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INTAXMOD - Inheritance and Gift Taxation in the Context of Ageing

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Executive Summary

European countries are growing older, and we observe a decreasing labour share in total income. Against this background, options to secure the long-term sufficiency and sustainability of European tax systems need to be explored, since labour taxation represents a major source of income for governments. Wealth taxation is increasingly regarded as a potential source of public revenues which remains largely untapped. Further, a review of the empirical evidence shows that behavioural responses to inheritance taxes are less pronounced compared to a net wealth tax.

This project models the future household-level wealth distribution in five selected EU Member States (Finland, France, Germany, Ireland and Italy) to simulate inheritances based on demographic and wealth projections. On this basis, various inheritance tax scenarios are simulated to estimate potential inheritance tax revenues for a projection period of 30 years.

Based on the most recent data from the European Central Bank's "Household Finance and Consumption Survey", we develop INTAXMOD - a flexible and extendable model - that allows to simulate the development of wealth transfers and associated inheritance tax revenues in European countries until 2050. The development of such model is in part motivated by the difficulty to assemble sufficient data on inheritances and gifts, which are events based. In order to palliate this shortcoming, INTAXMOD builds upon plausible assumptions about demographic change, long-term asset appreciation rates for wealth components, age-specific saving rates and the distribution of inheritances between donees (i.e. recipients). By design, the users can easily alter these parameters and explore the associated effects on model outcomes so as to derive possible policy analysis.

Our results indicate that multiple factors coincide in favouring a growing revenue potential for inheritance taxation in the medium-term. Wealth accumulation and appreciation lead to higher average wealth levels. In addition, the shift of the baby boomer generation out of the labour force results in an increase of the older population, both in absolute and relative terms. Eventually, this will lead to a rise in the number of deaths and the number of inheritances. Additionally, low fertility rates lead to a reduction of the average number of successors and thereby decrease the importance of exemption thresholds. This study focuses on the cases of five European countries, namely Finland, France, Germany, Ireland and Italy, which illustrate the future evolution of inheritance taxes and the potential effects of reforms in this area.

Note: Tax revenue amounts to 100% in the reference year 2020. Source: HFCS 2017. Own calculations using INTAXMOD.

We project that inheritance tax revenues in France and Germany will double by 2050. Finland and Italy will reach this mark in 2040 and an increase by another 40% of today's revenues until 2050. In Ireland, the initially younger population relative to the other countries considered results in more rapid demographic expansion which coincides with dynamic wealth accumulation. This results in an even more dynamic path concerning inheritance tax revenues. According to our projections, Ireland is expected to see a doubling of inheritance tax revenues until 2030, which will triple around 2040 and reach 450% of today's revenues in 2050.

A comparative analysis of inheritance tax legislation shows that the treatment of wealth transfers for tax purposes differs substantially across countries. These differences concern the level of marginal rates, the number and progressivity of tax rates and brackets, the percentage of assets that are actually considered in the determination of the tax base, and exemption amounts for different degrees of the heir-donor relationship.

Current rules have resulted in highly progressive tax burdens across the board. Average tax rates are below 7%, while – with the exception of Finland – more than 90% of inheritances are currently not subject to taxation. Overall, valuation rules and exemption levels seem more important for the degree of progressivity compared to the design of the tax tariff (i.e. flat tax versus progressive rates) or the highest marginal tax rate. Overall, our simulations show that the future revenue potential of inheritance taxes may be substantial. In practice, it can be expected that the theoretical revenue potential demonstrated by our simulations will be reduced by tax avoidance, real responses and general equilibrium effects on other taxes. We leave their quantification to derive reasonable estimates for the net revenue potential of inheritance taxes to future research.

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Abstract

Based on the most recent data from the ECB's Household Finance and Consumption Survey, the project models the future household-level wealth distribution in five selected EU member countries (Finland, France, Germany, Ireland, and Italy) to derive inheritances based on different demographic and wealth projection scenarios. On this basis, various inheritance tax scenarios are simulated to estimate potential inheritance tax revenues for a projection period of 30 years. Our results indicate that multiple factors coincide in favouring a growing revenue potential for inheritance taxation in the medium-term. Wealth accumulation and appreciation lead to higher average wealth levels. The shift of the baby boomer generation out of the labour force results in an increase of the older population both in absolute and relative terms. Eventually, this will lead to a rise in the number of deaths and the number of inheritances. Additionally, low fertility rates lead to a reduction of the average number of successors and thereby decrease the importance of exemption thresholds, as individual inheritances become larger. Overall, our simulations show that the future revenue potential of inheritance taxes may be substantial. In practice, it can be expected that the theoretical revenue potential demonstrated by our simulations will be reduced by tax avoidance, real responses, and general equilibrium effects on other taxes. A review of the empirical evidence shows that behavioural responses to inheritance taxes are less pronounced compared to a net wealth tax.

JEL classification: H24, H3

Keywords: inheritance taxation, wealth taxation, ageing, HFCS, behavioural effects

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We project that inheritance tax revenues in France and Germany will double by 2050. Finland and Italy will reach this mark in 2040 and an increase by another 40% of today's revenues until 2050. In Ireland, the initially younger population relative to the other countries considered results in more rapid demographic expansion which coincides with dynamic wealth accumulation. This results in an even more dynamic path concerning inheritance tax revenues. According to our projections, Ireland is expected to see a doubling of inheritance tax revenues until 2030, which will triple around 2040 and reach 450% of today's revenues in 2050.

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Overall, our simulations show that the future revenue potential of inheritance taxes may be substantial. In practice, it can be expected that the theoretical revenue potential demonstrated by our simulations will be reduced by tax avoidance, real responses and general equilibrium effects on other taxes. We leave their quantification to derive reasonable estimates for the net revenue potential of inheritance taxes to future research.

1. Introduction

Demographic developments taking place in all European countries are leading to ageing societies and a decrease of the labour force, which may also depress the labour share in total income. Against this background, options to secure the long-term sufficiency and sustainability of European tax systems need to be explored. Strengthening the taxation of inheritances and gifts presents itself as a very promising option in this regard, not only for fiscal reasons, but also based on equity and efficiency arguments (OECD 2021). In particular, inheritance taxation can be an effective tool to support social mobility and equality of opportunity, as argued, for example, for France by Garbinti and Goupille-Lebret (2018), for Sweden by Waldenström (2018) and for Germany by Bach (2021).

However, there is a lack of precise and comparable statistics regarding inheritances and gifts as well as their taxation Against this background, the study develops INTAXMOD, a microsimulation model to simulate the future wealth distribution in five selected EU Member States (Finland, France, Germany, Ireland and Italy) to derive a future path with respect to inheritances based on different demographic and wealth projection scenarios described in the third wave of the "Household and Consumption Survey" (HFCS) provided by the European Central Bank (ECB). On this basis, various inheritance tax scenarios are simulated to estimate potential inheritance revenues for a projection period of 30 years, i.e. until 2050. The study is structured as follows.

Chapter 2 presents the considerations behind the selection of the five EU Member States included in the study and the most important features of their inheritance tax system.

Chapter 3 consists of the top tail adjustment[1] of the household net wealth distribution based on the third wave of the HFCS data released in 2019 for the five countries examined in the study. The HFCS data are thus adjusted for underreporting at the top. Chapter 4 shows the effect of the data adjustment on aggregates of private wealth and on its distribution. In Chapter 5, a dynamic projection of wealth distribution is undertaken based on assumptions for demographic change, asset appreciation and age-specific (dis)saving patterns. Household wealth dynamics are modelled for a period of 30 years (relative to the data collection year 2017), drawing upon two separate databases: the original HFCS, and the adjusted HFCS.

Chapter 6 explains the algorithm and the assumptions for the projection of inheritance tax revenues for a 30-year period for the five countries included in the study. On this basis, various inheritance scenarios are simulated in Chapter 7. The focus of our simulations is on the revenue potential of inheritance taxation, while INTAXMOD is not able to estimate the distributional consequences of inheritance taxes.

Chapter 8 provides a survey of the empirical evidence on behavioural responses to the taxation of inheritances.

Finally, Chapter 9 concludes.

2. Countries covered and their inheritance tax regimes

2.1 Selected countries

The simulations of various inheritance tax scenarios undertaken in this study are conducted for Finland, France, Germany, Ireland and Italy. The selection of countries was driven by several considerations. First of all, several factors restrict the number of countries available for the study. The ECB's HFCS, as the primary data source for the simulations, does not include all EU Member States. The third wave of the HFCS released in 2019 covers 22 EU Member States:

[1] By top tail adjustment we refer to adjusting the wealth distribution for the missing rich in survey data to better represent total wealth concentration.

19 Euro Area countries, as well as Croatia, Hungary and Poland. Thus, five EU Member States are not available for study selection due to missing comparable estimations for net household wealth (Sweden, Denmark, the Czech Republic, Bulgaria and Romania).

Moreover, only 15 out of the 22 HFCS countries currently levy an inheritance tax. Several HFCS countries have abolished their inheritance taxes since the beginning of the 2000s (OECD, 2021): Cyprus in 2001, Portugal in 2004,[2] Slovakia in 2005, and Austria in 2008. Although the various simulation scenarios could, of course, use the inheritance tax provisions in place prior to the elimination of the inheritance tax, this would complicate several tasks to be performed in the study; for example, the comparison of officially reported inheritance tax revenues with those simulated for the baseline scenario based on the existing inheritance tax provisions and on the HFCS estimates for the size and composition of inheritances. Some HFCS countries (Malta, Estonia and Latvia) have never levied an inheritance tax and therefore also have to be excluded from the group of candidates for the simulations. Therefore, only 15 HFCS countries (Belgium, Croatia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Lithuania, Luxembourg, the Netherlands, Poland, Slovenia and Spain) remain as potential candidates.

The five HFCS countries selected provide – as far as this is possible given the above restrictions and with a rather small group out of 27 EU countries – a reasonably balanced geographical coverage and an adequate representation of the economic and welfare state models prevailing in the EU. More precisely, the selected Member States represent several "families of taxation" (Wagschal 2005; Obinger and Wagschal 2010) existing in the EU, which have evolved from different traditions, institutional, historical and cultural factors and developments as well as different religious and partisan influences across the EU. Departing from the welfare state research starting with the seminal contribution by Esping-Andersen (1990),[3] Wagschal (2005) identifies four "families of taxation" in the OECD, primarily differing with regard to the overall level of taxation and the dominant taxing principle (benefit versus ability to pay principle[4]): (i) an English-speaking family (which includes the UK as the only – now former – EU country), (ii) a Continental family (Germany, France, Austria, Netherlands and Belgium), (iii) a Nordic family (Finland, Sweden and Denmark), and (iv) a peripheral or residual family, including a Southern (or Mediterranean) cluster (Italy, Spain, Portugal, Greece) as well as Ireland. As Ebbinghaus (2012) notes, the research on families of taxation, with its origins dating back to the mid-2000s, ignores – as does the welfare state literature in general – the previously socialist Central and Eastern European "new" member countries. The group of the 13 Member States that have joined the EU since 2004 could be labelled as a "new" family, which is, however, characterised by a considerable degree of heterogeneity.

Our country selection covers the four "established" families of taxation. The three predetermined countries Germany, France and Italy represent two families of taxation: Germany and France belong to the Continental family, Italy to the Southern family. The choice of Finland is motivated by the fact that it is the only representative of the Nordic family of taxation among the HFCS countries. Ireland is the only HFCS country which is a member of the peripheral family outside the Mediterranean cluster. Furthermore, it can be regarded as kind of a bridge towards the English-speaking family, which otherwise is not represented at all in our country selection, as the UK (the only – now former – EU country belonging to the English-speaking family) is not a HFCS country.

Thus, our group of selected countries does not include a member of the "new family" of taxation. While this of course could be regarded as a deficit, the decision not to include the potential candidates Croatia, Hungary, Lithuania and Poland is not only justified by the heterogeneity of the new family of taxation. There are also pragmatic reasons not to

[2] The Portuguese inheritance tax was replaced by a stamp tax as of 2004.

[3] See Wagschal (2015) for an overview.

[4] The ability to pay principle stipulates that those with a higher ability to pay (in terms of income and wealth) should pay more. In contrast, the benefit principle states that those who benefit more from the provision of public goods should also pay more taxes.

conduct simulation exercises within a pilot study (of which this project can well be regarded) for a country for which the access to national statistics and other national sources, including tax-law provisions, will most likely be even more challenging (also due to language barriers) than for the "old" EU Member States selected.

2.2 Important features of inheritance taxation in the selected countries

Table 1 shows the most essential features of the inheritance tax systems of the five selected countries. Although many important provisions (valuation rules for business assets and real property, or exemptions for transfers of real property, e.g. for a main residence) are not included in this first overview, Table 1 illustrates that all countries under examination apply rather complex inheritance tax systems. This complexity is exacerbated if inheritance tax regimes have a "double-progressive" nature, i.e. if they combine a directly progressive tax tariff with several tax classes differentiating the tax rates according to the distance of the relationship between bequeather and heir (Drometer et al. 2018). Among the five countries included, France, Germany and Finland apply a double-progressive inheritance tax schedule.

Also, the coordination of the taxation of gifts and inheritances is a source of complexity. As gifts may be used as an instrument to avoid inheritance taxes, the taxation of wealth transfers generally covers both inheritances and gifts. The majority of EU countries have integrated taxation systems which are applied to both inheritances and gifts; only a few Member States tax inheritances and gifts separately (Drometer et al. 2018). In our country sample, France, Germany, Ireland and Italy have implemented a united inheritance and gift taxation system, while Finland applies separate taxation systems.

In addition, exemptions regarding the tax base (e.g. for the transfer of business assets or real property), and the rules for the valuation of business assets and real property add to the complexity of inheritance and gift tax systems.

Table 1: Inheritance and gift taxation in selected EU countries, 2019 (marginal tax rates)

Country	Family of taxation	Tax regime	Tax classes	€ 50,000	€ 100,000	€ 250,000	€ 500,000	€ 1,000,000	€ 5,000,000	€ 30,000,000	(Personal) exemptions in €	Inheritance and gift tax revenues (2019)	
												In % of GDP	In % of total tax revenues
Finland8)10)	Nordic	Double progressive	Spouse, children, grandchildren, fiancé	10.0	13.0	16.0			19.0		-	0.31	0.74
			Others	25.0	29.0	31.0			33.0				
France9)10)	Continental	Double progressive	Children	20.0				40.0	45.0		100,000	0.63	1.38
			Siblings	45.0							15,932		
			Blood relatives up to the fourth degree	55.0/60.0							-		
Germany9)10)	Continental	Double progressive	Spouse, children, grandchildren, parents (inheritance)	7.0	11.0		15.0	19.0		30.0	500,000[1]); 200,000 - 400,000[2]); 100,000[3])	0.20	0.52
			Parents (gifts), stepparents, sib-lings, nephews/ nieces, in-laws, divorced spouse	15.0	20.0		25.0	30.0		43.0	20,000		
			Others	30.0						50.0	20,000[4]); 80,724[5]); 31,865[6]); 5,310[7])		
Ireland9)	Peripheral	Progressive relationship	Child, grand-child, partner of predeceased child, parents	33.0							320,000	0.15	0.68
			Siblings, niece/ nephew, sibling-in-law								32,500		
			Others								16,250		
Italy9)	Southern	Progressive relationship	Spouse, linear relatives	4.0							1,000,000	0.05	0.11
			Siblings	6.0							100,000		
			Other relatives & certain relatives by marriage								0.0		
			Others	8.0									
			Persons with disablement	The rate depends on the relationship of heir and deceased.							1,500,000		

Source: Drometer et al. (2018), Ernst & Young (2019), OECD (2020), own research and presentation. - 1) Spouse. - 2) Children and grandchildren. 3) Others. 4) Inheritances. - 5) Gifts for spouses. - 6) Gifts for grandchildren. - 7) Gifts for great-grandchildren. – 8) Separate inheritance and gift taxation systems. – 9) United inheritance and gift taxation systems. – 10) Simplified representation of tax schedules.

In all five EU countries under consideration, revenues from inheritance taxation measured relative to GDP and to total tax revenues are rather limited. In 2019, they range between 0.63% of GDP and 1.38% of total tax revenues in France and only 0.05% of GDP and 0.11% of total tax revenues in Italy.

To simulate the inheritance tax rules, in place in 2020, we need to simplify the complexity of the tax rules. Naturally, we face a trade-off between generalisation and comparability on the one hand and accuracy on the other hand. The tax provisions on which our simulations are based are taken from two sources: the Country Tax Guides provided by IBFD,[5] and the EWIGE 2 Euromod Wealth Taxation Project (European Commission 2019).

First of all, three types of donees are distinguished: the partner or spouse; children and direct relatives; and other donees. Although it is important to acknowledge that children and other relatives enjoy different levels of exemption limits, we subsume them under one category in our modelling strategy and uniformly apply the more generous exemptions for direct descendants. Furthermore, it is assumed that the conditions for favourable treatment are fulfilled. As there is no natural anchor to simulate the timing and amount of gifts, we focus on the inheritance tax. Wealth transfers due to the death of the bequeather can be modelled by using age- and gender-specific mortality probabilities. These have been an essential ingredient of population statistics and demographic projections for several decades. Contrary to bequests, the research on the timing and amount of gifts is far less advanced. This uncertainty leads us to focus on modelling wealth transfers only in the form of inheritances. This implies that simulated wealth transfers occur later, on average, than actual transfers. Indeed, inter-vivo transfers are implicitly considered at the latest moment possible – the time of death – and consequently, we observe associated tax revenues with a time lag. Taxation rules are rather similar for both types of transfers; hence, the aggregated total of tax revenues over the projection period is very likely still unbiased.

Table 2 gives an overview of the tax provisions relevant for the determination of the tax base, i.e. valuation rules and deductions.

Table 3 contains the most important[6] personal tax exemptions granted to donees by different degrees of relationship to the testator: spouses/partners, children, other relatives, and unrelated others. Overall, the level of personal exemptions has a rather broad range in the five countries under consideration; and it depends on the closeness between bequeather and heir. Finland is an exception insofar as personal exemptions are rather moderate compared to the other countries included, and as only spouses/partners, children and grandchildren enjoy exemptions. In all of the other four countries, various groups of heirs beyond spouses and partners and direct ascendants (e.g. parents or grandparents) are granted exemptions at varying and differentiated levels.

For partners/spouses, the tax exemptions are most generous, ranging between € 90,000 (Finland) and € 1 million (Italy). In France and Ireland, partners[7]/spouses are completely tax exempt. For children and other direct relatives, exemptions are less generous in all countries except Italy, where children enjoy the same tax-free amount as partners/spouses (i.e., € 1 million). Tax exemptions for most other donees are considerably lower.

[5] IBFD Country Tax Guides by Ambagtsheer-Pakarinen (2020) for Finland, Joannard-Lardant (2020) for France, Perdelwitz (2020) for Germany, Rodriguez (2020) for Ireland, and Gallo (2020) for Italy.

[6] Specific additional tax exemptions may apply, e.g. for physically or mentally disabled heirs in France.

[7] In France, partners are tax exempt within a civil partnership (PACS) and if the bequeather has made a corresponding will.

