the redistributive effects of wealth tax for different income concepts. We employ the Reynolds-Smolensky index for redistribution effects (Reynolds and Smolensky, 1977), defined as the difference between the Gini coefficient of pre-tax income and the Gini coefficient of post-tax income. In other words, we compare income inequality with and without wealth tax. We also provide estimates for the Kakwani tax progressivity index (Kakwani, 1977), measured as the difference between the concentration coefficient of tax paid (ranked by pre-tax income) and the Gini coefficient of pre-tax income. We find that wealth tax is both more progressive and more tax redistributive (Reynolds-Smolensky redistribution) with respect to lifetime income than to annual income, see Table 4. Thus, these results indicate that employing lifetime income rankings (instead of rankings according to annual income) results in more favorable wealth tax distributional effects.[20]

4.2 Dynastic income and wealth tax

The fourth main explanation for having low annual income and still paying wealth tax is inheritance, see Section 2. Recall that we propose two ways of accounting for dynastic income. One is to adjust lifetime household income for inheritances,

[20] As the measures of imputed income are derived from rather simplistic models, it would be interesting to see if results hold when we compare imputed lifetime income to actual (observed) income for selected cohorts. If we narrow the income concept to labor income we have longer income histories available. Labor income histories are observed for a maximum of 44 years in 2011, thus covering almost the entire work history of individuals who are 60-65 years old in 2011. In Table D.1 in Appendix D we compare 44 years of labor income to imputed labor income for cohorts born 1946-1951. Descriptive statistics for both measures of income are compared to annual income for the same group. These results suggest that the imputation method for labor income works well. Although this validation must be characterized as limited, we find it reassuring that the framework is not rejected by this evidence.

both previous and future expected transfers. The second is to take an average of lifetime individual incomes over two or three generations. As argued above, it is easier to follow dynastic linkages from individual to individual, because using the household as the unit involves more than one family lineage. Therefore, we present the redistributive effects of a shift from lifetime income to dynastic income for a data set based on information on individuals only.

Table 5. Results for the dynastic income concept. Tax progressivity and redistributive effects

	Main sample		Dynasty sample	
	Lifetime	Lifetime +inheritance	Lifetime	Multi-generational
	Household	Household	Individual	Individual
Pre-tax inequality (Gini)	0.205	0.209	0.300	0.256
Post-tax inequality (Gini)	0.202	0.204	0.294	0.249
Reynolds-Smolensky	0.004	0.005	0.018	0.018
Kakwani progressivity	0.484	0.488	0.419	0.432

Note: See Reynolds and Smolensky (1977) and Kakwani (1977) for further details about the indexes employed.

First, we consider the method whereby we add previously received and future potential inheritances. In Table 5 the tax redistributive and tax progressivity effects are compared to the corresponding results for household lifetime income. Adding inheritance increases inequality, although not by much, because for most individuals, as argued in Section 3.3, an inheritance spread out over the entire lifespan is not large relative to annual income. However, wealth tax seems to be somewhat more redistributive with respect to inheritance-augmented lifetime income than to household lifetime income, indicating that inheritance disproportionately benefits those with lifetime wealth. Tax progressivity increases very little; see Table 5.

Summing lifetime income over generations provides a different picture. In this case, dynastic income is more equal than individual lifetime income. As mentioned in Section 2, there is reason to expect income and wealth accumulation in dynasties are generated by several transmission channels, including genes, family culture, and money transfers. These factors are discussed by a large body of literature that considers inter-generational relationships, often focusing on inter-generational earnings correlations; see the survey in Björklund and Jäntti (2009). However, as seen in Table 5, we find that income inequality is reduced when one moves from lifetime income to lifetime income in the dynasty. This suggests that there is a relatively high level of inter-generational income mobility in Norway, which is also found in other studies, see Bratsberg et al. (2007) and Nilsen et al. (2012).[21] The high level of inter-generational mobility in combination with relatively low income inequality (Gini coefficient for annual income is 0.33, according to Table 1), means that Norway is positioned at the (low) left-hand side of the "Great Gatsby curve". Norway and other Scandinavian countries exhibit a combination of low inequality and high levels of mobility across generations.[22] As with the results for inheritance-augmented lifetime income, there is not much difference with respect to tax progressivity and redistribution between the lifetime-dynastic income concept and lifetime income alone. Looking at the overall tax redistributiion and tax progressivity indexes in Table 5, we note that there is no change in the redistributive effect of going from a lifetime income concept to a dynastic income concept.

It is not clear how one this result can be explained. The dynastic income concept would eliminate the potential measurement error following from inter-generational transfers of income, as it would internalize any inter-generational wealth transfers, as discussed in Atkinson and Harrison (1978). Of course, ability (or rate of return) may vary both within a generation (across siblings) and across generations (from parent to child). It is not uncommon for children of very successful entrepreneurs to be unable to obtain the same rate of return as their parents. In the latter case, dynastic income will be lower than the parent's lifetime income, which implies that wealth tax may be seen as less redistributive with respect to dynastic income than with respect to individual lifetime income. On the other hand, if there are strong correlations in ability across generations, causing some dynasties to have an overall higher rate of return on their wealth than other families, we would expect to see high inequality in dynastic income. One cannot rule out the possibility that there are privileges, for example resulting from a business monopoly, that result in strong persistence in both income and wealth across generations.