Table 2: Tax provisions determining the inheritance tax base

	Valuation		Important deductions	
Country	General	Selected specifics	Household main residence	Business assets
Germany	Market value		-100%[1)]	-85% / - 100%[1)]
Finland	Market value	Business assets: Valuation Law[1)]	-	-60%[1)]
France	Market value	-	-	-75%[1)2)]
Ireland	Market value	-	-100%[1)]	-90%[1)]
Italy	Market value	Household main residence andreal estate: cadastral values	-	-90%

Source: Country Tax Guides IBFD, EWIGE 2 Euromod Wealth Taxation Project; own representation. – [1]) If certain conditions are met. – [2]) Plus reduction of tax liability by 50% if transfer of firms before the age of 70 years.

Table 3: Tax exemptions within the inheritance tax

	Donee			
Country	Spouse/Partner	Child	Other relatives	Unrelated others
Germany	€ 500,000	€ 400,000[2)]	€ 20,000[7)8)] / 100,000[5)6)] / 200,000[4)]	€ 20,000
Finland	€ 90,000	€ 60,000[1)10)]	€ 60,000[1)4)]	-
France	100%	€ 100,000	€ 1,594[11)] / € 7,967[8)] / 15,932[5))] / 100,000[6)]	€ 1,594
Ireland	100%	€ 335,000[3)]	€ 32,500[4)6)7)8)] / 335,000[5)]	€ 16,250 / € 335,000[10)]
Italy	€ 1,000,000	€ 1,000,000	€ 100,000[7)] / 1,000,000[4)5)6)]	-

Source: Country Tax Guides IBFD, EWIGE 2 Euromod Wealth Taxation Project; own representation. – [1]) Below 18 years. – [2]) Including stepchild; additional exemptions (decreasing with age) for children up to 26 years of age. – [3]) Including foster child, minor child of a deceased child. – [4]) Grandchild. – [5]) Sibling. - [6]) Parent. – [7]) Grandparent. – [8]) Niece/nephew. – [9]) Grandchild. – [10]) Widow(er) of a deceased child. – [11]) First cousin.

An overview of the tax schedules for the selected five countries is provided in Table 4. Tax schedules differ markedly across countries. Ireland and Italy levy a flat tax with a uniform tax rate of 33% and 4%, respectively, for children; in Italy the 4% flat rate applies also to partners/spouses (who are tax exempt in Ireland). The remaining three countries have double progressive taxes: the tax schedule includes several tax brackets (five brackets in Finland, seven brackets in France and Germany) with increasing tax rates. France and Finland apply progressive marginal tax rates, i.e. the increasing marginal tax rate is applied to the amount exceeding the value limit of the respective tax brackets only. In Germany, the design of the tax schedule is special insofar as it implies progressive average tax rates: if the taxable inheritance exceeds the respective upper bound of a tax bracket, the higher tax rate is applied to the total taxable acquisition and not only to the part exceeding the lower tax bracket.

Tables 5, 6 and 7 contain the tax schedules for Germany, Finland and France for direct relatives[8] as well as for other related and unrelated donees.

[8] Direct relatives include, besides partner and spouse, direct descendants, i.e. blood relatives in the direct line of descent (children, grandchildren, etc.) as well as direct ascendants, i.e. blood relatives preceding in lineage (parent, grandparent, etc.).

Table 4: Overview of inheritance tax schedules

Country	Type	Donee Spouse/Partner Children	Other relatives	Unrelated others
Germany	progressive average rates	7 brackets 7% - 30%[1)]	7 brackets 7% - 30%[2)3)4)5)] 7 brackets 15% - 43%[6)7)]	7 brackets 30% - 50%
Finland	progressive marginal rates	5 brackets 7% - 19%	5 brackets 7% - 19%[2)3)4)5)9)] 5 brackets 19% - 33%[6)7)12)]	5 brackets 19% - 33%
France	progressive marginal rates	7 brackets[8)]	7 brackets 5% - 45%[2)3)4)5)9)] 2 brackets 35% - 45%[6)] 55%[10)] 60%[11)]	60%
Ireland	flat tax rate	33%[8)13)]	33%	33%
Italy	flat tax rate	4%[8)]	Flat rate 4%[2)3)4)5)9)] flat rate 6%[6)10)] flat rate 8%[11)]	8%

Source: Country Tax Guides IBFD, EWIGE 2 Euromod Wealth Taxation Project; own representation. – [1]) Including stepchild. – [2]) Grandchild. – [3]) Great grandchild. – [4]) Parent. – [5]) Grandparent. – [6]) Sibling. – [7]) Nephew/niece. – [8]) Spouse/partner tax exempt. – [9]) Other direct ascendants or descendants. – [10]) Other blood relatives up to the 4th degree. – [11]) Remote blood relatives. – [12]) Other relatives. – [13]) Including foster child.

Table 5: Inheritance tax schedule Germany

Inheritance up to €	Average rates (%)[1)] Direct relatives[2)]	Other relatives[3)]	Unrelated others[4)]
75,000	7	15	30
300,000	11	20	30
600,000	15	25	30
6,000,000	19	30	30
13,000,000	23	35	50
26,0000,000	27	40	50
>26,000,000	30	43	50

Source: Country Tax Guides IBFD, EWIGE 2 Euromod Wealth Taxation Project; own representation. – [1]) The average tax rate is applied on the total amount of the wealth transfer, not only on the corresponding amount per bracket. – [2]) Spouse/partner, child, stepchild, grandchild, great grandchild, parent, grandparent. – [3]) Sibling, nephew, niece, stepparent, son-/daughter-in-law, parent-in-law, divorced spouse/partner. – [4]) Including legal entities.

Table 6: Inheritance tax schedule Finland

Taxable amount	Marginal rates (%)	
From € to €	Direct relatives[1)] tax on lower amount (€) / rate on excess (%)	Other relatives and unrelated others tax on lower amount (€) / rate on excess (%)
20,000 – 40,000	100 / 7	100 / 19
40,000 – 60,000	1,500 / 10	3,900 / 25
60,000 – 200,000	3,500 / 13	8,900 / 29
200,000 – 1,000,000	21,700 / 16	49,500 / 31
1,0000,000 and above	149,500 / 19	297,500 / 33

Source: Country Tax Guides IBFD, EWIGE 2 Euromod Wealth Taxation Project; own representation. –
[1]) Spouse/partner, any direct descendant or ascendant (including adoptive child) of the bequeather, any direct descendant of the bequeather's spouse.

Table 7: Inheritance tax schedule France

Net taxable share (€)	Marginal rates (%)	
Up to	Direct relatives[1)]	Others[5)]
8,072	5	55[3)] / 60[4)] flat rate
8,072 – 12,109	10	
12,109 – 15,932	15	
15,932 – 552,324	20	
552,324 – 902,838	30	
902,838 – 1,805,677	40	
Over 1,805,677	45	

Source: Country Tax Guides IBFD, EWIGE 2 Euromod Wealth Taxation Project; own representation. – [1]) Direct ascendants or descendants. – [2]) Spouse/partner tax exempt. – [3]) Blood relatives up to the 4th degree. – [4]) Remote blood relatives and unrelated others. – [5]) Siblings: 35% up to € 24,430, 45% above € 24,430.

3. Estimating the tax base for potential inheritance tax schemes

Since the 2007/08 global financial and economic crisis, and especially after the publication of Thomas Piketty's "Capital in the Twenty-First Century" (Piketty 2014), empirical research on the distribution and taxation of wealth has gained momentum. The current pandemic-induced economic crisis and the question of how to finance the massive fiscal intervention of governments will increase the need for reliable estimations of wealth-related tax revenues. The basis for our estimation is the Household, Finance and Consumption survey (HFCS) conducted by the European Central Bank (ECB). In the spring of 2020, the third wave of the HFCS was released, providing information about the composition and distribution of wealth in 22 EU Member States for the year 2017.

The HFCS is designed and conducted to explore the wealth situation of private households within the Euro Area in order to evaluate the potential risk of macroeconomic shocks on private households. The shortcomings of this survey, especially with regard to questions of inequality, are differential non-reporting, i.e. that non-reporting is positively correlated with wealth, and underreporting of wealth.

There is strong empirical evidence suggesting that the top tail of wealth distributions follows a Pareto distribution (see e.g. Davies, 1993, Bach et al., 2019, Eckerstorfer et al., 2016). Vermeulen (2014, 2016, and 2018) suggests dealing with the differential non-response issue by combining household survey data with rich lists to estimate a Pareto distribution for the top tail of the wealth distribution.

Thus, we augment the survey data of each country with the observations from a rich list (e.g. the *Forbes* billionaires list), and then we estimate the shape parameter of the Pareto distribution for that augmented sample. Finally, we replace the top tail of the household survey by the estimated Pareto top tail.

The second issue is the under-reporting of certain assets in surveys like the HFCS, meaning that aggregated wealth for a given country is typically considerably lower according to the survey as compared to national (financial) balance sheets. For example, compared to national balance sheets, 73.12% of Italy's financial wealth is missing in the third wave of the HFCS[9]. Vermeulen (2016) suggests the introduction of rescaling factors for the three main assets categories (real assets, financial assets, and liabilities) so that the totals of the survey match the totals of the national balance sheets. We use this concept of Vermeulen (2016) and the work of Chakraborty et al. (2019) to create a method that estimates the Pareto tail and adjusts to the financial balance sheet aggregates while keeping most of the socio-demographic micro data of the HFCS intact. By using only data sources that are readily available for all euro Area countries, namely the HFCS data, financial balance sheets and the Forbes rich list, this method can be applied to all HFCS countries and all countries that conduct surveys similar to the HFCS.

[9] This gap is reduced but not closed by estimating the Pareto tail of the wealth distribution.

HFCS

The HFCS is conducted in a decentralised manner by all the national banks of the Eurosystem, the central banks of three EU countries that have not yet adopted the euro, and several national statistical institutions (European Central Bank 2020B).

The HFCS generally contains five implicates, i.e. it imputes missing or invalid responses to also harvest the information of incomplete observations (see European Central Bank 2020B). Although almost all HFCS countries use multiple imputation, three out of the five countries we are considering in this report (i.e. France, Italy and Finland) do not have implicates. For variance estimation, the survey provides bootstrap replicate weights.[10]

For most countries, the HFCS also tries to oversample wealthy households to address potential non-observation bias based on different criteria, such as regional indicators, personal income, dwelling size, etc.

The gross and net sample size, the response rate, and the oversampling rate for the five countries considered in this study are shown in Table 8.

Table 8: Summary statistics for the HFCS

	Summary statistics HFCS				
Country	Germany	Finland	Ireland	Italy	France
Gross sample size	16 375	13 396	13 200	15 379	21 484
Net sample size	4 942	10 210	4 793	7 420	13 685
Response rate (%)	16.1	60.1	38.5	36.6	64.2
Effective oversampling rate of the top 10%	140	83	72	5	158

Source: European Central Bank (2020B), p. 33 and 37.

Forbes rich list

The Forbes magazine creates a wealth ranking of very rich individuals or families every year since the 1980s. To make it on the Forbes list, one must have an estimated fortune of at least US$ 1 billion.

As noted in Bach et al. (2019), the reliability of rich lists is contested because of a lack of transparency and consistency. Many different data sources, e.g. public registers, financial markets, business media and interviews of wealthy individuals, are used to compile those rich lists. We use the Forbes World's billionaires list of 2017 to match the data as best as possible to the fieldwork period of the third wave of the HFCS.

Bach et al (2019) discuss in detail a variety of potential issues associated with rich lists. One issue that could be problematic for our estimations is potential over-estimation of the wealth concentration at the very top of the wealth distribution as rich lists report wealth for entire entrepreneurial families that in reality consist of several households. We partially address this issue by also relying on the latest Forbes rich list of 2020 to approximate families among the Forbes entries. In particular, the 2020 list includes an indicator "& family", i.e. wealth is held by more than one household. Although one can observe significant changes between annual Forbes rich lists (rank and size of wealth), we could match many of the names of the 2017 list to the 2020 edition. Thus, we assume that if wealth is held by more than one household in 2020 that this was already the case in 2017. If no information was available, it is assumed that wealth was held by one household. Table 9 displays the number of Forbes US$ billionaires, the least rich and the richest person and the sum of billionaires' wealth for each of the five relevant HFCS countries.

[10] The replicate weights allow calculating correct standard errors in the multiple imputation framework (see HFCN, 2020).

Table 9: Summary statistics of the Forbes rich list

	Summary statistics Forbes lists				
Country	Germany	Finland	Ireland	Italy	France
N	114	7	8	42	38
Total wealth, bn. €	414	11.4	30.3	134.5	217
Mean, bn. €	3.6	1.6	3.8	3.2	5.7
Least rich person, bn. €	1	1.1	1	0.9	1
Richest person, bn. €	24.1	3.1	12.7	22.3	36.7

Source: Forbes World's billionaires list 2017; own representation.

Financial balance sheets

In chapter 3.2 we discuss at length how survey data can be adequately compared with the financial balance sheets, and Tables 11 to 13 show to what extent the HFCS covers the aggregated wealth outlined in the financial balance sheets.

However, we cannot take for granted that aggregated data in the national accounts in general, and in the financial balance sheets in particular, are superior to aggregated survey data. This becomes apparent when looking at the case of German business wealth in the respective household balance sheet. The system of national accounts seems to be particularly failure-prone for accounting for the so-called "German *Mittelstand*" and attributing it to the household balance sheet.

A large share of the "*Mittelstand*", i.e. the wealth of non-publicly traded corporations, seems to be missing in the Household balance sheet (see also Albers et al. 2020). As already mentioned in Bach et al. (2019), the large amount of corporate net wealth (€ 3.4 trillion in 2017) must belong to somebody. Therefore, Bach (2020) conservatively estimates that compared to the aggregate outlined in the household balance sheet of 2017, business wealth held by German households has to be increased by € 1.3 trillion. The methodology we employ allows us to account for such considerations by simply changing the aggregates to which the survey data has to be adjusted.

3.1 Methodology

We briefly sketch the methodology in the following, as it is described in detail in Vermeulen (2014, 2016 and 2018), Bach et al. (2019) and Chakraborty et al. (2019).[11]

The tail density function of the Pareto distribution is given by

$$f(w_i) = \begin{cases} \frac{\alpha w_{min}^{\alpha}}{w_i^{\alpha+1}} & \text{if } w_i \geq w_{min} \\ 0 & \text{if } w_i < w_{min} \end{cases} \quad (1)$$

where w_i is the gross wealth of household i , w_{min} is the lower bound of the Pareto distribution, and α is the shape parameter which is to be estimated. The lower α, the fatter is the tail of the distribution and the more unequal wealth is distributed among households.

The complementary cumulative distribution function (ccdf) reports the probability of observing wealth above a certain wealth level w_i and can be derived as follows:

$$P(W \leq w_i) = F(w_i) = \int_{w_{min}}^{w} f(t)dt = 1 - (\frac{w_{min}}{w_i})^{\alpha}\ ;\ \forall w_i \geq w_{min} \quad (2)$$

[11] For an in-depth analysis and critical review of the methodology see Dalitz (2016).

$$\mathrm{P(W > w_i) = 1 - P(W \leq w_i) = (\frac{w_{min}}{w_i})^{\alpha} ; \forall w_i \geq w_{min}} \tag{3}$$

If, in a finite Population of N households, each has wealth at or above $\mathrm{w_{min}}$ we denote by $\mathrm{N(w_i)}$ the number of households that have wealth at or above $\mathrm{w_i}$. Then, wealth follows a power law if being distributed according to the following relationship:

$$\frac{\mathrm{N(w_i)}}{\mathrm{N}} \cong (\frac{\mathrm{w_{min}}}{\mathrm{w_i}})^{\alpha} ; \forall \mathrm{w_i} \tag{4}$$

This implies that the fraction of households with wealth at or above $\mathrm{w_i}$ follow the regularity of a power function. If we draw a random sample from that population, we can denote by $\mathrm{n(w_i)}$ the number of observations that have wealth at or above $\mathrm{w_i}$, which is also called the rank of an observation. The wealthiest household in the sample has rank one, the second-wealthiest has rank two, etc. The relative frequency in the sample ($\frac{\mathrm{n(w_i)}}{\mathrm{n}}$) is an estimate of the relative frequency in the population ($\frac{\mathrm{N(w_i)}}{\mathrm{N}}$):

$$\frac{\mathrm{n(w_i)}}{\mathrm{n}} \cong \frac{\mathrm{N(w_i)}}{\mathrm{N}} ; \forall w_i \tag{5}$$

Now we can combine the relative frequency of the sample with the ccdf (equations 4 and 5):

$$\frac{\mathrm{n(w_i)}}{\mathrm{n}} \cong (\frac{\mathrm{w_{min}}}{\mathrm{w_i}})^{\alpha} ; \forall w_i \tag{6}$$

In order to estimate α using OLS, we take the logarithm of (6):

$$\ln \frac{\mathrm{n(w_i)}}{\mathrm{n}} = -\alpha \ln \frac{\mathrm{w_i}}{\mathrm{w_{min}}} \tag{7}$$

Vermeulen (2014) emphasises the importance of taking into account the complex survey design of the HFCS. In the HFCS the survey weight of each observation stands for the number of households that this sample point represents. In a first step, the households have to be ranked: the wealthiest household with $\mathrm{w_1}$ and rank $n(w_1) = 1$ has a survey weight of $\mathrm{N_1}$,etc. The relative frequency of the wealthiest household is $\frac{\mathrm{N_1}}{\mathrm{N}}$, the relative frequency of the second-richest household is $\frac{\mathrm{N_1+N_2}}{\mathrm{N}}$, etc. Now the rank of $\mathrm{n(w_i)}$ can be replaced by the sum of all survey weights of sample observations at or above a wealth level of $\mathrm{w_i}$. Finally, the sample size n can be replaced by the population size N, whereas N is the sum of all survey weights of the sample points with wealth at or above $\mathrm{w_{min}}$ (Vermeulen 2014).

It should be noted, however, that usually shape parameters of power laws are estimated via maximum likelihood (ML). Vermeulen (2014) provides a pseudo maximum likelihood estimator, which also accounts for the complex survey design of the HFCS. However, after conducting a Monte Carlo simulation comparing both estimators, he decides to go along with OLS instead of ML.

The more important remaining question, however, is how to determine $\mathrm{w_{min}}$. Vermeulen (2014 and 2016) circumvents the problem by providing three different scenarios, estimating α for lower bounds of € 500,000, € 1 million, and € 2 million. This approach is criticised in Eckerstorfer et al. (2016) who estimate the Pareto parameters for Austria based on the HFCS data of the first wave. The authors rightly point out that the “correct” lower bound is crucial: a lower bound that is in fact too low would bias the results, whereas a lower bound which is too high would ignore useful information. Following Clauset et al. (2009), Eckerstorfer et al. (2016) compare the goodness of fit of 30 combinations of lower bound and shape parameter and choose subsequently the best fitting combination. They apply the Cramer-van Mises criterion to test the goodness of fit. As concluded in Dalitz (2016) the Cramer-van Mises criterion and the Kolmogorov-Smirnov criterion (KS) have typically the same qualitative dependency on w_{min}. This means that both criteria yield very similar optimal choices for w_{min}. For our purposes we indeed use the KS in order to test the goodness of fit of scenarios with lower bounds between € 500,000 and € 3 million (interval size of € 250,000). Normally, the goodness of fit is measured by the distance between the empirical cumulative distribution function $F_{emp}(w)$ and the fitted cumulative distribution function $F_{fit}(w)$ according to w_{min} and the corresponding estimated α. Clauset et al. (2009) prefer the KS test statistic, which maximizes the distance between the two distributions ($N(w_i)$and $N(w_{min})$), here being the sum over all weights at or above either w_i or w_{min}):

$$KS = \max_{w \geq w_{min}} \left|F_{fit}(w) - F_{emp}(w)\right| = \max_{w_i \geq w_{min}} \left| \left(\frac{w_i}{w_{min}}\right)^{-\alpha} - \frac{N(w_i)}{N(w_{min})} \right| \tag{8}$$

We chose the optimal level of w_{min} such that KS is minimized. In line with Bach et al. (2019), we find that lower bounds of € 1 million and € 2 million are indeed too high for Germany, Italy and Finland. For those three countries the goodness of fit for combinations of the shape parameter with a lower bound of € 500,000 was better than combinations with € 1 million and € 2 million, respectively. We find, however, that the optimal lower bound of Ireland is € 1 million, whereas for France it is even € 3 million.

3.2 Adjustment to national balance sheets

As mentioned above, there is a large gap between the aggregates of financial assets and liabilities in the HFCS and the ones outlined in the national balance sheets. However, a comparison between HFCS variables and financial balance sheets is not always straightforward. Based on the work of Kavonius and Törmälehto (2010), Chakraborty et al. (2019) focus on how to best compare those two data sources. In order to make both sources comparable at the aggregate level, they not only eliminate all assets and liabilities that are only covered in one of the two sources, but also those that are hard to compare. Table 10 illustrates the matching of HFCS asset components to their counterparts in national aggregates. Although efforts are being made by the ECB[12] to harmonise all micro-level and macro-level household wealth data, we follow Chakraborty et al. (2019) and focus on how household financial wealth based on the HFCS matches the corresponding aggregates from financial accounts. The most important category of households' real assets, namely housing wealth, that can be derived from the national accounts, is a rough estimation in itself and is not applicable for most of the Euro Area countries. European Central Bank (2020A, p. 21)[13] states "For seven countries, information on dwellings and land underlying dwellings can be combined to derive a good estimate of housing wealth (although it covers NPISHs[14])." Thus, we do not adjust housing wealth – reported in the HFCS -because the households' own valuation of real assets is not fully comparable with the estimation derived from the national accounts, which include also housing wealth of NPISHs, and is not available for all Euro Area countries.

[12] ECB Expert Group on Linking Micro and Macro Household Data (EG-LMM).

[13] https://www.ecb.europa.eu/pub/pdf/scpsps/ecb.sps37~433920127f.en.pdf.

[14] Non-profit institutions serving households such as churches, unions, etc.

Table 10: Comparability of HFCS and financial balance sheets

Financial Accounts (ESA 2010)	HFCS variables
financial assets (+)	
F.21 Currency	N/A
F.22 + F.29 Deposits	HD1110 + HD1210
F.3. Debt Securities	HD1420 Bonds and other debt securities
F.4 Loans	HD1710 Money owed to household
F.5 Equity and investment fund shares	HD1510 Shares, publicly traded
	HD1010 Investment in non-self-employed business
	HD0200 Investment in self-employed business
	HD1320x Mutual Funds
F.6 Insurance, pension and standardised guarantee schemes	PF0920 Voluntary pension/whole life insurance schemes
	PF0700 Occupational Pension Plans
F.7 Financial derivatives and employee stock options	HD1920 Other financial assets
F.8 Other accounts receivable	HD1920 Other financial assets
N/A	HD1620 Managed Accounts
liabilities (-)	
F.4 Loans	DL1100 Mortgages and loans
	DL1200 Other, non-mortgage debt
F.8 Other accounts payable	N/A
financial net worth	
non-financial assets (+)	
N. 111 Dwellings	HB0900 Household main residence
N. 112 Other buildings/structures	HB28$x + HB2900 Other properties
N. 113 Machinery and equipment	N/A
N. 13 Valuables	HB4710 Valuables
N/A	HB4400 + HB4600 Vehicles
N. 211 Land	N/A (included in entries above)
net worth	

Source: Chakraborty et al. (2019, p. 35).

The comparison of national accounts variables and HFCS variables allows for the calculation of different coverage ratios, whereby the coverage ratio is simply defined as:

$$\text{coverage ratio financial assets} = \frac{\text{financial assets}_{\text{HFCS}}}{\text{financial assets}_{\text{ESA(2010)}}} \tag{9}$$

The **"Naïve Concept"** (Chakraborty et al. 2019) compares the following HFCS and ESA (2010) aggregates with each other:

$$\begin{aligned}\text{HFCS financial assets } = \text{DA2100} = {} & \text{HD1110} + \text{HD1210} + \text{HD1320x} + \text{HD1420} + \text{HD1010} + \\ & \text{HD1510} + \text{HD1620} + \text{HD1710} + \text{HD1920} + \text{DA2109}\end{aligned} \tag{10}$$

$$\begin{aligned}\text{ESA(2010) financial assets } = {} & \text{F.21} + \text{F.22} + \text{F.29} + \text{F.3} + \text{F.4(assets)} + \text{F.5} + \text{F.6} \\ & + \text{F.7} + \text{F.8}\end{aligned} \tag{11}$$

The **"Adjusted Concept"** excludes categories that are not comparable. For example, among all the subcategories of F.6 only F.62 "Life insurance and annuity entitlements" is included, while others, such as F.63 "pension entitlements" are not comparable to the survey and are thus excluded.[15] The adjusted concept also includes the value of self-employed business (DA1140) to total financial assets. This is owed to the fact that in the HFCS survey only the net value of the business is provided, whereas in the national accounts this value is spread across the balance sheet of the household sector including real assets and liabilities (Chakraborty et al. 2019). In a second adjustment scenario Chakraborty et al. (2019) split the self-employed businesses covered by the HFCS into their legal forms and subtract proprietors and partnerships from the value of self-employed business. Those two adjustment scenarios thus represent an upper and a lower bound of an adjusted coverage ratio.

$$\text{HFCS financial assets (adjusted)} = \text{DA2100} - \text{HD1710} - \text{HD1920} + \text{DA1140} \tag{12}$$

$$\text{ESA(2010)financial assets (adjusted)} = \text{F.22} + \text{F.29} + \text{F.3} + \text{F.5} + \text{F.62} \tag{13}$$

The comparison of Table 11 and Table 12 clearly demonstrates that the adjustment leads to significantly higher coverage ratios for all five countries.[16] Whereas the adjusted concept leads to Finland having a coverage ratio greater than 60%, the coverage ratio of Italy remains dramatically low (26.88%). Overall, the coverage ratios of liabilities:

$$\text{coverage ratio liabilities} = \frac{\text{liabilities}_{\text{HFCS}}}{\text{liabilities}_{\text{ESA(2010)}}}, \tag{14}$$

are not as low as those of financial assets. Both Finland's and Ireland's liabilities coverage ratios are close to 85% (Table 13).

[15] We disregard potential price effects when a growing fraction of pensioners exchanges their funds for other financial assets at the verge of retirement.

[16] Note that the values across implicates are identical for three of the five selected countries. Finland, Italy and France are among the small group of HFCS countries that do not use multiple imputation.

Table 11: Coverage ratios financial wealth, naïve concept

	Coverage ratio (%) financial wealth, naive concept				
Country	Germany	Finland	Ireland	Italy	France
Implicate 1	38.68	46.64	33.63	18.01	29.36
Implicate 2	38.30	46.64	35.29	18.01	29.36
Implicate 3	38.61	46.64	34.30	18.01	29.36
Implicate 4	38.41	46.64	34.84	18.01	29.36
Implicate 5	38.87	46.64	34.78	18.01	29.36

Source: HFCS, Eurostat.

Table 12: Coverage ratios financial wealth, adjusted concept

	Coverage ratio (%) financial wealth, adjusted concept				
Country	Germany	Finland	Ireland	Italy	France
Implicate 1	49.42	62.02	44.68	26.88	45.00
Implicate 2	49.84	62.02	46.71	26.88	45.00
Implicate 3	48.34	62.02	45.21	26.88	45.00
Implicate 4	49.66	62.02	45.76	26.88	45.00
Implicate 5	48.99	62.02	46.22	26.88	45.00

Source: HFCS, Eurostat.

Table 13: Liability coverage ratio (in %)

	Liability coverage ratio (%)				
Country	Germany	Finland	Ireland	Italy	France
Implicate 1	68.10	83.63	85.32	38.34	72.73
Implicate 2	69.07	83.63	85.57	38.34	72.73
Implicate 3	71.85	83.63	85.01	38.34	72.73
Implicate 4	70.30	83.63	84.64	38.34	72.73
Implicate 5	69.95	83.63	84.91	38.34	72.73

Source: HFCS, Eurostat.

3.3 Adjustment to financial accounts

Even after replacing the top tail of the wealth distribution according to the HFCS by an estimated Pareto distributed top tail (as described in section 3.2), a gap remains in many countries between total financial wealth according to the adjusted HFCS and aggregate financial wealth based on national accounts. This is why Vermeulen (2016) proposes to combine the Pareto tail adjustment to the HFCS with a reweighting approach to match exactly the financial balance sheets. We follow the author, as not including many billions of financial assets would result in a dramatic under-estimation of potential revenues of an inheritance tax. Basically, Vermeulen (2016) adjusts the HFCS data so that the totals of real assets, financial assets and liabilities from the Pareto tail combined with the ones below the Pareto tail match their counterparts in the national balance sheets. The problem with this approach is that it yields no unique solution as there are (at least) three unknown adjustment weights (one for each asset class).

Given that financial assets (including business assets) are severely under-represented and highly relevant for the top end of the wealth distribution, the lack of comparability between housing wealth of the two different data sources (HFCS and financial balance sheets), and the high coverage ratios for liabilities (up to 85%), we propose the following:

a. Real assets (mainly housing): relying on the original HFCS data
b. Liabilities: distributing the missing liabilities according to the empirical distribution (liabilities are not Pareto distributed)
c. Financial assets: adjusting them, such that total financial assets based on the adjusted wealth distribution (Pareto top tail adjustment combined with reweighting) matches total financial assets according to financial accounts.

Hence, financial assets should be reweighted by a factor (z) such that the sum of financial assets (fa) below the optimal lower bound w_{min}, real assets (ra) below the optimal lower bound w_{min}, and the Pareto tail (ranging between w_{min} and wealth of the "poorest" person of the Forbes rich list (F)) equals the sum of financial assets according to national accounts (FA) - net of total wealth held by Forbes entries (FW) -, and the total HFCS real assets[17]. We can denote by $N_{w_{min}}$ the number of households that have wealth between w_{min} and F.

$$z * \sum_{i=1}^{n_{w_{min}}} fa_i * hw_i + \sum_{i=1}^{n_{w_{min}}} ra_i * hw_i + N_{w_{min}} * \int_{w_{min}}^{F} w * f(w)dw \; = \; FA - FW + \sum_i ra_i * hw_i \; ^{18} \tag{15}$$

There is no analytical solution for equation (15), since for any given value of z, we estimate different values of w_{min} and α. Therefore, we propose a numerical solution to this problem. In particular, the algorithm has to find the optimal value for z_j.

$$z_j = \frac{j}{cr_{fa}} \; ; \; j \in \;]0,1] \; ^{19} \tag{16}$$

For every value of the adjustment factor of financial assets (z), a new gross wealth distribution is created, which in turn has a unique shape parameter (α) and a unique optimal lower bound (w_{min}). We determine numerically the optimal z_j (z*) for which the absolute value of the difference between adjusted HFCS data and the financial balance sheets is smallest:

$$z^* = \min_{z_j} \left| z_j * \sum_{i=1}^{n_{w_{min}}} fa_i * hw_i + \sum_{i=1}^{n_{w_{min}}} ra_i * hw_i + N_{w_{min}} * \int_{w_{min}}^{F} w * f(w)dw - \; [FA - FW + \sum_i ra_i * hw_i \,] \right| \tag{17}$$

There is a trade-off between precision, i.e. the difference between financial assets of the HFCS and the national accounts after all adjustments have been made, and computational time. The proposed settings, however, lead to differences between HFCS aggregates and national accounts being less than 0.1%.

[17] The necessary assumption being that wealth of the individuals on the Forbes rich list is solely composed of financial and business wealth.

[18] hw_i denotes the individual HFCS household weight; $n_{w_{min}}$ is the rank ordered observation at w_{min}; FW simply indicates the combined wealth of all Forbes rich list observations for the respective country.

[19] cr_{fa} denotes the coverage ratio for financial assets. The interval for j can be interpreted as a range of new coverage ratios. Italy's coverage ratio was 0.2688 before the adjustment via the weighting factor z. Italian households' financial assets are multiplied by z = 2.49, which is the result of the optimisation problem (see equation 17). Thus, the absolute value of the difference between adjusted HFCS data and the financial balance sheets is smallest for j = 0.669. In other words, the coverage ratio of financial assets in the Italian HFCS has to be 66.9% before the Pareto tail is estimated in order to be 100% after the Pareto adjustment. This means that 33.1% of Italian financial assets are added through the Pareto adjustment and 40% of financial assets are added through the adjustment factor z.

Table 14: Optimal parameters of the estimated Pareto top tail

Country	Germany	Finland	Ireland	Italy	France
Alpha	1.43	1.78	1.54	1.52	1.49
w_min (in €)	500,000	500,000	1,000,000	500,000	3,000,000
Households above w_min	5,808,017	354,109	187,384	3,617,814	239,274
Z	1.13	1.32	1.46	2.49	2.00

Source: own calculations.

3.3.1 Business wealth

Whereas the socio-demographic details as well as all subcategories of real assets of the HFCS remain the same, the subcategories of financial wealth get lost in the adjustment process. Very relevant in the design of every wealth tax is the question to what extent business wealth should be treated differently compared to other forms of wealth. In order to simulate respective scenarios, financial assets have to be split into a business wealth component and a non-business wealth component. It can be debated to what extent the financial balance sheets are capable of capturing business wealth owned by the household sector and what subcategories of the financial balance sheets best represent "business wealth". We propose that "unlisted shares" (F.512) and "other equity" (F.519) best represent the kind of business wealth that might be treated differently in potential inheritance taxation schemes.

Especially the categories F.512 and F.519, owned by households, might be undervalued in the financial balance sheets as discussed earlier based on the example of Germany. Ireland, however, is problematic too as wealth according to F.519 is not reported.

We approximate the business wealth component (included in total financial assets) by[20]:

$$\frac{\text{business wealth}_{\text{above wmin}}}{\text{financial assets}_{\text{above wmin}}} = \frac{\text{F.521}+\text{F.519}-\sum_{\text{i}=1}^{\text{n}_{\text{w}_{\text{min}}}} \text{bw}_{\text{i}}}{N_{w_{min}} * \int_{\text{w}_{\text{min}}}^{\text{F}} \text{w}*\text{f(w)}dw - \sum_{\text{i}=\text{n}_{\text{w}_{\text{min}}}} \text{ra}_{\text{i}}*\text{hw}_{\text{i}} + FW} \tag{18}$$

The business wealth component, thus, is a fixed share of financial assets.[21] Blanchet et al. (2019), for instance, proposes more sophisticated adjustment techniques matching the survey covariates to the estimated top tail of the (income) distribution. However, the huge gap in the HFCS financial asset information in general and business wealth information in particular make such an approach difficult. Overall, it can be argued that in general business wealth is more skewed than financial assets. The problem in this regard is that we purposefully exclude "listed shares" from the business wealth component in the anticipation that "listed shares" will not be exempted or treated differently compared to other forms of financial assets in potential inheritance schemes. The wealth of the very rich, however, is often composed of "listed shares" and not "unlisted shares".[22] Should future research indicate that the distribution of F.512 and F.519 is heavily skewed towards the top, our approach can easily be corrected as it is corrected in the case of the missing German "*Mittelstand*" (generally German small and medium-sized enterprises) described above and in detail in Albers et al. (2020), Bach et al. (2019) and Bach (2020).

[20] Business wealth owned by household i, as reported in the HFCS survey is denoted as bw_{i}

[21] Naturally this reduces the variation in the share of business assets in total assets across household. This should be taken into account in the inheritance tax simulations, in particular if business assets are treated differently from other financial assets.

[22] When analysing the fortunes in the Forbes rich list, like that of Bernard Arnault (resident of France), one finds that they are often composed of the shares of listed companies.

3.3.2 Liabilities

In contrast to business wealth, the HFCS covers liabilities reasonably well. As outlined in Table 13, for countries such as Ireland or Finland roughly 15% of total liabilities are missing in the survey data and even for countries where the respective coverage ratio is smaller the overall distribution across gross wealth deciles is very similar. The missing liabilities are therefore distributed among all households according to the empirical distribution in the HFCS. Table 15 shows the empirical distribution of liabilities across gross wealth deciles.

Table 15: Distribution (%) of liabilities across gross wealth deciles (implicate 1)

	Distribution (in %) of liabilities across gross wealth distribution (implicate 1)				
Deciles	Germany	Finland	Ireland	Italy	France
1	1	1	0	1	0
2	1	1	0	1	2
3	1	2	1	1	1
4	2	5	3	4	3
5	2	8	8	8	9
6	6	12	10	11	14
7	12	13	11	11	14
8	16	16	13	12	14
9	18	16	18	14	17
10	41	27	34	36	27
	100	100	100	100	100

Source: HFCS.

3.4 Creating synthetic households

After estimating the lower bound (w_{min}) and shape (α) of the Pareto distribution separately for every country, we have all indispensable ingredients to impute the missing wealth at the top of the distribution.

This procedure consists of several steps. First, we determine the number of observations in the survey between the cut-off w_{min} and the start of the Forbes rich list as well as the corresponding sum of household weights. The ratio of these two numbers will be used later as the base weight for all observations within the range of Pareto imputations. The second step is to draw as many random values from a Pareto distribution as we observe in the original HFCS above the cut-off, w_{min}. In other words, we replace original HFCS observations by randomly generated synthetic observations in the wealth distribution between w_{min} and wealth of the poorest Forbes list observation. Actually, as we are aiming for a good representation over the complete wealth spectrum[23], we draw two separate samples with the same α parameter. The first and larger sample starts at w_{min}, the second sample of the remaining hundred draws starts at € 100 million. The benefit of this approach is that it combines two desired properties: (i) it achieves a fairly good representation of the wealth distribution between w_{min} and the observations from the Forbes rich list at the very top, while (ii) relying on a comparatively small sample. Other authors have drawn large numbers of random values and thereby achieve a precise representation of the implied upper tail. However, such a procedure is not feasible for our application, as it would cause significant computational burden during the probabilistic simulation of deaths and wealth transfers.

[23] We create synthetic observations such that they provide a fairly good (discrete) representation of the continuous Pareto distribution in the top tail, based on the parameters estimated in the step before.

An additional measure to resemble a Pareto distribution as closely as possible is our calibration of survey weights within segments of the upper tail. Without recalibration of survey weights, the distribution of wealth in the Pareto tail would be determined by random draws of the synthetic observations. Therefore, we recalibrate their weights such that they represent fairly well the continuous Pareto distribution in the top tail. In particular, we define several strata, from € 5 million, in steps of € 1 million until we reach € 10 million. Above this value, we use two more intervals that are bounded above by € 100 million and € 1 billion, respectively. For each of these segments, we calculate the sum of weights according to the (continuous) theoretical Pareto distribution, determined before, and re-adjust the individual weights of the synthetic observations accordingly.

The next step is to combine the vector of Pareto distributed assets with the HFCS data. We conduct the matching based on the wealth rank of the observed household. This means that the ranking of households in the data remains the same after the data adjustments. We retain all sociodemographic variables and some wealth components and replace their total assets by the draws of the Pareto distribution. Based on the total assets and the information on real assets in the raw data, we derive the implied value of adjusted financial assets (financial and business assets) in the upper tail.