All in all, Table 5 shows that the role of wealth tax as a distributional backstop mechanism is somewhat more effective when viewed in a life-time dynastic perspective,

[21] Inter-generational links are conventionally measured by the coefficient from a linear regression of log child lifetime income on log father lifetime income. When using this methodology on the data available for the present study, we obtain a parameter estimate of 0.217, corresponding to a Spearman rank correlation of 0.254. The rank correlation increases to 0.269 if we consider only sons (not daughters). Furthermore, if we split income into labor and capital income, the inter-generational elasticity is 0.167 for labor income and 0.415 for capital income. The corresponding Spearman rank correlation is 0.231 for labor income and 0.285 for capital income. Rank correlation estimates are less subject to attenuation bias in income than elasticities. However, since our lifetime income measure is extrapolated from a selected period of the life-cycle, there may still be a problem with life-cycle bias in the measure.

[22] See Corak (2013) on mobility and inequality in an international perspective.

but that the pattern is relatively close to that seen for lifetime income (alone).

5 Summary

A comeback of wealth taxation has been supported by seminal contributors in the field, see for example Piketty et al. (2013), Piketty (2014) and Atkinson (2015). These calls come at a time when this type of taxation has been on the decline. The initial conjecture here is that part of its discrediting can be explained by its apparent inability to serve as a forceful distributive backstop mechanism. Hence, we discuss whether this is attributable to the standard procedure of measuring the distribution of the tax burden against annual income: Do other income concepts produce different depictions of wealth tax distributive effects?

We find that this is indeed the case. Other income concepts generate far more favorable distributive effects. The adverse high tax burdens at low income levels according to annual individual income are more or less eliminated when other income concepts are employed. Ultimately, we apply an income concept based on the lifetime income of the family dynasty. According to this income definition, wealth tax is clearly redistributive. Thus, if one is willing to envisage the tax burden of wealth tax in a longer time perspective, a wealth tax is predominantly paid by the lifetime wealthy.

Of course, there may be other reasons for not letting a wealth tax schedule be part of the taxation of individuals. However, the argument that a wealth tax lacks redistributive properties is not verified here. On the contrary, the evidence presented here suggests that a wealth tax does represent a valuable redistributive supplement to income tax. Thus, before following the example of several countries and eliminating this type of taxation, one should consider the distributional implications of such a move. The present study has shown how this can be done.

References

Aaberge, R. and M. Mogstad (2015). Inequality in current and lifetime income. *Social Choice and Welfare 44*, 217–230.

Albanesi, S. and C. Sleet (2006). Dynamic optimal taxation with private information. *Review of Economic Studies 73*, 1–30.

Altshuler, R. and A. E. Schwartz (1996). On the progressivity of the child care tax credit: Snapshot versus time-exposure incidence. *National Tax Journal 49*, 55–71.

Atkinson, A. B. (2015). *Inequality: What Can be Done.* Harvard University Press.

Atkinson, A. B. and A. J. Harrison (1978). *Distribution of Personal Wealth in Britain.* Cambridge University Press.

Atkinson, A. B. and J. E. Stiglitz (1976). The design of tax structure: Direct versus indirect taxation. *Journal of Public Economics 6*, 55–75.

Bach, L., L. E. Calvet, and P. Sodini (2017). Rich pickings? Risk, return, and skill in the portfolios of the wealthy. CEPR Discussion Paper 11734, Centre for Economic Policy Research, Centre for Economic Policy Research.

Bach, S., M. Beznoska, and V. Steiner (2014). A wealth tax on the rich to bring down public debt? Revenue and distributional effects of a capital levy in Germany. *Fiscal Studies 35*, 67–89.

Banks, J., R. Blundell, and J. P. Smith (2003). Understanding differences in household financial wealth between the United States and Great Britain. *Journal of Human Resources 38*, 241–279.

Bastani, S. and D. Waldenström (2018). How should capital be taxed? Theory and evidence from Sweden. CESifo Working Paper 7004, CESifo, CESifo, Munich.

Becker, G. and N. Tomes (1979). An equilibrium theory of the distribution of income and intergenerational mobility. *Journal of Political Economy 87*, 1153–1189.

Bengtsson, N., B. Holmlund, and D. Waldenström (2016). Annual vs lifetime tax progressivity: Sweden 1968–2009. *Scandinavian Journal of Economics 118*, 619–645.

Benhabib, J. and A. Bisin (2018). Skewed wealth distributions: Theory and empirics. *Journal of Economic Literature 56*, 1261–91.