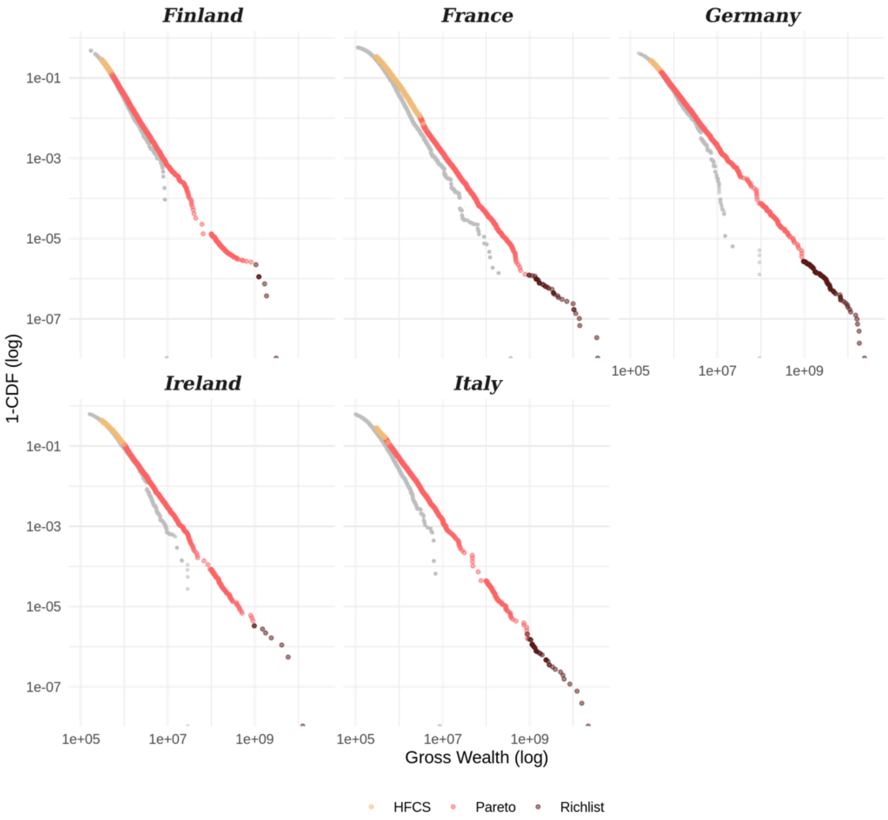
Furthermore, at the very top of the wealth distribution we add information about the super-rich by including the observation from the Forbes rich list since they are the best empirical estimate for the very top. In each of the five countries several individuals made it on the Forbes rich list. Their number ranges between seven (Finland)to more than 100 (Germany). Assuming real assets to be covered well in the survey, the wealth of billionaires is assumed to consist only of financial and business assets. In addition to their levels of adjusted financial wealth, we add some socio-economic variables from the super-rich as well. These include their age and gender and an indicator if they share their fortune with a larger family.

The adjusted financial assets of the Pareto-interpolated households and the richest individuals from the Forbes rich list is then further separated into an estimate for financial assets and another one for business assets. As described above, this is done by applying a constant factor that is derived from the fraction of business wealth in relation to adjusted financial assets above w_{min}. Finally, we close the gap between observed levels of debt and the data from financial accounts, by adding the average gap stratified by deciles of total assets to the liabilities of every household.

Figure 1 gives a first impression on the results of the exercise. It is a so-called log-log diagram of total assets on the x-axis and the probability of a household holding at least that level of assets[24] for all households above € 500,000, which was found to be the optimal starting value for the Pareto distribution in a majority of countries on the y-axis. The Pareto distribution is a special case in the family of exponential distributions, which is why the points in the graph should follow a linear path on a double-logarithmic scale. The grey dots represent the original HFCS as they appear in the survey, whereas the coloured dots are based on the adjusted and augmented data. These shift to the right, which means that the observed levels of total assets lie well above the original data. The maximum values by country in the raw data are between € 10 million (Finland and Italy) and € 100 million (Germany). After the augmentation of our data with observations from the Forbes rich list (depicted in dark red) and the Pareto interpolation (in red), the maximum value is greater than € 10 billion in all five countries.

[24] This is equivalent of 1 – cumulative density function.

Figure 1: Log-log diagram of total assets before and after data adjustments



Source: HFCS 2017, own calculations.

4. Impact of data adjustments on wealth aggregates and on the wealth distribution

This section provides descriptive statistics that reveal the effect of the data adjustment procedure on aggregates of household wealth and its components. Furthermore, we show that the alignment of financial assets to the sums implied by financial accounts, the imputation of missing wealth at the top of the distribution as well as the inclusion of data from the Forbes list cause a significant upward shift of measured wealth concentration levels across various inequality metrics.

Aggregates

Table 16 compares the aggregates of wealth components of the original HFCS data (raw) with the adjusted ones. The change in net wealth is large for all five countries and is a result of the adjusted financial assets as well as adjusted liabilities. The biggest change (Delta) in net wealth can be observed for Italy (+47%). The large increase (more than triplication) in financial assets[25] is solely responsible for the change in total assets as the small changes in real assets are a by-product of the weighting procedure, which is necessary for creating the synthetic households.

Table 17 splits aggregate wealth between three segments, (i) the segment of the population below and (ii) above the optimal lower bound, which is different for France and Ireland, as well as (iii) the observations of the Forbes rich list. It also shows again the assumption that the high fortunes are solely comprised of business and financial assets, the latter including listed shares.

Inequality

Tables 18 to 23 offer descriptive statistics of the unconditional distribution of total assets, net wealth, and their components. In these table we specifically look at the distribution of the variables without conditioning on other variables. Hence, the concentration indicators (e.g. top 5% share) show the share of assets that belong to those households with the largest possession of this asset category. In contrast, Table 24 and 25 look at the joint distribution of total assets and net wealth with their components. Here households are sorted into deciles based on total or net wealth levels, and average wealth levels as well as shares of totals are reported for the subcomponents of their portfolios.

Table 18 allows a comparison between the change of the mean gross wealth and the median gross wealth. The median for all five countries increases only slightly between 4.79% and 13.17%, while the mean of the same four countries increases between 16.3% and 51.83%. All Gini coefficients increase accordingly.

Table 19 applies the same inequality indicators to the net wealth distribution before and after the adjustment. The changes to the median of the net wealth distribution are also less pronounced and range between -2.13% and 10.88% for all five countries. With the stark exception of Germany, where the distribution of net wealth is the least equal (Gini of 0.81), the Gini coefficients are very similar among the studied countries (0.70–0.73).

Table 20 applies the inequality indicators to real assets. The Delta in this table is always close to zero because the only change of real assets happened as a by-product in the process of creating the synthetic households. The most striking result is the unequal distribution of unadjusted real assets in Germany (Gini: 0.74) compared to the other four countries (Gini: 0.58–0.63), which is partly due to the comparatively low home-ownership rate in Germany.

[25] This emphasises the poor coverage of financial assets in the Italian part of the HFCS compared to financial accounts. Naturally, any survey adjustment is associated with uncertainty due to the modelling choices. The same holds true for the chosen Pareto adjustment, which is well-stablished in the literature. However, in interpreting the simulation results we have to bear in mind the implicit uncertainty due to the Pareto adjustment.

Table 21 applies the inequality indicators to financial assets. After the adjustment, the median household in our data holds between roughly € 11,000 and € 24,000, while the mean is in a range from roughly € 71,000 to € 184,000. The Gini coefficients for the adjusted financial assets are in the record-breaking range of 0.80 to 0.90. Worth noting is also the Delta in the "share top 5%". Germany's Delta is 73.87%, i.e. the share of financial assets held by the top 5% increases from 39% to 86%.

In Table 22 the median household of all five countries holds zero business wealth and the respective Gini coefficients are all close to one. The adjusted mean business wealth of all five countries is reassuringly comparable in magnitude and very similar between Italy, Germany and France (between € 40,500 and € 44,000) and Finland and Ireland (between € 24,500 and € 28,500), respectively.

Table 23 shows inequality statistics for liabilities. With the exception of the Theil index, all inequality measures indicate a substantial reduction of the dispersion of debt. How can this be accounted for? The gap between the survey and the financial accounts was closed by adding the average absolute difference between observed and predicted levels of debt in each decile. Thereby the relative shares of debt by deciles of total assets remain constant (see Table 23), but the within inequality in each decile is dampened significantly. As a consequence, nearly all households hold at least small amounts of liabilities in the adjusted data.

Table 24 displays the mean value per deciles of total assets for every asset category as well as what percentage of the respective asset category is owned per decile. Table 25 provides similar statistics for deciles of net wealth.

Table 16: Wealth aggregates before and after data adjustments (€ billion)

	Finland	*France*	*Germany*	*Ireland*	*Italy*
Net Wealth					
HFCS (raw)	550	7050	9297	662	5459
Adjusted	636	9897	12606	843	7998
Delta (%)	16	40	36	27	47
Total Assets					
HFCS (raw)	670	8012	10493	769	5727
Adjusted	780	11220	14318	980	8698
Delta (%)	16	40	36	28	52
Real Assets					
HFCS (raw)	499	5825	7231	612	4673
Adjusted	513	5968	7640	603	4540
Delta (%)	3	2	6	-2	-3
Financial Assets					
HFCS (raw)	138	1530	2184	125	740
Adjusted	190	3965	5007	333	3122
Delta (%)	38	159	129	167	322
Business Assets					
HFCS (raw)	33	657	1078	31	315
Adjusted	76	1288	1670	44	1036
Delta (%)	134	96	55	41	229
Liabilities					
HFCS (raw)	120	962	1196	106	268
Adjusted	144	1323	1712	138	699
Delta (%)	20	37	43	30	161

Note:

The table compares the total sums of wealth aggregates and their components before and after data adjustment. The adjustment includes imputation of financial assets based on a Pareto distribution, adding new observations from FORBES rich list and alignment to financial accounts.

[a] Real assets exclude business wealth (DA1000-DA1140).

[b] Financial assets are based on an adjusted concept and exclude money owed to other households and "other" financial assets (DA2100-HD1710-HD1920).

[*] Source: HFCS 2017 and own calculations using INTAXMOD.

Table 17: Wealth aggregates after data adjustments by segment (€ billion)

	Finland	France	Germany	Ireland	Italy
Net Wealth					
Total	*636*	*9897*	*12606*	*843*	*7998*
HFCS (below w_{min})	265	7481	3262	348	2956
Pareto (above w_{min})	360	2199	8930	464	4908
Rich list	11	217	414	30	134
Total Assets					
Total	*780*	*11220*	*14318*	*980*	*8698*
HFCS (below w_{min})	362	8769	4171	440	3366
Pareto (above w_{min})	406	2235	9733	510	5198
Rich list	11	217	414	30	134
Real Assets					
Total	*513*	*5968*	*7640*	*603*	*4540*
HFCS (below w_{min})	287	5371	2852	354	2518
Pareto (above w_{min})	226	596	4788	248	2022
Rich list	0	0	0	0	0
Financial Assets					
Total	*190*	*3965*	*5007*	*333*	*3122*
HFCS (below w_{min})	73	3043	1250	78	791
Pareto (above w_{min})	110	814	3467	229	2237
Rich list	7	108	290	27	95
Business Assets					
Total	*76*	*1288*	*1670*	*44*	*1036*
HFCS (below w_{min})	2	354	69	8	57
Pareto (above w_{min})	70	825	1477	32	939
Rich list	4	109	124	4	40
Liabilities					
Total	*144*	*1323*	*1712*	*138*	*699*
HFCS (below w_{min})	97	1287	909	92	410
Pareto (above w_{min})	46	36	803	46	289
Rich list	0	0	0	0	0

Note:
The table shows the total sums of wealth aggregates after adjustments for different segments of the adjusted data. The adjustment includes imputation of financial assets based on a Pareto distribution, adding new observations from Forbes rich list and alignment to financial accounts.
[a] Real assets exclude business wealth (DA1000-DA1140).
[b] Financial assets are based on an adjusted concept and exclude money owed to other households and 'other' financial assets (DA2100-HD1710-HD1920).
* Source: HFCS 2017 and own calculations.

Table 18: Inequality indicators for total assets before and after data adjustments

	Finland	*France*	*Germany*	*Ireland*	*Italy*
Mean					
HFCS (raw)	250.38	273.20	260.05	425.03	224.41
Adjusted	291.19	382.58	354.75	541.90	340.72
Delta (%)	16.30	40.04	36.42	27.50	51.83
Median					
HFCS (raw)	159.90	162.32	85.80	241.00	144.49
Adjusted	167.56	183.71	94.56	254.00	162.65
Delta (%)	4.79	13.17	10.21	5.39	12.56
Gini					
HFCS (raw)	0.60	0.64	0.71	0.63	0.60
Adjusted	0.64	0.69	0.77	0.69	0.68
Delta (%)	5.49	8.02	8.62	9.45	13.26
Atkinson Index (e=1)					
HFCS (raw)	0.73	0.71	0.81	0.71	0.65
Adjusted	0.74	0.74	0.85	0.75	0.70
Delta (%)	1.68	4.18	4.72	5.67	7.67
Theil Index					
HFCS (raw)	0.72	0.87	1.02	0.77	0.68
Adjusted	0.99	1.30	1.82	1.34	1.27
Delta (%)	38.76	49.75	77.69	73.58	86.97
Ratio P90/P50					
HFCS (raw)	3.45	3.70	7.16	3.77	3.46
Adjusted	3.58	4.06	7.19	4.13	3.85
Delta (%)	3.94	9.75	0.54	9.38	11.34
Ratio P80/P20					
HFCS (raw)	46.32	35.09	71.62	31.49	26.50
Adjusted	40.50	30.47	69.33	29.38	19.66
Delta (%)	-12.57	-13.17	-3.20	-6.72	-25.83

Table 18: Inequality indicators for total assets before and after data adjustments (continued)

	Finland	France	Germany	Ireland	Italy
Share Top 5%					
HFCS (raw)	0.30	0.33	0.39	0.34	0.30
Adjusted	0.35	0.42	0.52	0.43	0.43
Delta (%)	19.12	27.18	32.88	28.95	44.27
Share Top 10%					
HFCS (raw)	0.42	0.46	0.53	0.47	0.43
Adjusted	0.48	0.54	0.64	0.55	0.54
Delta (%)	11.86	17.68	19.80	17.29	27.08
Share P50-P90					
HFCS (raw)	0.48	0.46	0.43	0.43	0.46
Adjusted	0.44	0.39	0.33	0.37	0.37
Delta (%)	-8.88	-15.79	-22.70	-14.90	-20.40

Note:
The table compares the inequality measures of the unconditional distribution of total assets before and after data adjustment. The adjustment includes imputation of financial assets based on a Pareto distribution, adding new observations from Forbes rich list and alignment to financial accounts.
[a] The Gini coefficient corresponds to the normalised area between the Lorenz curve of the distribution and the 45 degrees line. The Atkinson index is defined as 1 minus the ratio of the equally distributed equivalent level of wealth to the mean of the actual wealth distribution. The Atkinson index lies between zero and one. The Theil index is a special case of the Generalised Entropy (GE) family of indexes. It corresponds to the index GE with parameter a = 1 and lies between zero and infinity.
[b] The Atkinson index and the Theil index are not applicable to variables with zero or negative values. Hence, observations with non-positive values have been dropped from the calculations for these indicators.
[c] P20, P50, P80 and P90 refer to 20th, 50th, 80th and 90th percentile of the corresponding marginal distribution.
[d] Share P50-P90 refers to the share of the middle class (operationalised as spanning from the median to the 90th percentile) in the aggregate of the variable.
* Source: HFCS 2017 and own calculations using INTAXMOD.

Table 19: Inequality indicators for net wealth before and after data adjustments

	Finland	*France*	*Germany*	*Ireland*	*Italy*
Mean					
HFCS (raw)	205.50	240.39	230.42	366.31	213.91
Adjusted	237.53	337.48	312.34	465.86	313.33
Delta (%)	15.59	40.39	35.55	27.18	46.48
Median					
HFCS (raw)	105.75	117.06	68.30	184.50	132.01
Adjusted	107.14	129.80	68.84	180.58	138.44
Delta (%)	1.31	10.88	0.79	-2.13	4.87
Gini					
HFCS (raw)	0.66	0.67	0.74	0.67	0.61
Adjusted	0.70	0.73	0.81	0.73	0.70
Delta (%)	6.32	8.30	9.35	9.38	14.76
Atkinson Index (e=1)					
HFCS (raw)	0.69	0.72	0.79	0.72	0.65
Adjusted	0.67	0.76	0.80	0.70	0.68
Delta (%)	-2.39	5.33	1.24	-2.49	4.68
Theil Index					
HFCS (raw)	0.75	0.94	1.02	0.83	0.68
Adjusted	1.07	1.44	1.89	1.46	1.32
Delta (%)	43.20	53.03	84.77	75.03	94.97
Ratio P90/P50					
HFCS (raw)	4.53	4.70	8.09	4.59	3.63
Adjusted	4.74	5.21	8.59	5.08	4.12
Delta (%)	4.70	11.05	6.20	10.70	13.44
Ratio P80/P20					
HFCS (raw)	78.45	38.80	128.41	45.93	26.76
Adjusted	91.63	41.52	205.86	42.44	22.02
Delta (%)	16.81	6.99	60.32	-7.59	-17.72

Table 19: Inequality indicators for net wealth before and after data adjustments (continued)

	Finland	*France*	*Germany*	*Ireland*	*Italy*
Share Top 5%					
HFCS (raw)	0.33	0.35	0.41	0.35	0.30
Adjusted	0.40	0.46	0.56	0.47	0.45
Delta (%)	22.12	29.14	36.56	33.52	50.58
Share Top 10%					
HFCS (raw)	0.47	0.49	0.55	0.50	0.43
Adjusted	0.53	0.58	0.68	0.59	0.56
Delta (%)	13.78	18.64	22.34	18.51	29.77
Share P50-P90					
HFCS (raw)	0.47	0.45	0.42	0.43	0.47
Adjusted	0.42	0.37	0.31	0.35	0.36
Delta (%)	-11.69	-18.40	-27.54	-18.17	-22.58

Note:

The table compares the inequality measures of the unconditional distribution of net wealth before and after data adjustment. The adjustment includes imputation of financial assets based on a Pareto distribution, adding new observations from FORBES rich list and alignment to financial accounts.

[a] The Gini coefficient corresponds to the normalised area between the Lorenz curve of the distribution and the 45 degrees line. The Atkinson index is defined as 1 minus the ratio of the equally distributed equivalent level of wealth to the mean of the actual wealth distribution. The Atkinson index lies between zero and one. The Theil index is a special case of the Generalised Entropy (GE) family of indexes. It corresponds to the index GE with parameter a = 1 and lies between zero and infinity.

[b] The Atkinson index and the Theil index are not applicable to variables with zero or negative values. Hence, observations with non-positive values have been dropped from the calculations for these indicators. .

[c] P20, P50, P80 and P90 refer to 20th, 50th, 80th and 90th percentile of the corresponding marginal distribution.

[d] Share P50-P90 refers to the share of the middle class (operationalised as spanning from the median to the 90th percentile) in the aggregate of the variable.

* Source: HFCS 2017 and own calculations using INTAXMOD.