Benhabib, J., A. Bisin, and S. Zhu (2011). The distribution of wealth and fiscal policy in economies with finitely lived agents. *Econometrica 79*, 123–157.

Björklund, A. (1993). A comparison between actual distributions of annual and lifetime income: Sweden 1951–89. *Review of Income and Wealth 39*, 377–386.

Björklund, A. and M. Jäntti (2009). Intergenerational income mobility and the role of family background. In B. Salverda, W. Nolan and T. Smeeding (Eds.), *The Oxford Handbook of Economic Inequality*, pp. 491–521. Oxford University Press.

Björklund, A., J. Roine, and D. Waldenström (2012). Intergenerational top income mobility in sweden: Capitalist dynasties in the land of equal opportunity? *Journal of Public Economics 96*, 474–484.

Boadway, R., E. Chamberlain, and C. Emmerson (2010). Taxation of wealth and wealth transfers. In S. Adam, T. Besley, R. Blundell, S. Bond, R. Chote, G. M., P. Johnson, G. Myles, and J. Poterba (Eds.), *Dimensions of Tax Design: The Mirrlees Review*, pp. 737–814. Oxford University Press.

Boserup, S. H., W. Kopczuk, and C. T. Kreiner (2018). Born with a silver spoon? Danish evidence on wealth inequality in childhood. *Economic Journal 128*, F514–F544.

Bratsberg, B., K. Røed, O. Raaum, R. Naylor, T. Eriksson, and E. Österbacka (2007). Nonlinearities in Intergenerational Earnings Mobility: Consequences for Cross-Country Comparisons. *Economic Journal 117*, C72–C92.

Brülhart, M., J. Gruber, M. Krapf, and K. Schmidheiny (2017). The elasticity of taxable wealth: Evidence from Switzerland. Technical report, University of Lausanne.

Cameron, L. and J. Creedy (1994). Taxation and the distribution of lifetime income. In J. Creedy (Ed.), *Taxation, Poverty and Income Distribution*, pp. 140–162. Edward Elgar.

Carroll, C. D. (2000). Why do the rich save so much? In J. B. Slemrod (Ed.), *Does Atlas Shrug? The Economic Consequences of Taxing the Rich*, pp. 465–489. Harvard University Press.

Chamley, C. (1986). Optimal taxation of capital income in general equilibrium with infinite lives. *Econometrica 54*, 607–622.

Corak, M. (2013). Income inequality, equality of opportunity, and intergenerational mobility. *Journal of Economic Perspectives 27*, 79–102.

Cowell, F., E. Karagiannaki, and A. McKnight (2017). Accounting for cross-country differences in wealth inequality. *Review of Income and Wealth 64*, 332–356.

Cowell, F. A. and P. Van Kerm (2015). Wealth inequality: A survey. *Journal of Economic Surveys 29*, 671–710.

Creedy, J., E. Halvorsen, and T. O. Thoresen (2013). Inequality Comparisons in a Multi-Period Framework: The Role of Alternative Welfare Metrics. *Review of Income and Wealth 59*, 235–249.

Davies, J. B., F. St-Hilaire, and J. Whalley (1984). Some calculations of lifetime tax incidence. *American Economic Review 74*(4), 633–649.

Fagereng, A., L. Guiso, D. Malacrino, and L. Pistaferri (2016a). Heterogeneity and persistence in returns to wealth. Working Paper 22822, National Bureau of Economic Research, Cambridge, MA.

Fagereng, A., L. Guiso, D. Malacrino, and L. Pistaferri (2016b). Heterogeneity in Returns to Wealth and the Measurement of Wealth Inequality. *American Economic Review: Papers & Proceedings 106*, 651–655.

Förster, M., A. Llena-Nozal, and V. Nafilyan (2014). Trends in top incomes and their taxation in oecd countries. OECD Social, Employment and Migration Working Papers 159, OECD Publishing.

Friedman, M. (1962). *Capitalism and Freedom.* University of Chicago Press.

Fullerton, D. and N. Rao (2016). The Lifecycle of the 47%. CESifo Working Paper 6051, CESifo, Munich.

Fullerton, D. and D. L. Rogers (1991). Lifetime versus annual perspectives on tax incidence. *National Tax Journal 44*, 277–87.

Fullerton, D. and D. L. Rogers (1993). *Who Bears the Lifetime Tax Burden.* Brookings Institution.

Golosov, M., M. Troshkin, A. Tsyvinski, and M. Weinzierl (2013). Preference heterogeneity and optimal capital income taxation. *Journal of Public Economics 97*, 160–175.

Guvenen, F., G. Kambourov, K. Burhan, S. Ocampo-Diaz, and D. Chen (2018). Use it or lose it: Efficiency gains from wealth taxation. Unpublished manuscript, University of Minnesota.

Halvorsen, E. and T. O. Thoresen (2017). Distributional effects of the wealth tax under a lifetime-dynastic income concept. CESifo Working Paper 6614, CESifo, Munich.