Table 20: Inequality indicators for real assets before and after data adjustments

	Finland	France	Germany	Ireland	Italy
Mean					
HFCS (raw)	186.51	198.61	179.21	338.59	183.08
Adjusted	191.60	203.49	189.30	333.12	177.84
Delta (%)	2.73	2.45	5.63	-1.62	-2.86
Median					
HFCS (raw)	134.38	134.10	28.50	213.50	127.00
Adjusted	134.47	134.40	30.00	215.00	127.00
Delta (%)	0.07	0.22	5.26	0.70	0.00
Gini					
HFCS (raw)	0.58	0.62	0.73	0.61	0.59
Adjusted	0.59	0.63	0.74	0.60	0.58
Delta (%)	1.17	1.20	0.89	-1.68	-2.15
Atkinson Index (e=1)					
HFCS (raw)	0.58	0.76	0.79	0.69	0.68
Adjusted	0.59	0.76	0.80	0.68	0.67
Delta (%)	1.05	0.57	0.83	-1.08	-1.43
Theil Index					
HFCS (raw)	0.47	0.77	0.89	0.71	0.64
Adjusted	0.48	0.80	0.90	0.64	0.59
Delta (%)	2.83	3.81	0.69	-10.35	-8.01
Ratio P90/P50					
HFCS (raw)	3.25	3.41	16.30	3.36	3.19
Adjusted	3.34	3.44	16.67	3.48	3.19
Delta (%)	2.54	0.80	2.26	3.64	0.00
Ratio P80/P20					
HFCS (raw)	218.67	61.84	956.67	55.37	47.14
Adjusted	220.48	61.67	1000.00	56.01	44.92
Delta (%)	0.83	-0.29	4.53	1.16	-4.73

Table 20: Inequality indicators for real assets before and after data adjustments (continued)

	Finland	*France*	*Germany*	*Ireland*	*Italy*
Share Top 5%					
HFCS (raw)	0.24	0.29	0.37	0.32	0.28
Adjusted	0.25	0.30	0.38	0.29	0.26
Delta (%)	3.54	4.79	1.88	-7.98	-7.73
Share Top 10%					
HFCS (raw)	0.38	0.42	0.53	0.44	0.41
Adjusted	0.39	0.43	0.54	0.43	0.39
Delta (%)	2.84	2.83	2.83	-3.70	-4.65
Share P50-90					
HFCS (raw)	0.53	0.51	0.46	0.45	0.49
Adjusted	0.52	0.50	0.45	0.47	0.50
Delta (%)	-1.64	-2.07	-3.17	2.93	3.34

Note:

The table compares the inequality measures of the unconditional distribution of real assets before and after data adjustment. The adjustment includes imputation of financial assets based on a Pareto distribution, adding new observations from FORBES rich list and alignment to financial accounts.

[a] The Gini coefficient corresponds to the normalised area between the Lorenz curve of the distribution and the 45 degrees line. The Atkinson index is defined as 1 minus the ratio of the equally distributed equivalent level of wealth to the mean of the actual wealth distribution. The Atkinson index lies between zero and one. The Theil index is a special case of the Generalised Entropy (GE) family of indexes. It corresponds to the index GE with parameter a = 1 and lies between zero and infinity.

[b] The Atkinson index and the Theil index are not applicable to variables with zero or negative values. Hence, observations with non-positive values have been dropped from the calculations for these indicators.

[c] P20, P50, P80 and P90 refer to 20th, 50th, 80th and 90th percentile of the corresponding marginal distribution.

[d] Share P50-P90 refers to the share of the middle class (operationalised as spanning from the median to the 90th percentile) in the aggregate of the variable.

* Source: HFCS 2017 and own calculations using INTAXMOD.

Table 21: Inequality indicators for financial assets before and after data adjustments

	Finland	*France*	*Germany*	*Ireland*	*Italy*
Mean					
HFCS (raw)	51.72	52.17	54.11	69.04	28.99
Adjusted	71.12	135.18	124.06	184.32	122.31
Delta (%)	37.51	159.10	129.25	166.96	321.90
Median					
HFCS (raw)	10.04	10.64	15.50	6.26	6.13
Adjusted	13.60	24.03	20.02	11.64	17.72
Delta (%)	35.46	125.75	29.15	86.05	189.02
Gini					
HFCS (raw)	0.79	0.80	0.73	0.86	0.79
Adjusted	0.80	0.81	0.85	0.90	0.84
Delta (%)	1.33	1.56	17.42	4.31	5.86
Atkinson Index (e=1)					
HFCS (raw)	0.84	0.84	0.78	0.90	0.73
Adjusted	0.85	0.86	0.88	0.93	0.81
Delta (%)	0.68	1.90	12.94	3.23	9.99
Theil Index					
HFCS (raw)	1.50	1.72	1.01	1.85	1.36
Adjusted	2.02	1.83	2.97	3.04	2.21
Delta (%)	34.73	6.72	193.02	63.93	62.44
Ratio P90/P50					
HFCS (raw)	11.46	10.30	9.06	21.98	9.78
Adjusted	10.53	11.85	8.29	25.00	11.64
Delta (%)	-8.11	15.12	-8.58	13.76	18.97
Ratio P80/P20					
HFCS (raw)	54.88	52.00	50.67	103.00	48.27
Adjusted	52.26	57.66	49.75	150.00	42.56
Delta (%)	-4.78	10.89	-1.81	45.63	-11.82

Table 21: Inequality indicators for financial assets before and after data adjustments (continued)

	Finland	France	Germany	Ireland	Italy
Share Top 5%					
HFCS (raw)	0.52	0.54	0.39	0.63	0.54
Adjusted	0.56	0.55	0.68	0.73	0.63
Delta (%)	6.38	2.54	73.87	15.85	17.25
Share Top 10%					
HFCS (raw)	0.67	0.67	0.55	0.77	0.67
Adjusted	0.68	0.70	0.77	0.83	0.74
Delta (%)	2.28	3.41	38.33	7.02	10.43
Share P50-90					
HFCS (raw)	0.31	0.30	0.41	0.21	0.29
Adjusted	0.29	0.28	0.21	0.16	0.23
Delta (%)	-4.92	-6.49	-47.68	-23.60	-20.56

Note:

The table compares the inequality measures of the unconditional distribution of financial assets before and after data adjustment. The adjustment includes imputation of financial assets based on a Pareto distribution, adding new observations from FORBES rich list and alignment to financial accounts.

[a] The Gini coefficient corresponds to the normalised area between the Lorenz curve of the distribution and the 45 degrees line. The Atkinson index is defined as 1 minus the ratio of the equally distributed equivalent level of wealth to the mean of the actual wealth distribution. The Atkinson index lies between zero and one. The Theil index is a special case of the Generalised Entropy (GE) family of indexes. It corresponds to the index GE with parameter a = 1 and lies between zero and infinity.

[b] The Atkinson index and the Theil index are not applicable to variables with zero or negative values. Hence, observations with non-positive values have been dropped from the calculations for these indicators.

[c] P20, P50, P80 and P90 refer to 20th, 50th, 80th and 90th percentile of the corresponding marginal distribution.

[d] Share P50-P90 refers to the share of the middle class (operationalised as spanning from the median to the 90th percentile) in the aggregate of the variable.

* Source: HFCS 2017 and own calculations using INTAXMOD.

Table 22: Inequality indicators for business assets before and after data adjustments

	Finland	*France*	*Germany*	*Ireland*	*Italy*
Mean					
HFCS (raw)	12.15	22.41	26.73	17.40	12.34
Adjusted	28.48	43.91	41.38	24.46	40.57
Delta (%)	134.33	95.92	54.84	40.60	228.83
Median					
HFCS (raw)	0.00	0.00	0.00	0.00	0.00
Adjusted	0.00	0.00	0.00	0.00	0.00
Delta (%)					
Gini					
HFCS (raw)	0.99	0.98	0.99	0.96	0.96
Adjusted	0.96	0.99	0.97	0.95	0.95
Delta (%)	-3.00	0.67	-2.18	-0.46	-1.57
Atkinson Index (e=1)					
HFCS (raw)	0.91	0.84	0.91	0.66	0.66
Adjusted	0.79	0.90	0.81	0.72	0.72
Delta (%)	-13.52	7.23	-10.97	9.22	8.99
Theil Index					
HFCS (raw)	1.68	1.46	1.61	0.97	0.91
Adjusted	1.85	2.54	2.59	1.96	1.77
Delta (%)	10.46	73.35	60.67	102.84	94.13

Table 22: Inequality indicators for business assets before and after data adjustments (continued)

	Finland	France	Germany	Ireland	Italy
Share Top 5%					
HFCS (raw)	1.00	0.98	0.99	0.87	0.88
Adjusted	0.86	0.99	0.87	0.83	0.80
Delta (%)	-14.02	0.73	-11.85	-4.88	-9.19
Share Top 10%					
HFCS (raw)	1.00	1.00	1.00	0.98	0.99
Adjusted	0.97	1.00	0.96	0.95	0.93
Delta (%)	-2.76	0.00	-4.19	-3.49	-6.20
Share P50-90					
HFCS (raw)	0.00	0.00	0.00	0.02	0.01
Adjusted	0.03	0.00	0.04	0.05	0.07
Delta (%)				216.03	510.83

Note:

The table compares the inequality measures of the unconditional distribution of net wealth before and after data adjustment. The adjustment includes imputation of financial assets based on a Pareto distribution, adding new observations from FORBES rich list and alignment to financial accounts.

[a] The Gini coefficient corresponds to the normalised area between the Lorenz curve of the distribution and the 45 degrees line. The Atkinson index is defined as 1 minus the ratio of the equally distributed equivalent level of wealth to the mean of the actual wealth distribution. The Atkinson index lies between zero and one. The Theil index is a special case of the Generalised Entropy (GE) family of indexes. It corresponds to the index GE with parameter a = 1 and lies between zero and infinity.

[b] The Atkinson index and the Theil index are not applicable to variables with zero or negative values. Hence, observations with non-positive values have been dropped from the calculations for these indicators.

[c] P20, P50, P80 and P90 refer to 20th, 50th, 80th and 90th percentile of the corresponding marginal distribution.

[d] Share P50-P90 refers to the share of the middle class (operationalised as spanning from the median to the 90th percentile) in the aggregate of the variable.

* Source: HFCS 2017 and own calculations using INTAXMOD.

Table 23: Inequality indicators for liabilities before and after data adjustments

	Finland	France	Germany	Ireland	Italy
Mean					
HFCS (raw)	44.87	32.81	29.63	58.72	10.51
Adjusted	53.66	45.10	42.41	76.05	27.40
Delta (%)	19.58	37.49	43.12	29.50	160.77
Median					
HFCS (raw)	4.00	0.00	0.00	0.30	0.00
Adjusted	14.09	16.90	11.43	17.72	18.82
Delta (%)	252.20			5806.87	
Gini					
HFCS (raw)	0.77	0.84	0.86	0.83	0.94
Adjusted	0.70	0.70	0.73	0.73	0.61
Delta (%)	-9.64	-16.30	-14.91	-12.41	-34.89
Atkinson Index (e=1)					
HFCS (raw)	0.64	0.71	0.77	0.78	0.72
Adjusted	0.71	0.72	0.73	0.80	0.57
Delta (%)	10.81	1.80	-4.91	3.46	-20.05
Theil Index					
HFCS (raw)	0.68	0.75	0.97	0.93	0.98
Adjusted	0.94	0.95	1.12	1.09	0.72
Delta (%)	37.83	26.52	16.27	17.54	-27.05
Ratio P90/P50					
HFCS (raw)	37.04			616.00	
Adjusted	11.55	8.15	10.16	12.01	4.30
Delta (%)	-68.82			-98.05	
Ratio P80/P20					
HFCS (raw)					
Adjusted	24.52	29.72	24.16	75.91	11.11
Delta (%)					

Table 23: Inequality indicators for liabilities before and after data adjustments (continued)

	Finland	*France*	*Germany*	*Ireland*	*Italy*
Share Top 5%					
HFCS (raw)	0.36	0.45	0.53	0.47	0.74
Adjusted	0.33	0.35	0.42	0.37	0.29
Delta (%)	-10.18	-21.88	-21.95	-21.17	-61.04
Share Top 10%					
HFCS (raw)	0.56	0.67	0.74	0.67	0.94
Adjusted	0.50	0.53	0.59	0.54	0.34
Delta (%)	-9.95	-20.63	-20.39	-18.25	-63.42
Share P50-90					
HFCS (raw)	0.44	0.33	0.26	0.33	0.06
Adjusted	0.44	0.40	0.37	0.42	0.51
Delta (%)	0.09	20.49	42.50	25.33	764.11

Note:

The table compares the inequality measures of the unconditional distribution of liabilities before and after data adjustment. The adjustment includes imputation of financial assets based on a Pareto distribution, adding new observations from FORBES rich list and alignment to financial accounts.

[a] The Gini coefficient corresponds to the normalised area between the Lorenz curve of the distribution and the 45 degrees line. The Atkinson index is defined as 1 minus the ratio of the equally distributed equivalent level of wealth to the mean of the actual wealth distribution. The Atkinson index lies between zero and one. The Theil index is a special case of the Generalised Entropy (GE) family of indexes. It corresponds to the index GE with parameter a = 1 and lies between zero and infinity.

[b] The Atkinson index and the Theil index are not applicable to variables with zero or negative values. Hence, observations with non-positive values have been dropped from the calculations for these indicators.

[c] P20, P50, P80 and P90 refer to 20th, 50th, 80th and 90th percentile of the corresponding marginal distribution.

[d] Share P50-P90 refers to the share of the middle class (operationalised as spanning from the median to the 90th percentile) in the aggregate of the variable.

* Source: HFCS 2017 and own calculations using INTAXMOD.

Table 24: Mean values and shares of wealth components by deciles of total assets after data adjustment

	Mean Value						Share of Total					
Decile	*Net*	*Gross*	*Real*	*Financial*	*Business*	*Liabilities*	*Net*	*Gross*	*Real*	*Financial*	*Business*	*Liabilities*
Finland												
1	-3.6	0.6	0.2	0.4	0.0	4.2	-0.2	0.0	0.0	0.1	0.0	0.8
2	-2.0	4.7	1.6	3.0	0.0	6.7	-0.1	0.2	0.1	0.4	0.0	1.2
3	17.6	26.8	11.3	15.5	0.1	9.2	0.7	0.9	0.6	2.2	0.0	1.7
4	62.1	86.2	64.9	20.8	0.5	24.0	2.6	3.0	3.4	2.9	0.2	4.5
5	97.7	141.6	120.3	21.1	0.2	43.9	4.1	4.9	6.3	3.0	0.1	8.2
6	134.0	196.0	162.8	32.5	0.7	62.1	5.6	6.7	8.5	4.6	0.2	11.6
7	187.1	257.2	209.7	47.0	0.6	70.2	7.9	8.8	10.9	6.6	0.2	13.1
8	248.7	336.3	271.4	63.8	1.2	87.7	10.5	11.6	14.2	9.0	0.4	16.4
9	388.8	478.1	366.3	92.9	19.0	89.3	16.4	16.4	19.1	13.1	6.7	16.6
10	1244.3	1383.5	707.2	414.0	262.4	139.2	52.4	47.5	36.9	58.2	92.2	26.0
France												
1	1.0	2.3	1.4	0.9	0.0	1.3	0.0	0.1	0.1	0.1	0.0	0.3
2	1.6	9.4	5.4	3.9	0.0	7.7	0.0	0.2	0.3	0.3	0.0	1.7
3	21.6	26.8	12.7	14.0	0.1	5.2	0.6	0.7	0.6	1.0	0.0	1.2
4	65.0	78.5	43.7	34.4	0.4	13.5	1.9	2.1	2.1	2.5	0.1	3.0
5	112.6	152.2	117.1	34.5	0.5	39.6	3.3	4.0	5.7	2.6	0.1	8.8
6	155.5	216.6	172.2	43.4	1.1	61.1	4.6	5.7	8.5	3.2	0.2	13.6
7	225.2	288.7	218.6	67.6	2.5	63.5	6.7	7.5	10.7	5.0	0.6	14.1
8	329.7	390.7	285.5	101.8	3.3	61.0	9.8	10.2	14.0	7.5	0.8	13.5
9	504.7	580.2	389.1	180.7	10.5	75.5	15.0	15.2	19.1	13.4	2.4	16.7
10	1957.6	2080.1	789.0	870.4	420.7	122.5	58.0	54.4	38.8	64.4	95.8	27.2
Germany												
1	-3.6	0.3	0.1	0.2	0.0	3.9	-0.1	0.0	0.0	0.0	0.0	0.9
2	-1.1	2.9	0.9	2.0	0.0	4.0	0.0	0.1	0.0	0.2	0.0	0.9
3	4.5	10.3	3.7	6.6	0.0	5.8	0.1	0.3	0.2	0.5	0.0	1.4
4	20.3	26.5	9.2	17.2	0.1	6.2	0.7	0.7	0.5	1.4	0.0	1.5
5	53.5	64.2	25.1	37.9	1.2	10.7	1.7	1.8	1.3	3.1	0.3	2.5
6	100.9	130.3	81.9	46.4	1.9	29.3	3.2	3.7	4.3	3.7	0.5	6.9
7	170.7	221.9	163.7	56.8	1.4	51.2	5.5	6.3	8.6	4.6	0.3	12.1
8	255.1	325.1	242.8	77.5	4.8	70.0	8.2	9.2	12.8	6.3	1.2	16.5
9	421.9	506.4	373.8	108.0	24.6	84.5	13.5	14.3	19.7	8.7	6.0	19.9
10	2100.7	2259.1	991.5	887.8	379.8	158.4	67.3	63.7	52.4	71.6	91.8	37.3

Table 24: Mean values and shares of wealth components by deciles of total assets after data adjustment (continued)

	Mean Value						Share of Total					
Decile	Net	Gross	Real	Financial	Business	Liabilities	Net	Gross	Real	Financial	Business	Liabilities
Ireland												
1	-2.4	1.1	0.7	0.4	0.0	3.5	-0.1	0.0	0.0	0.0	0.0	0.5
2	6.9	10.2	5.9	4.3	0.0	3.4	0.1	0.2	0.2	0.2	0.0	0.4
3	55.9	60.5	42.1	18.0	0.4	4.6	1.2	1.1	1.3	1.0	0.2	0.6
4	118.7	145.8	129.4	15.9	0.5	27.1	2.5	2.7	3.9	0.9	0.2	3.6
5	154.7	216.5	197.5	18.0	1.0	61.8	3.3	4.0	5.9	1.0	0.4	8.1
6	213.1	289.9	259.3	28.0	2.6	76.8	4.6	5.3	7.8	1.5	1.1	10.1
7	295.6	381.8	325.4	53.0	3.4	86.2	6.4	7.1	9.8	2.9	1.4	11.4
8	429.6	527.4	430.7	90.4	6.3	97.7	9.2	9.7	12.9	4.9	2.6	12.9
9	656.6	798.9	587.0	191.8	20.2	142.4	14.1	14.7	17.6	10.4	8.2	18.7
10	2729.0	2985.9	1352.5	1423.3	210.1	256.9	58.6	55.1	40.6	77.2	85.9	33.8
Italy												
1	-0.3	1.6	0.9	0.7	0.0	1.9	0.0	0.0	0.1	0.1	0.0	0.7
2	8.4	11.0	4.5	6.5	0.0	2.6	0.3	0.3	0.3	0.5	0.0	1.0
3	36.9	40.7	20.4	20.0	0.4	3.9	1.2	1.2	1.1	1.6	0.1	1.4
4	85.3	95.7	74.9	20.1	0.7	10.4	2.7	2.8	4.2	1.6	0.2	3.8
5	118.6	141.0	118.0	22.2	0.8	22.4	3.8	4.1	6.6	1.8	0.2	8.2
6	157.9	189.3	157.3	30.4	1.6	31.4	5.1	5.6	8.9	2.5	0.4	11.5
7	215.4	246.2	194.0	49.3	2.8	30.8	6.9	7.2	10.9	4.0	0.7	11.2
8	295.0	326.9	245.8	76.5	4.6	32.0	9.4	9.6	13.8	6.2	1.1	11.6
9	457.6	497.0	327.1	136.4	33.4	39.4	14.6	14.6	18.4	11.2	8.3	14.4
10	1757.5	1856.6	634.8	860.5	361.2	99.1	56.1	54.5	35.7	70.4	89.0	36.2

Note:

The table shows the arithmetic means as well as the decile shares of wealth aggregates and their components based on quantiles of total assets.