Heim, B. T., I. Z. Lurie, and J. Pearce (2014). Who pays taxes? A dynamic perspective. *National Tax Journal 67*, 755–778.

Jacobs, B. (2013). From optimal tax theory to applied tax policy. *FinanzArchiv/Public Finance Analysis 69*, 338–389.

Jakobsen, K., K. Jakobsen, H. Kleven, and G. Zucman (2018). Wealth taxation and wealth accumulation: Theory and evidence from Denmark. NBER Working Paper 24371, National Bureau of Economic Research, Cambridge (MA).

Jäntti, M., E. Sierminska, and T. Smeeding (2008). The joint distribution of household income and wealth. Evidence from the Luxembourg Wealth Study. OECD Social, Employment and Migration Working Papers 65, The Organisation for Economic Co-operation and Development.

Judd, K. L. (1985). Redistributive taxation in a simple perfect foresight model. *Journal of Public Economics 28*, 59–83.

Kakwani, N. C. (1977). Measurement of tax progressivity: An international comparison. *Economic Journal 87*, 71–80.

Kanbur, R. and J. E. Stiglitz (2016). Dynastic inequality, mobility and equality of opportunity. *Journal of Economic Inequality 14*, 419–434.

Kaplow, L. and S. Shavell (2002). *Fairness versus Welfare*. Harvard University Press.

Keane, M. P. and K. I. Wolpin (1994). The solution and estimation of discrete choice dynamic programming models by simulation and interpolation: Monte Carlo evidence. *Review of Economics and Statistics 74*, 648–72.

Keen, M. (2015). Some notes on taxing wealth. In C. Astarita (Ed.), *Taxing Wealth: Past, Present, Future*, pp. 16–20. European Commission.

Kirkebøen, L. (2010). Forskjeller i livsløpsinntekt mellom utdanningsgrupper. Rapporter 43/2010, Statistics Norway (in Norwegian).

Kocherlakota, N. R. (2005). Zero expected wealth taxes: A Mirrlees approach to dynamic optimal taxation. *Econometrica 73*, 1587–1621.

Kopczuk, W. (2013). Taxation of intergenerational transfers and wealth. In A. Auerbach, R. Chetty, M. Feldstein, and E. Saez (Eds.), *Handbook of Public Economics*, Volume 5, pp. 329–390. Elsevier.

MaCurdy, T. (2007). Practitioner's approach to estimating intertemporal relationships using longitudinal data: Lessons from applications in wage dynamics review. In J. J. Heckman and E. E. Leamer (Eds.), *Handbook of Econometrics*, Volume 6, Part A, pp. 4057–4167. Elsevier.

Mare, R. D. (2011). A multigenerational view of inequality. *Demography 48*, 1–23.

Metcalf, G. E. (1994). Life cycle versus annual perspectives on the incidence of a value added tax. In J. Poterba (Ed.), *Tax Policy and the Economy*, Volume 8, pp. 45–64. The MIT Press.

Ministry of Finance (2015). Bedre skatt - En skattereform for omstilling og vekst. St. meld. 4 (2015-2016) (in Norwegian).

Nilsen, Ø. A., K. Vaage, A. Aakvik, and K. Jacobsen (2012). Intergenerational earnings mobility revisited: Estimates based on lifetime earnings. *Scandinavian Journal of Economics 114*, 1–23.

Piketty, T. (2000). Theories of persistent inequality and intergenerational mobility. In A. Atkinson and F. Bourguignon (Eds.), *Handbook of Income Distribution*, Volume 1, pp. 430–476. Elsevier.

Piketty, T. (2014). *Capital in the Twenty-First Century.* Harvard University Press.

Piketty, T., E. Saez, and G. Zucman (2013). Rethinking capital and wealth taxation. Mimeo, Paris School of Economics, University of California at Berkeley, London School of Economics.

Poterba, J. M. (1989). Lifetime incidence and the distributional burden of excise taxes. *American Economic Review 79*, 325–330.

Poterba, J. M. and S. J. Weisbenner (2001). Capital gains tax rules, tax-loss trading, and turn-of-the-year returns. *Journal of Finance 56*, 353–368.

Quadrini, V. (2000). Entrepreneurship, saving and social mobility. *Review of Economic Dynamics 3*, 1–40.

Reynolds, M. and E. Smolensky (1977). *Public Expenditures, Taxes, and the Distribution of Income: The United States, 1950, 1961, 1970.* Academic Press.

Santos Silva, J. M. C. and S. Tenreyro (2006). The log of gravity. *Review of Economics and Statistics 88*, 641–658.

Sen, A. (1997). From income inequality to economic inequality. *Southern Economic Journal 64*, 384–396.

Slemrod, J. B. (1992). Taxation and inequality: A time-exposure perspective. In J. Brown (Ed.), *Tax Policy and the Economy*, Volume 6, pp. 105–128. The MIT Press.

Statistics Norway (2015). Inheritance tax. https://www.ssb.no/en/inntekt-og-forbruk/statistikker/arv/aar.

Statistics Norway (2016). Income and wealth statistics for households. https://www.ssb.no/en/inntekt-og-forbruk/statistikker/ifhus.

Appendix A Imputation of lifetime income

In this appendix we shall explain how the measured for lifetime income is obtained. We use two models to impute income for the individual, one for labor income and one for capital income. Income is not normally distributed, a fact that is commonly dealt with by log-transforming the dependent variable. However, transforming the dependent variable by taking the natural logarithm complicates predictions. Moreover, in order to calculate annual wealth tax as a fraction of lifetime income, we prefer imputations of lifetime income for different levels. We then estimate multiplicative models directly, using Poisson regression.[23] More specifically, we regress equivalized household labor income, Y_{it}^{L}, on age and a second degree polynomial in age, both interacted with fixed individual characteristics, such as gender and education, which are also fully interacted with each other, so that the age profiles are as flexible as possible,

$$Y_{it}^{L} = \exp\left(\alpha + \beta'\mathbf{X}_{it} + \delta_t \sum_{t=1993}^{2010} D_t + u_{it}\right),$$

where

$$\beta'\mathbf{X}_{it} = \beta_1 a_{it} + \beta_2 a_{it}^2 + \beta_3 e_i + \beta_4 s_i + \beta_5 a_{it} e_i + \beta_6 a_{it} s_i + \beta_7 a_{it}^2 e_i + \beta_8 a_{it}^2 s_i + \beta_9 e_i s_i,$$

and a is age, a^2 is age squared, s is gender, e is a variable describing the combination of length and field of education, $\{\beta_1, \beta_2, ..., \beta_9\}$ and δ_t are parameters, α is a constant, and u_{it} is the IID error term. A detailed classification of 50 educations (combinations of length and fields), established by Kirkebøen (2010), is used, and we also control for general income growth by including year dummies, D_t, where 2011 is the reference year.[24]

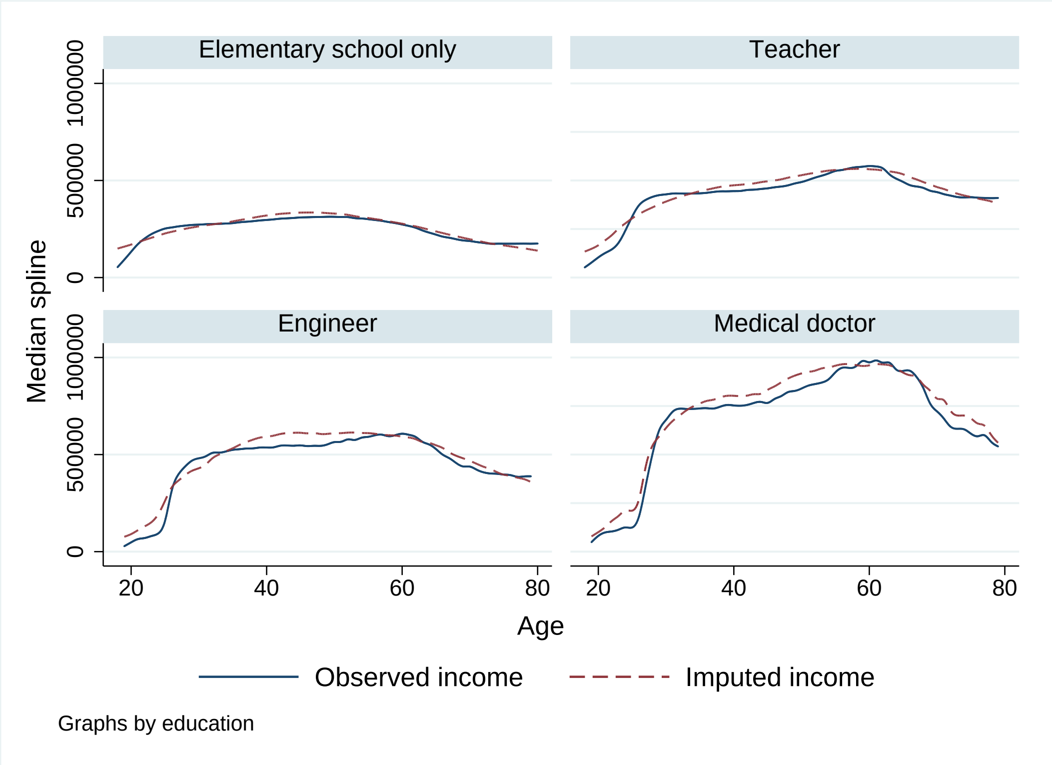
Note that this life-cycle model is expressed only in observables that are assumed fixed over the individual's life span and that the coefficients are assumed to be shared by all individuals. Essentially, the approach implies that gender-specific concave income profiles are estimated for each type of education over the life-cycle. Figure A.1 shows observed and predicted age profiles for four selected educations: elementary school only, teacher with bachelor or master degree, engineer, and degree in medicine. Corresponding figures for individual income can be found in Halvorsen

[23] The variance-covariance matrix of the estimates is obtained by the Huber/White/Sandwich linearized estimator. This estimator of the variance-covariance matrix does not assume $E(Y_i) = Var(Y_i)$, which is standard in Poisson regression, see Santos Silva and Tenreyro (2006).