[a] Real assets exclude business wealth (DA1000-DA1140).

[b] Financial assets are based on an adjusted concept and excludes money owed to other households and "other" financial assets (DA2100-HD1710-HD1920).

* Source: HFCS 2017 and own calculations using INTAXMOD.

Table 25: Mean values and shares of wealth components by net wealth deciles after data

	Mean Value						Share of Total					
Decile	Net	Gross	Real	Financial	Business	Liabilities	Net	Gross	Real	Financial	Business	Liabilities
Finland												
1	-15.1	24.3	21.2	3.0	0.1	39.5	-0.6	0.8	1.1	0.4	0.0	7.3
2	0.7	6.1	4.2	1.9	0.0	5.3	0.0	0.2	0.2	0.3	0.0	1.0
3	11.4	42.1	32.5	9.5	0.1	30.7	0.5	1.4	1.7	1.3	0.0	5.7
4	41.9	107.3	88.4	18.7	0.3	65.5	1.8	3.7	4.6	2.6	0.1	12.2
5	82.7	144.4	122.2	21.5	0.7	61.6	3.5	5.0	6.4	3.0	0.2	11.5
6	132.4	187.8	158.8	28.3	0.7	55.4	5.6	6.5	8.3	4.0	0.2	10.3
7	188.9	246.0	200.0	44.3	1.8	57.1	7.9	8.4	10.4	6.2	0.6	10.6
8	265.6	324.3	256.6	65.6	2.1	58.7	11.2	11.1	13.4	9.2	0.7	10.9
9	401.6	467.6	353.8	100.0	13.8	66.0	16.9	16.1	18.5	14.1	4.9	12.3
10	1264.6	1361.4	678.0	418.3	265.1	96.8	53.3	46.8	35.4	58.8	93.1	18.0
France												
1	-8.3	16.0	13.9	2.1	0.1	24.3	-0.2	0.4	0.7	0.2	0.0	5.4
2	5.3	11.9	8.6	3.2	0.0	6.5	0.2	0.3	0.4	0.2	0.0	1.5
3	18.8	38.7	27.5	11.2	0.1	19.9	0.6	1.0	1.3	0.8	0.0	4.4
4	48.9	94.1	67.3	26.5	0.4	45.3	1.4	2.5	3.3	2.0	0.1	10.0
5	100.5	148.3	110.7	37.0	0.6	47.8	3.0	3.9	5.4	2.7	0.1	10.6
6	160.1	210.0	164.0	44.9	1.0	49.8	4.7	5.5	8.1	3.3	0.2	11.0
7	231.4	283.3	212.0	68.1	3.2	52.0	6.9	7.4	10.4	5.0	0.7	11.5
8	334.3	382.8	276.9	102.7	3.2	48.5	9.9	10.0	13.6	7.6	0.7	10.7
9	513.9	569.1	381.0	177.6	10.6	55.2	15.3	14.9	18.8	13.2	2.4	12.3
10	1968.0	2069.6	772.1	877.8	419.7	101.7	58.3	54.1	38.0	65.0	95.6	22.6
Germany												
1	-18.4	18.8	15.6	3.0	0.2	37.1	-0.6	0.5	0.8	0.2	0.0	8.7
2	-0.2	4.0	2.9	1.1	0.0	4.2	0.0	0.1	0.2	0.1	0.0	1.0
3	5.2	10.2	4.2	6.0	0.0	5.0	0.2	0.3	0.2	0.5	0.0	1.2
4	18.5	30.4	15.9	14.3	0.2	11.9	0.6	0.9	0.8	1.1	0.1	2.8
5	48.2	69.8	35.8	32.8	1.3	21.6	1.5	2.0	1.9	2.6	0.3	5.1
6	93.2	136.5	90.2	44.9	1.4	43.3	3.0	3.8	4.8	3.6	0.3	10.2
7	166.4	217.4	158.1	57.8	1.5	51.0	5.3	6.1	8.3	4.7	0.4	12.0
8	262.3	313.3	228.4	79.2	5.7	51.0	8.4	8.9	12.1	6.4	1.4	12.0
9	431.4	503.6	370.9	110.8	21.9	72.2	13.8	14.2	19.6	8.9	5.3	17.0
10	2116.1	2243.0	970.8	890.6	381.6	126.9	67.8	63.2	51.3	71.8	92.2	29.9

Table 25: Mean values and shares of wealth components by net wealth deciles after data adjustment (continued)

	Mean Value						**Share of Total**					
Decile	Net	Gross	Real	Financial	Business	Liabilities	Net	Gross	Real	Financial	Business	Liabilities
Ireland												
1	-25.7	37.6	35.6	2.1	0.0	63.3	-0.5	0.7	1.1	0.1	0.0	8.2
2	4.9	16.1	12.8	3.3	0.1	11.2	0.1	0.3	0.4	0.2	0.0	1.5
3	35.1	81.6	67.3	14.0	0.3	46.5	0.8	1.5	2.0	0.8	0.1	6.1
4	92.5	159.5	141.0	17.7	0.7	67.0	2.0	3.0	4.2	1.0	0.3	8.8
5	152.8	219.6	195.6	23.0	1.1	66.8	3.3	4.1	5.9	1.2	0.4	8.8
6	215.9	274.4	248.9	24.4	1.1	58.5	4.6	5.1	7.5	1.3	0.4	7.7
7	301.0	381.7	326.2	51.7	3.7	80.6	6.5	7.0	9.8	2.8	1.5	10.6
8	433.8	500.2	396.9	95.2	8.1	66.4	9.3	9.2	11.9	5.2	3.3	8.7
9	690.7	790.1	580.5	187.3	22.3	99.3	14.8	14.6	17.4	10.2	9.1	13.1
10	2754.4	2955.6	1325.5	1423.1	207.0	201.2	59.2	54.6	39.8	77.3	84.7	26.5
Italy												
1	-1.1	2.9	2.2	0.7	0.0	4.1	0.0	0.1	0.1	0.1	0.0	1.5
2	8.5	15.4	9.0	6.3	0.1	6.9	0.3	0.5	0.5	0.5	0.0	2.5
3	33.1	45.5	26.9	18.3	0.3	12.3	1.1	1.3	1.5	1.5	0.1	4.5
4	78.9	99.6	79.4	19.6	0.7	20.7	2.5	2.9	4.5	1.6	0.2	7.5
5	118.0	139.2	114.7	23.4	1.1	21.3	3.8	4.1	6.5	1.9	0.3	7.8
6	161.4	186.9	152.7	32.2	2.0	25.5	5.1	5.5	8.6	2.6	0.5	9.3
7	216.3	244.2	193.9	47.7	2.6	27.9	6.9	7.2	10.9	3.9	0.6	10.2
8	296.7	324.9	240.7	78.4	5.7	28.2	9.5	9.5	13.6	6.4	1.4	10.3
9	459.9	496.6	329.3	135.4	31.9	36.7	14.7	14.6	18.5	11.1	7.9	13.4
10	1761.2	1851.6	629.4	860.9	361.3	90.5	56.2	54.3	35.4	70.4	89.1	33.0

Note:

The table shows the arithmetic means as well as the decile shares of wealth aggregates and their components based on quantiles of net wealth.

[a] Real assets exclude business wealth (DA1000-DA1140).

[b] Financial assets are based on an adjusted concept and excludes money owed to other households and “other” financial assets. (DA2100-HD1710-HD1920).

* Source: HFCS 2017 and own calculations using INTAXMOD.

5. Scenarios for wealth projections

5.1 Demographic change

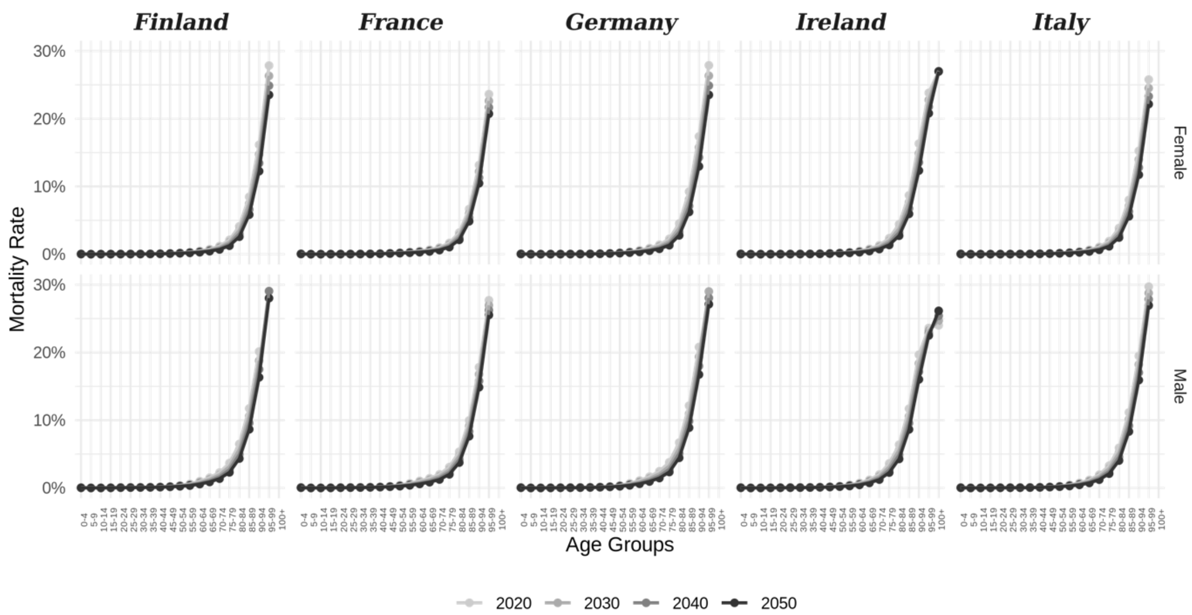
In developed societies, medical and technical progress has led to rising life expectancies in recent decades, which is a pattern that our calculations should reflect. The simulation of deaths requires information about the survival and mortality rates for different parts of the population.

For this reason, we will base our calculations on the population projections provided by Eurostat and make use of forecasts of age and gender mortality rates for the next 30 years. We use the latest vintage of population projections published in April 2020. Although these are based on the most recent data from EU Member States, the authors stress that repercussions of the COVID-19 pandemic on demographic dynamics are not yet embedded in the underlying models.[26] Currently, these figures are available for all Member States for a single scenario (labelled as "Baseline projection"). Besides the stratification by gender, Eurostat provides a very granular representation of the mortality probabilities by age in one-year intervals. However, some countries deliver their microdata only at a more aggregate level. Among these countries is Ireland, which provides data on the age of individuals only in five-year intervals. Consequently, we have opted for the most general approach that is applicable for all countries and recode the data in the other countries to similar age groups. This also extends to the mortality rates, which we aggregate by calculating average mortality rates across the five-year age intervals.

Figure 2 shows the results of this exercise for the predicted mortality rates in the years 2020, 2030, 2040 and 2050. Fortunately, in most European countries, mortality rates until the age of 60 are already at such low levels, making further reductions very hard to achieve. In contrast, Eurostat's projections suggest further significant decreases in mortality rates above 60 years over the forecast horizon. The most prominent example is the mortality rate of German women above 85 years. According to the projections, the mortality rate of this group drops from slightly below 20% in 2020 to around 15% in 2050. Another essential feature of the data is the gender difference between males and females that will not vanish until the end of the projection period. Even in 2050, the mortality rates of men in the oldest age groups lie a couple of percentage points above those of women at the same age.

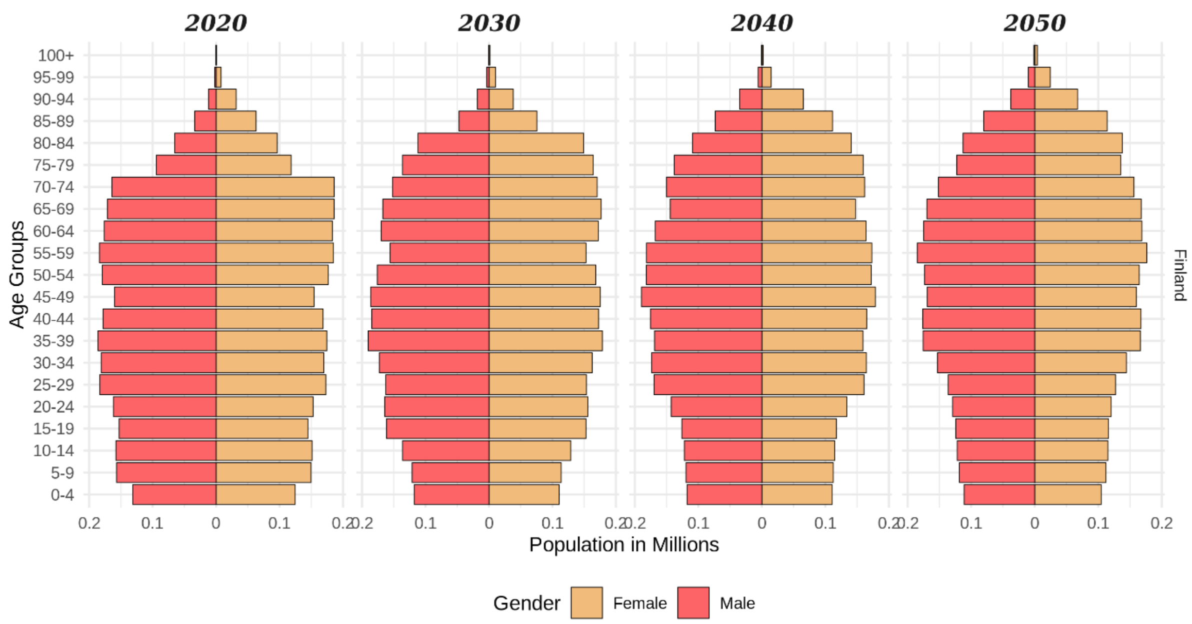
[26] See Eurostat (2020) for further details on methodological specifics.

Figure 2: Development of age-specific mortality rates, 2020-2050



Source: Eurostat 2020 (id: proj_19naasmr), own illustration.

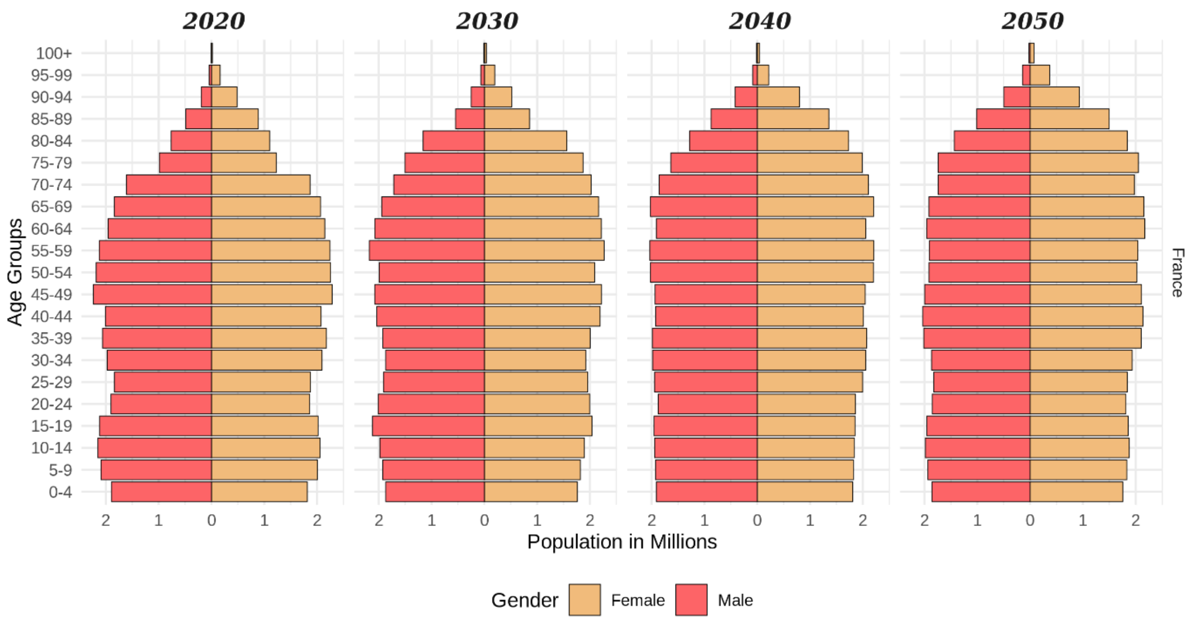
Figure 3: Population pyramids of Finland 2020-2050



Source: Eurostat 2020 (id: proj_19np), own illustration.

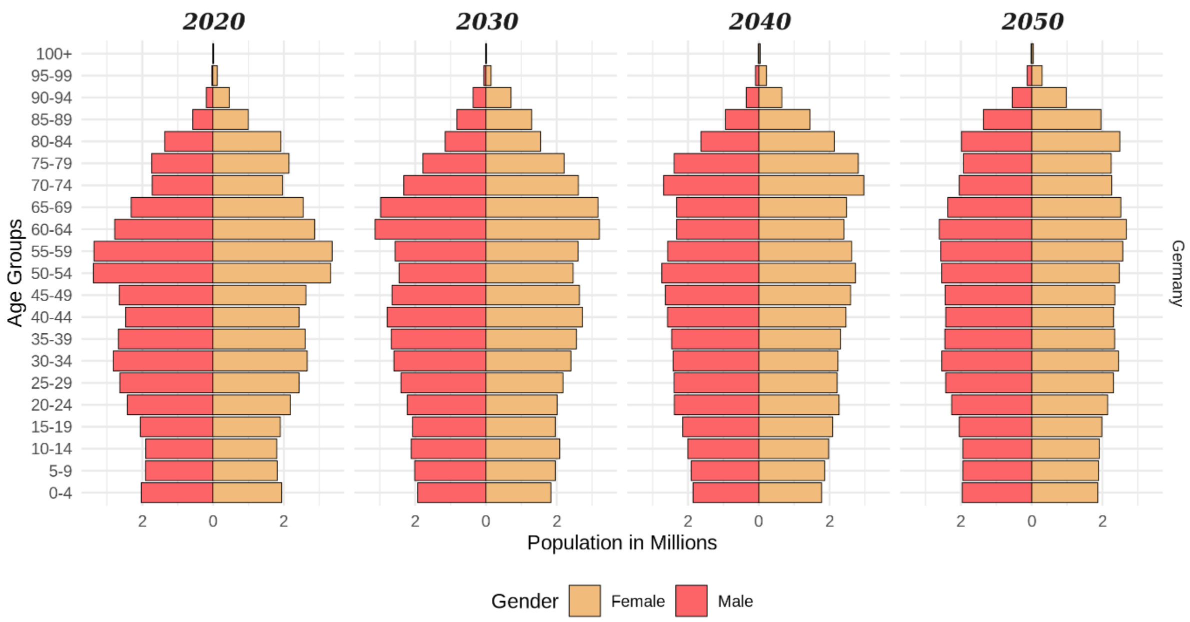
At first sight, these reductions may seem not very important. However, if the mortality rates are translated into population pyramids, the gravitas of these changes becomes more apparent. All five countries face significant demographic shifts. The number of males and females over 60 years increases both in absolute and relative terms. However, there are noteworthy differences in the proportions of young versus old inhabitants between the countries. Finland, Germany and Italy are countries where the population pyramids are inverted until 2050 (see Figure 3, Figure 5 and Figure 7). The size of the cohorts younger than 30 years will be significantly lower compared to the cohorts in the prime working-age and will, partially, also be outnumbered by retirees. On the other hand, in 2050 France and Ireland are projected to have a constant size of cohorts until the age of 70 years (see Figure 4 and Figure 6).