[24] A full set of regression results may be obtained by correspondence with the authors, as well as the Stata code used to estimate and impute lifetime income.

and Thoresen (2017).

Figure A.1. Observed and predicted age-income profiles for selected educations, labor income



We only know the person's type of education, not their actual occupation. The relationship between education and occupation varies, from being clear in the case of nurses, to quite unclear for persons with a master's degree in humanities. Thus, although the model may provide reasonable approximations of conditional means, as seen in Figure A.1, it may predict poorly for a given individual. Therefore, we would like to allow for some individual variation. There may be individual variations in level, slope and curvature of the lifetime income profile. However, since we are interpolating incomes outside the observed ages of each person, imposing individual-specific slopes and curvature may exaggerate patterns that are only weakly identified over a period of a minimum of 8 years. Hence, we choose to adjust only for differences in levels. This is done by utilizing the panel data structure and run a fixed effect regression of income against the predicted part of the model above. This gives us an estimate of the individual fixed effect. Calibration over the whole life-cycle is then done by extrapolating age over the range 18 to 80, and using the model to predict labor income,

$$\hat{Y_{ia}^L} = \exp\left(\hat{\alpha} + \hat{\beta}'\mathbf{X}_{ia}\right) + \hat{\theta_i^L} \qquad a \in [18, 80]$$

where $\hat{\alpha}$ and $\hat{\beta}$are the estimated coefficients from the model, $\mathbf{X}_{ia}$ are the extrapolated values of age, education and gender, and $\hat{Y_{ia}^L}$ is the predicted value of lifetime labor income in each period. The final step is to obtain the lifetime annual equivalent by taking the individual average of $\hat{Y_{ia}^L}$ over age.

Capital income is even more skewed than labor income, and follows a different pattern over the life cycle. In the capital income model, different quintiles of the capital income distribution are estimated separately, thus allowing parameters to vary with income level. Since we observe each individual for a minimum of 8 years, we have chosen to first identify each person's position in the capital income distribution by age and year in the observation period. Next, we assign the overall lifetime position using the mode position, i.e., the position in the distribution observed most frequently over the period of minimum 8 years and maximum 19 years.

Inspection of the data shows that equivalized household capital income, Y_{it}^K, is best fitted by a 5th degree polynomial in age over the life-cycle for each quintile, q.[25] Furthermore, we find differences between males and females, whereas level of education has little predictive power. The polynomial in age is therefore allowed to vary with gender. The capital income model can then be seen as,

$$Y_{qit}^K = \kappa + \gamma \mathbf{Z}_{qit} + \lambda_t \sum_{t=1993}^{2010} D_t + \upsilon_{qit} \qquad \text{for each } q \in [1, 2, 3, 4, 5],$$

where

$$\gamma \mathbf{Z}_{qit} = \left(\gamma_1 a_{qit} + \gamma_2 a_{qit}^2 + \gamma_3 a_{qit}^3 + \gamma_4 a_{qit}^4 + \gamma_5 a_{qit}^5 \right) s_i + \gamma_6 s_{qi},$$

and $\{\gamma_1, \gamma_2, ..., \gamma_6\}$ are parameters, κ is a constant, υ_{qit} is the IID error term and $q \in [1, 2, 3, 4, 5]$ defines the mode capital income quintile of the individual. We control for annual variation by including year dummies, D_t. In the same way as for labor income, we extrapolate the estimated relationship over the entire age range and add individual fixed effects.

Table A.1 summarizes the characteristics of the resulting predictions of lifetime income, and compares them to corresponding information based on annual income. The averages of the two income distributions are close, which is to be expected since individual residuals are used in obtaining lifetime income levels.

[25] Capital income follows closely the level of financial assets over the life-cycle. An alternative would be to model financial assets, and subsequently derive capital income as a function of financial assets. However, as already discussed, even though capital income is a function of the capital stock, the rate of return is not necessarily the same for all ages and for all levels of assets – for example, the average return depends on the composition of assets.

Table A.1. Descriptive statistics for annual household income and lifetime household income

	Gross income		Labor income		Capital income	
	Annual	Lifetime	Annual	Lifetime	Annual	Lifetime
Mean	488	458	464	431	27	27
Std	434	299	321	171	268	221
Gini coefficient	.281	.205	.321	.184	.888	.771
Atkinson index	.145	.073	.236	.057	.919	.717
P90/P10	3.33	2.32	4.13	2.24	322.7	31.32

Notes: Based on information on approximately 600,000 individuals, maximum 80 years old. observed for 8 years. All incomes are in thousands of 2011 NOK. The Atkinson index is reported for the inequality aversion parameter (ε) set at 1.

Appendix B Different time spans

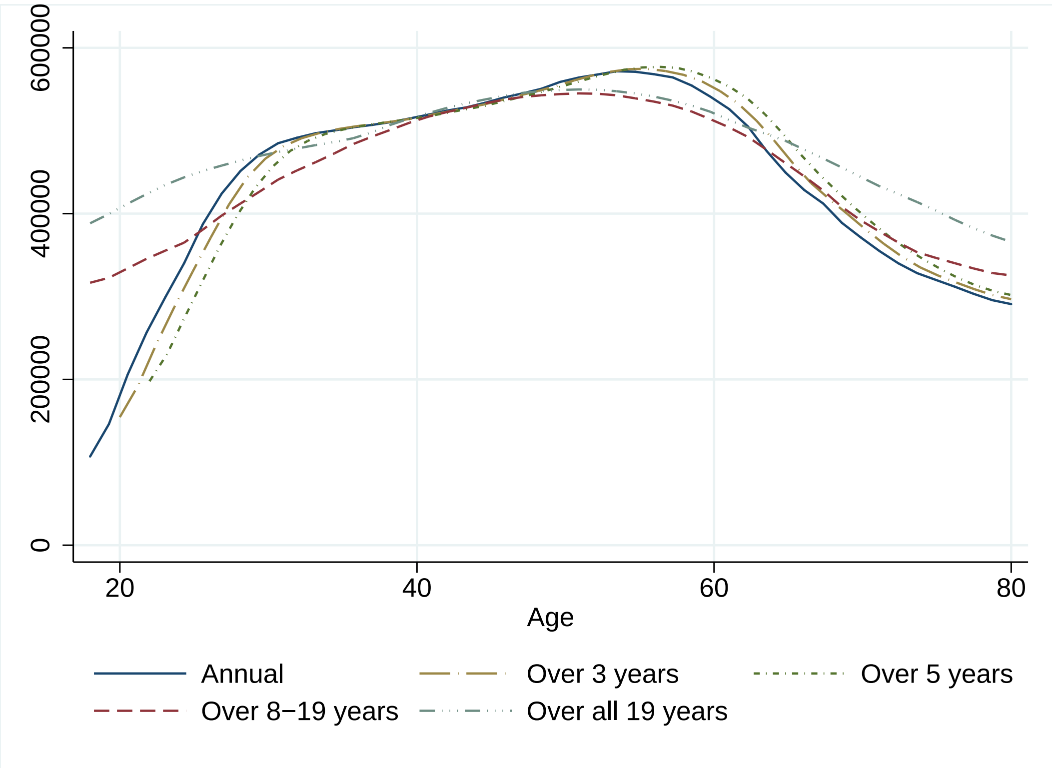
This appendix discusses the implication of different time spans for the calculation of income over time. First, Table B.1, presents estimates of inequality for different assumptions regarding the time span for which we aggregate income when we calculate average income over time. We see that the measured income inequality decreases as the number of years increases. Further, Figure B.1 illustrates that even when we observe incomes over a long period, such as 19 years, we only have information about a fraction of the lifespan. The income profile remains clearly hump-shaped and the lifetime income of the young and the old would be underestimated compared relative to the middle-aged.

Table B.1. Characteristics of household income over time with varying observation time spans

	Household equivalized average income over				
	Annual	3 years	5 years	min 8 year	19 years
Mean	488	480	472	464	506
Std	434	374	368	385	413
Gini coefficient	.281	.269	.267	.260	.239
Atkinson index	.145	.131	.125	.117	.097
P90/P10	3.33	3.21	3.18	3.02	2.64
No. of obs	600,276	600,276	600,276	600,276	452,524

Notes: All incomes in thousands of 2011 NOK. Income over time is adjusted using the income growth in the sample to obtain income levels that are comparable to the annual income level in 2011. The Atkinson index is reported for the inequality aversion parameter (ε) set at 1.

Figure B.1. Age profiles of averages based on different time spans



Appendix C Description of the linked-generations data set

We are able to establish a lifetime-dynastic data set by exploiting information on individuals from the Norwegian population register. The population register contains information on all Norwegians holding a Norwegian personal identification number, and is used here to link a person to his parents and grown children. There are several inter-generational lines within the dynasty, depending on which persons are linked. To obtain a manageable empirical framework, the strategy here is based on letting males born between 1933 and 1957 take the role as the "head of the dynasty". These males are then linked to their fathers, their children, or both. Only dynasties with relatively simple descendance lines were selected, which is achieved by requiring that the head of the dynasty and his father have registered children with only one partner. As in the preceding part of the analysis, each individual is required to be observed for a minimum of 8 of the 19 years for which we have observations. When we further restrict the data set to dynasties where the dynasty head was observed in 2011, we end up with observations of approximately 160,000 dynasties.