Figure 4: Population pyramids of France 2020-2050



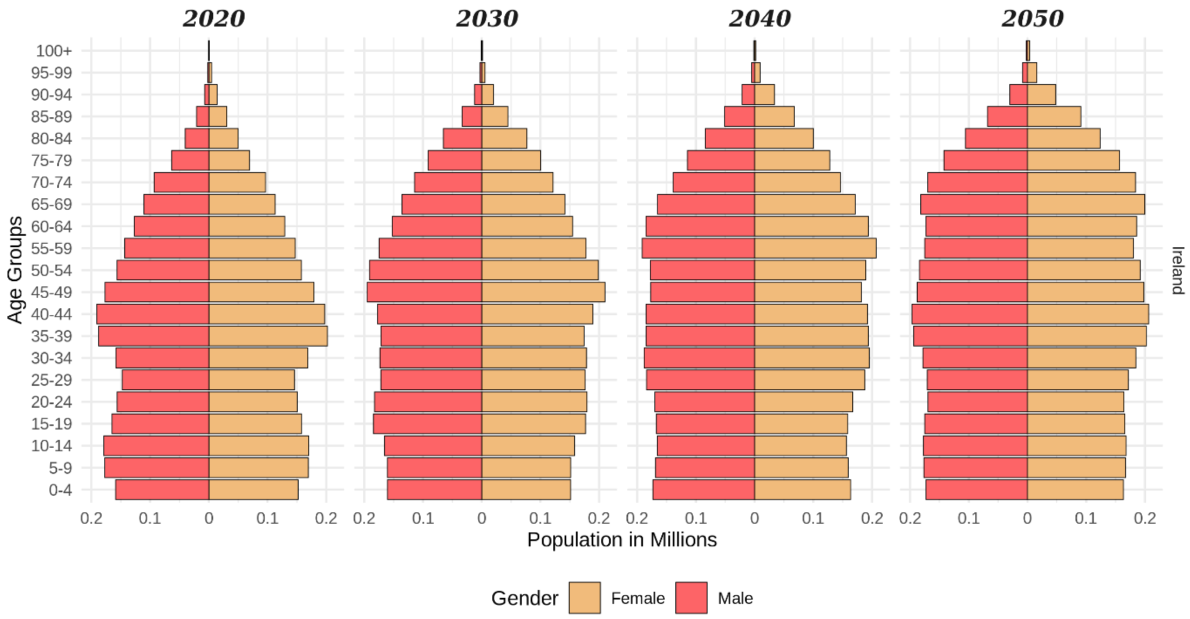
Source: Eurostat 2020 (id: proj_19np), own illustration.

Figure 5: Population pyramids of Germany 2020-2050



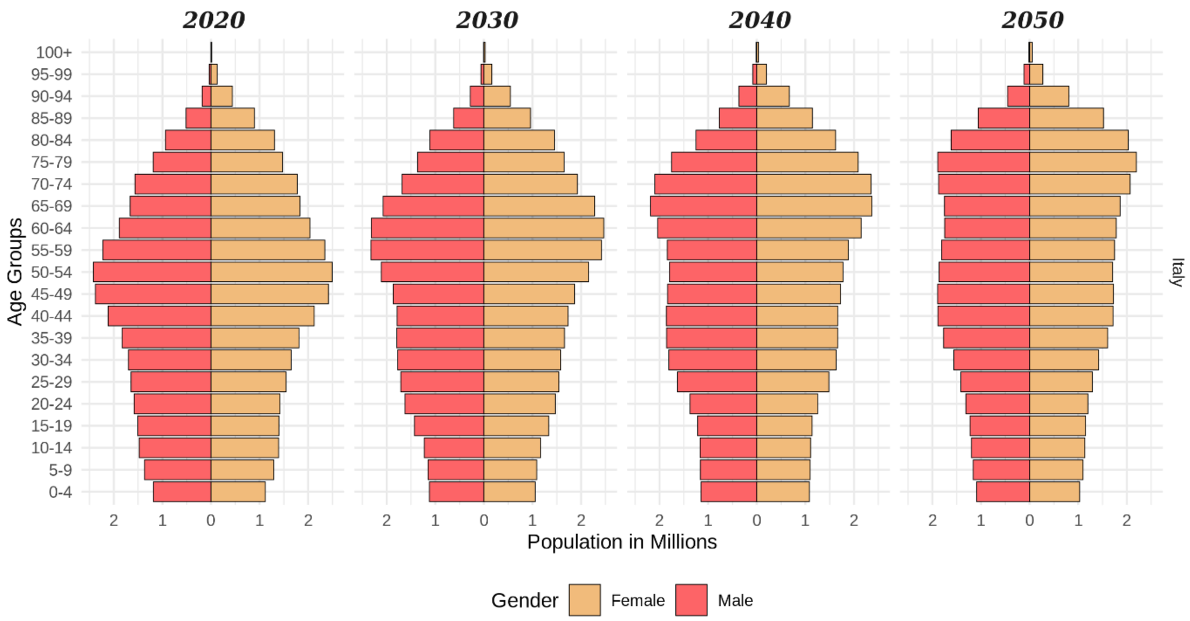
Source: Eurostat 2020 (id: proj_19np), own illustration.

Figure 6: Population pyramid of Ireland 2020-2050



Source: Eurostat 2020 (id: proj_19np), own illustration.

Figure 7: Population pyramid of Italy 2020-2050



Source: Eurostat 2020 (id: proj_19np), own illustration.

5.2 Wealth and saving dynamics

This project aims to provide a reasonable estimate of probable paths of wealth and inheritance flows over the next 30 years. Future revenues from wealth-related taxation depend to a considerable extent on the development of the assets themselves. The experience of the last decades has shown that, over time, asset valuations can be subject to significant volatility. For example, since the dawn of the global financial and economic crisis, valuations of real estate have increased rapidly, especially in urban areas of Europe. More recently, supply and demand shocks induced by the COVID-19 pandemic have led to spiking price levels. Central banks could see the need to adjust financial conditions to stabilise medium-term inflation, potentially affecting different asset classes in various ways. Looking ahead, structural trends like digitalisation, demographics and the transition to carbon-free economies will likely shape economic performance and asset valuation in ways that are impossible to foresee. For example, equilibrium rate of returns could change once the largest age cohorts retire and begin dissaving. Climate change and natural disasters could lead to economic contraction and destruction of capital. On the other hand, investments in new technology and innovations could bring about a new era of growth and shared prosperity. Against this backdrop, assumptions about growth rates for the various asset classes over such a long period are connected to a substantial degree of uncertainty.

However, ruling out any form of wealth appreciation does not seem to be very realistic either. Therefore, we will follow the example of Kotlikoff and Summers (1981) and Kotlikoff (1988) and capitalise the wealth stock by using a constant proxy of the average rate of return to wealth. For example, Tiefensee and Grabka (2017) use an appreciation rate of 2% per year across all wealth components. In our judgement, the assumption of a long-term interest rate in the range between 2% and 3% seems plausible and will be our default choice. However, as this will be implemented as a free modelling parameter for the four components of net wealth, the users of our program are free to explore the implications of different magnitudes on wealth dynamics and the projection of tax revenues.

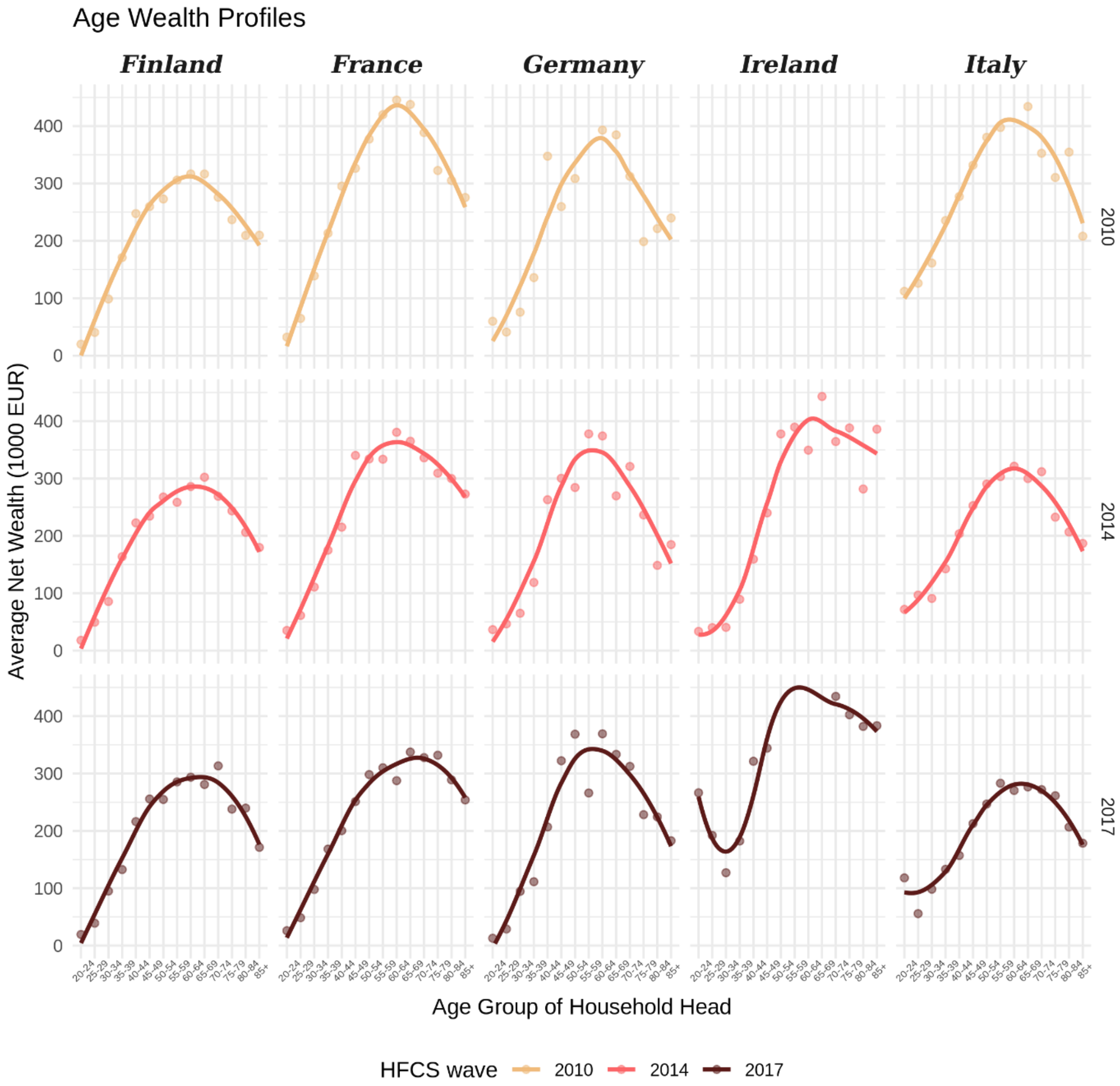
Besides the development of asset valuations, the second driver of changes in the stock of wealth is the difference between income and consumption flows. If income is larger than consumption, the wealth stock increases in the form of savings. On the other hand, if consumption exceeds income, parts of the expenditures must be financed out of existing wealth or by debt.

Following the seminal contribution by Modigliani and Brumberg (1954), the life-cycle hypothesis was the predominant model to contemplate the relationship between age and savings. It postulates that individuals form expectations regarding their lifetime income and choose a smooth level of consumption accordingly. Therefore, individuals are expected to have low or even negative saving rates at the beginning of their career, then saving rates should surge until retirement and afterwards will turn negative again during the last phase of life. However, these implications of the model are not unambiguously in line with empirically observed saving patterns. Based on Austrian HFCS data, Fessler and Schürz (2017) show that the relationship between age and savings is not statistically significant after appropriately controlling for income and household size. Tiefensee and Grabka (2017) also discuss the phenomenon that, at least on average, negative saving rates among the group of older people in Germany are not observed.

Against this background, there is a reason to believe that saving patterns across the life cycle depend on institutional characteristics of the respective economy. The design of the tax system, the health and pension system and how elderly care is organised might be crucial to understand the relationship between saving patterns and age, income and other household characteristics.

In Figure 8, we investigate this hypothesis with the help of age-wealth profiles for the five countries across the three available waves of the HFCS data. The graphs show the arithmetic mean across the five implicates, but note that there is no between variation in the data from Finland, France and Italy. We use inflation adjustment factors based on the harmonised index of consumer prices to express nominal values in prices of the most recent wave. The general pattern follows the prediction of the life-cycle hypothesis: i.e. accumulation of assets until the retirement age, followed by declining average wealth levels later on. Interestingly, we observe some country-specific patterns that repeatedly appear in subsequent waves.

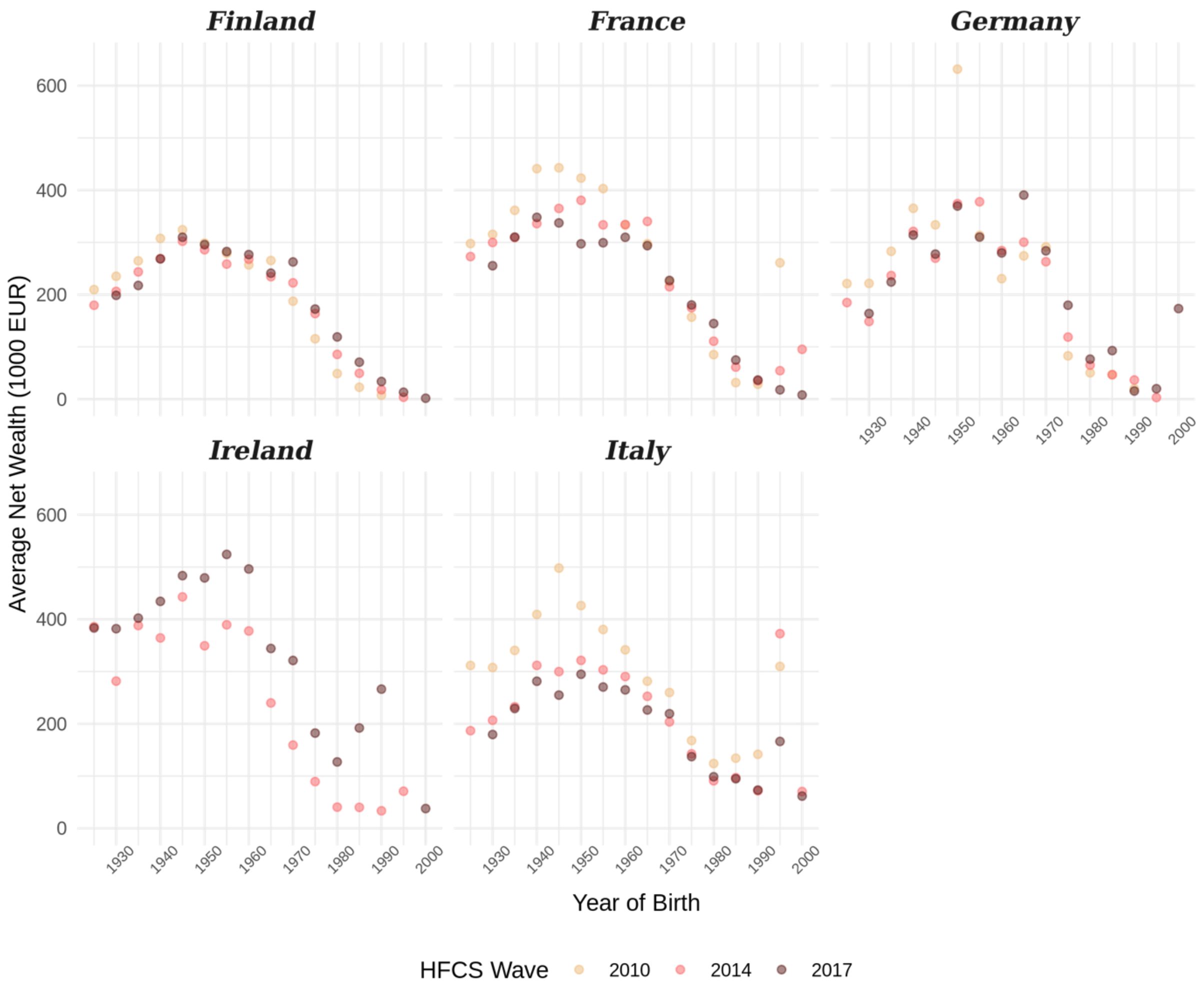
Figure 8: Comparison of age wealth profiles across three HFCS waves



Source: HFCS 2010, 2014, 2017. Own calculations and illustration. Nominal values expressed in prices of 2017.

For example, the rise and fall of average wealth levels are less pronounced in Finland. In France, households reach the highest average wealth levels at the end of career, and the subsequent decay is only moderate. Germany and Italy have very similar profiles; however, Germany is characterised by higher levels of volatility around the general pattern. Ireland sticks out in multiple ways. Firstly, Ireland participated only in the second and third wave of the HFCS. Secondly, the pattern of the age-wealth profile is less stable, especially among young adults. Thirdly, the average wealth levels of Irish households aged 70 and above are extraordinarily high, and we do not observe a significant reduction of wealth levels in older households. These patterns are likely linked to the substantial changes in housing wealth between the two waves of the survey in which Ireland participated.

Figure 9: Net wealth levels by birth cohort of household head across three HFCS waves



Source: HFCS 2010, 2014, 2017. Own calculations and illustration. Nominal values expressed in prices of 2017.

Although we can observe that there are cross-country differences in the relationship between age and wealth, such age-wealth profiles do not necessarily answer the question if the predictions of the life-cycle hypothesis are accurate. We can detect a slight tendency that the peak of the profiles is moving slowly to higher age groups. However, the fundamental question remains as to whether the reductions of asset holdings in later years are due to age or cohort effects.