Table C.1 shows descriptive statistics for the dynasty data set and how it compares

Table C.1. Descriptive statistics for different data sets

	Full dynasty sample	Dynasty head	Main sample
Gross income	514	478	447
Labor income	482	440	425
Capital income	32	38	22
Age	55	67	50
Male	.78	1	.50
Wealth tax	5.8	7.2	4.1
Financial wealth	724	856	754
No. of observations	403,196	156,735	600,276

Notes: Measured in thousands of NOK in 2011. Results referred to under "Main sample" are for individual income (in one year). "Full dynasty sample" is the sample before various restrictions.

to the previously used main sample, i.e., reflecting the implications of restricting the data set to a sample based on the "heads" of dynasties. The individuals in the dynasty data differ from the representative population sample by being on average older, wealthier and consisting predominantly of males.[26] This follows from the way the data set is constructed, focusing on male dynasty heads born between 1933 and 1957.

The lifetime income of members of the dynasty is obtained by means of the same estimated coefficients derived by imputing labor income and capital income as described in Appendix B, but on individual income rather than household income. There are birth cohort differences in the level of lifetime income. As income of a dynasty is simply the average lifetime incomes of the members of the dynasty, and as the members belong to different generations, we first normalize lifetime incomes to comparable levels, irrespective of birth cohort. We obtain the cohort-specific levels by regressing lifetime income, $\hat{Y_i^{LT}}$, on dummies for cohort, D_i^c, as

$$\hat{Y_i^{LT}} = \exp\left(\eta + \delta_c D_i^c + \nu_i\right),$$

where δ_c and η are parameters and ν_i is the error term. The 1948-52 birth cohort is used as reference level. Lifetime incomes are then adjusted according to the percentage deviation from the reference cohort, and finally we obtain estimates of dynasty income, $\hat{Y^D}$, based on the average lifetime income of members of the dynasty:

$$\hat{Y^D} = \frac{1}{M}\sum_{m=1}^{M}\left(\left(1-\delta_c\right)\hat{Y_m^{LT}}\right),$$

where M is the number of dynasty members (either two or three). Table C.2 shows

[26]The "Full dynasty sample" is the sample before restricting to gender, year of birth and inter-generational links.

how the dynasty income distribution compares to the distributions of annual income and lifetime income, in terms of descriptive measures.

Table C.2. Descriptive statistics for annual, lifetime and dynastic income. Dynasty head sample

	Annual income	Lifetime income	Dynastic income
Mean	478	431	428
Std	599	515	444
Gini coefficient	.33	.30	.26
Atkinson index ($\varepsilon = 1$)	.18	.15	.11
P90/P10	3.4	3.0	2.7

Notes: Based on information on 156,735 individuals. Annual income in thousands of NOK in 2011, and average lifetime income in thousands of 2011 NOK.

Appendix D Alternative individual lifetime labor income

Table D.1. Distribution of wealth tax by annual labor income, 44-year average labor income, and lifetime labor income

Annual labor income	Wealth tax in NOK	Fraction paying	Wealth tax rate	Income tax rate
0–p10	4,282	0.26	0.031	0.107
p10–p50	2,753	0.28	0.010	0.171
p50–p90	4,741	0.35	0.011	0.267
p90–p95	12,052	0.44	0.017	0.322
p95–p99	24,091	0.51	0.025	0.384
p99–p99.9	97,341	0.54	0.064	0.448
p99.9–p100	251,362	0.91	0.065	0.348

44-year history	Wealth tax in NOK	Fraction paying	Wealth tax rate	Income tax rate
0–p10	2,443	0.23	0.016	0.176
p10–p50	2,352	0.28	0.007	0.200
p50–p90	4,142	0.34	0.008	0.230
p90–p95	13,382	0.49	0.020	0.337
p95–p99	29,049	0.56	0.037	0.366
p99–p99.9	86,790	0.70	0.080	0.470
p99.9–p100	578,365	0.92	0.196	0.368

Lifetime labor income	Wealth tax in NOK	Fraction paying	Wealth tax rate	Income tax rate
0–p10	1,102	0.21	0.006	0.092
p10–p50	1,591	0.25	0.005	0.174
p50–p90	3,611	0.36	0.008	0.246
p90–p95	8,105	0.52	0.012	0.334
p95–p99	26,283	0.65	0.032	0.409
p99–p99.9	94,612	0.73	0.081	0.398
p99.9–p100	624,162	0.92	0.165	0.242

Notes: Restricted data set, household heads 60–65 years old in 2011. The number of observations is 12,110 individuals. Average calculated on wage-deflated incomes.

Table D.2. Descriptive statistics for annual, lifetime and dynastic income. Dynasty head sample

	Mean	Std	Gini coeff.	Atkinson index	P90 /P10
Annual labor income (2011)	393	253	0.28	0.13	3.2
44-year history of labor income	412	186	0.24	0.13	3.3
Imputed lifetime labor income	414	242	0.22	0.09	2.6

Notes: Restricted data set, individuals 60-65 years old in 2011. The number of observations is 12,110 individuals. Average calculated on wage-deflated incomes.