Figure 9 addresses this issue by transforming the age groups into birth cohorts and plots the arithmetic mean of net wealth in five-year intervals. Again, we use information from all five implicates and express nominal values in prices of the HFCS's most recent wave. The idea is that whereas the age of individuals changes over time by definition, the birth cohort is a fixed characteristic. As the HFCS is generally not designed as a proper panel survey in most participating countries, we observe different households in repeated waves. If we can safely assume that each HFCS wave provides representative information for the cross-section, the average wealth by age cohort in the sample should be an unbiased estimator of the average wealth of the age cohort in the population. Hence, we can use the three waves of the HFCS and analyse if, e.g. average wealth of the birth cohort 1940 as measured in HFCS 2010 is different from our measurement based on HFCS 2017. The life-cycle model predicts negative saving rates for this age group: people are expected to use their savings to smooth their consumption intertemporally. A closer look at Figure 9 reveals that there is no clear evidence for such behaviour. In Finland, we see that household heads born between 1950 and 1985 accumulate assets; their average wealth levels increase from survey to survey. Among the elderly, we do not see further accumulation, at least on average. However, against the prediction of standard economic theory, households are also not running down their assets. Similar conclusions can be drawn for France and Germany, albeit the pattern is less clean and noisier compared to Finland. Both countries show jumps from one age group to the next, but again there is no convincing evidence for dissaving in later years. In Ireland, almost all age groups managed to increase the value of their portfolios significantly. The only exception is Italy. Here, we see constant wealth levels for those who are born later than 1965, and declining levels of assets for the elderly. This development seems more pronounced between the first and second wave of the HFCS compared to the transition from 2014 to 2017.

For the purpose of projecting wealth dynamics, our primary interest lies in long-term average growth rates of private wealth from one age group to the next. In a regression framework, we can estimate these parameters by pooling the three HFCS waves together and running a model that explains the logarithm of wealth by birth cohort dummies, a linear time trend and the interaction effects of cohort dummies with the linear trend. Obviously, such a simple model should not be mistaken for a structural model of wealth accumulation. Although it is not an accurate representation of the causal relationships at work, we use it as a descriptive summary of the unconditional correlations in the data.

Table 26 provides the results of this exercise separately for all five countries in our sample. The first half of the table shows the estimated values for the birth cohort coefficients. Based on the ratio of estimated coefficients and associated standard errors, we see that the overwhelming majority of these parameters is precisely estimated. The coefficients of younger birth cohorts are primarily negative, indicating that younger households hold on average lower levels of wealth than their older peers. The parameters of interest are shown in the second half of the table. The interaction between the cohort dummy and the linear time trend gives us an estimate of the yearly average growth rate of private assets for different birth cohorts between 2010 (2014 in the case of Ireland) and 2017. The calculations tell us that, for example, in Finland the cohort born between 1980 and 1985 was able to increase the total value of their assets by 50% between 2010 and 2017. Among the group of households born between 1940 and 1945, we get a slightly negative albeit not statistically significant estimate of around -2%.

In summary, we must conclude that the empirical evidence on constant age-specific wealth growth rates is not particularly strong. There is considerable heterogeneity in the data, and arguably, many more factors influence the shape of the wealth accumulation process. Since the specification of more elaborate models would result in the need to model and project the development of all other model inputs as well, we nevertheless use the patterns we have identified in Figure 8 and Figure 9 as well as the output of the regressions presented in Table 26 as guidance for our baseline configuration. More specifically, we assume that the estimated wealth growth rates by age cohorts between 2010 and 2017 are representative and applicable to the following cohorts in the projection period 2020 to 2050 as well. Especially the results of Italy remind us that the period we used to train the model might not be indicative of wealth accumulation patterns in the next three decades. The repercussions of the European sovereign debt affected the Euro Area as a whole, but some countries within the group were more severely hit than others. Subdued economic growth rates and fiscal austerity packages are associated with less space for *new* private savings.

On the other hand, the last decade was characterised by an evident appreciation of existing asset portfolios, most notably stocks and real estate in and around economic centres. Against the backdrop of the uncertainties around the long-term consequences of the current COVID-19 crises, there is absolutely no guarantee that these developments will continue without alterations. However, all these parameters will be implemented in the codes such that it is easy to explore the effects of different saving profiles on wealth dynamics throughout the projection period.

Table 26: Linear regressions of log(wealth) on birth cohort dummies

	Finland	France	Germany	Ireland	Italy
(Intercept)	11.82 (0.12)***	12.53 (0.04)***	12.17 (0.13)***	12.10 (0.60)***	11.83 (0.04)***
Birth cohort 1930	0.61 (0.16)***	0.07 (0.06)	0.25 (0.17)	-0.27 (0.78)	0.24 (0.06)***
Birth cohort 1935	0.61 (0.16)***	0.04 (0.05)	-0.14 (0.15)	0.02 (0.72)	0.55 (0.06)***
Birth cohort 1940	0.69 (0.15)***	0.27 (0.05)***	0.68 (0.15)***	-0.05 (0.70)	0.45 (0.06)***
Birth cohort 1945	0.68 (0.14)***	0.23 (0.05)***	-0.11 (0.15)	0.64 (0.68)	0.79 (0.06)***
Birth cohort 1950	0.35 (0.14)**	0.28 (0.05)***	-0.28 (0.15)	-0.69 (0.67)	0.81 (0.06)***
Birth cohort 1955	0.11 (0.14)	0.09 (0.05)	-1.18 (0.15)***	-1.76 (0.66)**	0.33 (0.06)***
Birth cohort 1960	-0.21 (0.14)	-0.29 (0.05)***	-1.03 (0.15)***	-2.73 (0.66)***	0.42 (0.06)***
Birth cohort 1965	-0.60 (0.14)***	-0.87 (0.05)***	-1.27 (0.15)***	-6.62 (0.65)***	-0.30 (0.06)***
Birth cohort 1970	-1.07 (0.14)***	-1.40 (0.05)***	-1.55 (0.16)***	-9.27 (0.65)***	-0.53 (0.07)***
Birth cohort 1975	-2.64 (0.15)***	-2.15 (0.06)***	-3.14 (0.17)***	-12.59 (0.65)***	-1.07 (0.08)***
Birth cohort 1980	-5.96 (0.15)***	-3.24 (0.06)***	-6.23 (0.17)***	-15.32 (0.66)***	-1.61 (0.09)***
Birth cohort 1985	-7.18 (0.15)***	-4.28 (0.07)***	-6.58 (0.19)***	-7.67 (0.70)***	-2.12 (0.15)***
Birth cohort 1990	-5.40 (0.23)***	-3.24 (0.15)***	-5.43 (0.36)***	-6.05 (0.88)***	-0.32 (0.37)
Linear Time Trend	0.02 (0.05)	0.15 (0.02)***	0.03 (0.05)	0.14 (0.10)	-0.05 (0.02)**
Birth cohort 1930:Trend	-0.09 (0.06)	-0.06 (0.02)**	-0.07 (0.06)	0.03 (0.13)	0.00 (0.02)
Birth cohort 1935:Trend	-0.05 (0.06)	-0.05 (0.02)*	0.01 (0.05)	0.00 (0.12)	-0.00 (0.02)
Birth cohort 1940:Trend	-0.02 (0.06)	-0.02 (0.02)	-0.03 (0.05)	-0.01 (0.12)	0.04 (0.02)*
Birth cohort 1945:Trend	-0.01 (0.06)	-0.04 (0.02)*	0.03 (0.05)	-0.11 (0.11)	-0.04 (0.02)*
Birth cohort 1950:Trend	0.02 (0.05)	-0.10 (0.02)***	0.01 (0.05)	0.03 (0.11)	-0.02 (0.02)
Birth cohort 1955:Trend	0.03 (0.05)	-0.12 (0.02)***	0.14 (0.05)*	0.19 (0.11)	-0.00 (0.02)
Birth cohort 1960:Trend	0.06 (0.05)	-0.09 (0.02)***	0.05 (0.05)	0.29 (0.11)**	-0.02 (0.02)
Birth cohort 1965:Trend	0.05 (0.05)	-0.03 (0.02)	0.08 (0.05)	0.79 (0.11)***	0.01 (0.02)
Birth cohort 1970:Trend	0.15 (0.06)**	-0.02 (0.02)	0.09 (0.05)	0.99 (0.11)***	0.03 (0.02)
Birth cohort 1975:Trend	0.24 (0.06)***	0.02 (0.02)	0.17 (0.06)**	1.38 (0.11)***	0.04 (0.02)
Birth cohort 1980:Trend	0.51 (0.06)***	0.12 (0.02)***	0.46 (0.06)***	1.67 (0.11)***	0.02 (0.02)
Birth cohort 1985:Trend	0.38 (0.06)***	0.09 (0.02)***	0.43 (0.06)***	0.55 (0.12)***	0.05 (0.03)
Birth cohort 1990:Trend	-0.32 (0.06)***	-0.09 (0.03)**	-0.08 (0.08)	0.39 (0.16)*	-0.22 (0.06)***
R^2	0.14	0.08	0.08	0.17	0.03
Adj. R^2	0.14	0.08	0.08	0.17	0.03
Num. obs.	158705	284565	133166	69326	204310

***$p < 0.001$; **$p < 0.01$; *$p < 0.05$

Source: HFCS 2010, 2014 and 2017, own calculations. Nominal values are expressed in prices of 2017. Regressions are estimated on the country levels using all household observations from all five implicates in a pooled cross-section of waves 2010, 2014 and 2017 with household heads born in 1990 or earlier (i.e. at least 20 years old in the first HFCS wave). Reference group for birth cohort dummies: 1925.

5.3 Outline of projection scenarios

Based on the discussions of the previous sections, the following table summarises our modelling choices regarding the dynamic projection of wealth for a period of 30 years and offers a short explanation of the implementation and the associated options for users to adjust the computations to specific research questions. Be aware that we define the projection "scenarios" such that we can isolate the contribution of each of the modelling components on the projected outcome. The Baseline, for instance, keeps the population structure as of 2020 (being aged in the following years) – which is arguably unrealistic – but allows to compare the impact of the demographic change scenario against it. The same holds for the other modelling components (wealth and savings dynamics). For the actual inheritance and policy simulations, we rely on the joint modelling of demographic change and wealth and savings dynamics.

Table 27: Summary and implementation of projection scenarios of INTAXMOD (impact of the modelling components)

Scenario/Modelling component	Defaults	Description & Implementation
Baseline	Project HFCS 2017 with constant 2020 mortality rates until 2050 (Source: Eurostat), keeping the population structure constant. No asset appreciation and no wealth accumulation.	This scenario will be used as a benchmark that allows us to isolate the effects of the other scenarios on the quantitative and qualitative path of wealth transmissions.
Demographic Change	Instead of constant 2020 mortality rates, we will use Eurostat's projections of age and gender mortality rates for the next 30 years (see section 5.1) and apply the respective mortality rates in the corresponding simulation year.	The algorithm refers to the projected path of mortality rates. As Eurostat updates its projections periodically, the codes allow the user to update to the most recent projection data automatically.
Wealth Dynamics	Appreciate the value of assets based on assumptions about long-term growth rates of four major wealth components: (i) real assets, (ii) financial assets, (iii) business assets and (iv) liabilities (see section 5.2).	The parameters are specified in the dedicated Excel sheet (Configuration.xlsx, see section 10.4). The default values are set to 2% for all four asset categories and can be adjusted separately for each country and each wealth component.
Saving Dynamics	Increase the assets of households in each projection period based on assumptions about age-specific wealth growth rates (see section 5.2).	The parameters are specified in the dedicated Excel sheet (Configuration.xlsx). The default values are informed by the regression results based on pooled data from all three HFCS waves (see section 5.2, Table 26). The parameters can be adjusted separately for each country and each birth cohort.
Joint Modelling of Demographic Change and Wealth and Saving Dynamics	Combine the assumptions about demographic change as well as wealth and saving dynamics (all of the above).	The results will be derived by combining the default parameters of the sections above. However, this is only one of many potential configurations. The program allows the user to adjust the parameters and update the projections whenever new information emerges or if the aim is to explore the effects of certain assumptions.

Note: Be aware that the projection scenarios describe the different modelling components and are not (necessarily) realistic projections of reality. The Baseline, for instance, keeps the population structure as of 2020 being aged – which is arguably unrealistic – but allows to compare the impact of the demographic change scenario against it. The same holds for the other modelling components (wealth and savings dynamics).

6. Algorithm and assumptions for projecting inheritance tax revenues

In this section, we provide a general outline of the algorithm and discuss the necessary modelling assumptions. As mentioned already, the treatment of inheritances and gifts for tax purposes differs substantially across countries (see section 2.2). These differences concern the level of marginal tax rates, the number and progressivity of tax brackets, the percentage of assets that are actually considered in the derivation of the tax base and exemption amounts for different degrees of relationship to the donor. Against this backdrop, we are aiming to optimise the trade-off between the required level of generalisation to come up with a joint modelling framework that fits all major peculiarities at the country level and nevertheless scarifies only the absolute minimum of specific country-level modelling in terms of predicting the aggregate and the distribution of wealth transmissions as well as the associated tax revenues.

In a nutshell, the general principle is the following: Departing from the observed wealth levels of the most recent HFCS wave from the year 2017, we approximate wealth levels in period t by appreciating wealth components by asset-specific long-run rate of returns as well as country- and age-specific (dis)saving rates for the time period t to t_0. Next, we increase the age of observations (i.e. $age_{t_0} + (t-t_0)$) and adjust sample weight such that the distribution of individuals by age and gender in period t matches with Eurostat's population projections. By applying projections of age-specific mortality rates for period t, we compute the expected number of deaths. This approach has been successfully applied in a similar context by Altzinger et al. (2013) and Tiefensee et al. (2017). Thereafter, we use historical fertility data to model the distribution of recipients and calculate the associated tax liability conditional on the degree of relationship to the donor and the composition of the wealth portfolio. Finally, the algorithm derives the expected value of inheritance tax by integrating over the possible recipient constellations. Box 1 provides a schematic overview of the steps in our projection algorithm. They are composed of two groups which consist of two and nine building blocks, respectively.

We discuss the implementational choices and their implications in greater detail in the following paragraphs. However, three general simplifications have to be stressed.

Some countries differentiate extensively between degrees of relationships within the inheritance tax schedule; others do not. As a general rule, close relatives are granted higher exemption thresholds and lower marginal tax rates. In order to reproduce this pattern, we aggregate the taxation parameters into three types of donees: (i) partner/spouse, (ii) children and direct relatives, and (iii) others.

Valuation rules and exemption thresholds may depend on certain conditions. Examples include the continuation of economic activities in the case of business assets or the usage of real estate as the main residence for an extended period of time. Due to a lack of data, we are not able to model compliance with such conditions. Instead, we have to assume that all requirements for favourable treatment are fulfilled. Consequently, our estimates are shifted downwards, and actual revenues might be higher than expected if, in reality, a significant number of cases cannot fulfil the relevant requirements.

Wealth transfers materialise in two forms: inheritances and gifts. Whereas mortality rates are heavily used in the field of demography and population statistics to model life expectancy and the expected number of deaths in the next decades, the research on the timing and the amount of gifts is far less advanced. This uncertainty leads us to focus on modelling wealth transfers only at the time of death. Qualitatively, this implies a time shift of actual and simulated wealth transfers and that we observe associated tax revenues with a lag. Taxation rules are very similar for both types of transfers; hence the sum of tax revenues over the projection period is very likely still unbiased.

Preparation in t_0

a) Distribute wealth within household

b) Append modelling parameters from Excel

Do for every period t of the projection frame

1) Ageing of individuals

2) Wealth dynamics

3) Population reweighting

4) Get tax base

5) Distribute tax base to scenarios of recipients

6) Derive tax liabilities

7) Expected value of potential inheritance tax

8) Expected value of actual inheritance tax

9) Summarise aggregate and distribution of taxes

Box 1: Overview of steps in our projection algorithm

6.1 Preparation in t_0

Before starting the projections for every period t in the projection time frame, the algorithm distributes the wealth observed at the household level to its members and attaches the modelling and taxation parameters from the configuration document.

6.1.1 Distribute wealth within households

The HFCS is primarily a household survey. Although the survey collects data on all household members' age, gender, education, income, and labour market characteristics, the main data on assets and their components is only available as a sum for the household. However, as modelling of mortality hinges on individual characteristics, we have to come up with a reasonable assumption about the distribution of assets within the family. This will subsequently determine the amount of assets subject to wealth transfer taxation if a household member is modelled to die.

The main assumptions in these steps are:

- Equal sharing of resources among reference person (defined based on Canberra concept, see HFCN 2020) and partner[27]

[27] The within household distribution of assets impacts the simulated inheritance tax revenue. The more equal assets are shared among partners the lower the average bequest being distributed to the next generation upon death of one of them. Because a lower average inheritance leads to a higher share of inheritances being exempt from taxation thanks to the personal allowances. In the extreme case where all household wealth is owned by the same person, the number of heirs facing a tax liability would *ceteris paribus* be the highest. By choosing an equal sharing of assets among partners, we take a conservative stance with respect to simulated tax revenue.

- Portfolio held constant within the household

Hence, we refrain from splitting the assets portfolio along the stereotype gender dimensions (e.g. business and financial assets to males, the household main residence and other tangible assets to females). Although there is some evidence in the literature, the signal in the data is not strong enough to inform a general imputation rule.

Reasonable candidates for a sensitivity analysis would be to a) allocate all assets to the oldest person in the household or b) split assets equally among all adults. Approach a) results in an upward shift of tax revenues compared to our benchmark scenarios, whereas approach b) implies a downward shift and delay of tax revenues.

Another caveat is that rich lists in general, and Forbes data are no exception in this respect, usually provide only a limited set of sociodemographic characteristics of the family head. They do not provide data on household size and age of the partner or other household members. Obviously, top tail observations hold significant amounts of assets and, therefore, very likely influence the revenue estimates. However, the relative importance of exemption thresholds (usually in the range of € 100,000 to € 1,000,000) fades out as taxable transfers increase and become more or less negligible for high-wealth individuals. This implies that projection results are most likely not very sensitive to assumptions about the household composition of rich list observations. As a benchmark, we assume that rich list observations predominantly live with a partner and we therefore generate a spouse with the opposite gender in the same age group as the rich list observation.

6.1.2 Append modelling parameters from Excel

The projected paths of wealth accumulation and transfers are affected by a range of parameters and modelling choices. Within this step of the algorithm, we fetch these quantities from the specified configuration file and append them to the data. The parameters belong to three groups:

(i) asset appreciation: time constant long-term rate of return for real assets, financial assets, business assets and liabilities and time constant age-specific annual saving rates (five-year age groups),

(ii) historical fertility data and distribution of the number of offspring by birth cohorts and educational attainment from 1920 to 2020, and

(iii) taxation parameters: type of tax tariff (progressive increase of marginal or average rates), the minimum absolute value of the tax liability (applies in our sample of countries to Finland only) and the actual tax brackets and marginal rates for direct relatives and other recipients

All of these parameters are allowed to differ between countries. On the one hand, this is a necessary requirement to account for country-specific characteristics. On the other hand, it will enable exploring the effects of country-specific scenarios within a comparative and unified framework.[28]

6.2 Do for every period t

6.2.1 Ageing of individuals

Many economic and demographic variables are correlated with age. Obviously, this applies to mortality probabilities but also extends to the distribution of births, the achieved level of education and saving rates. Some variables depend on the stage of the life cycle, others are cohort-specific. In both cases, we have to control for these demographic dependencies, otherwise we would miss an essential source of dynamics in the projections of INTAXMOD.

[28] For more information on the syntax of the parameters and how to deviate from the defaults, see chapter 10 in the User guide.

In order to account for the changing composition of the population in the projection period, we adjust the observations' age in every step of our forecasts. As some countries deliver age data only in five-year age brackets, the process of ageing is also carried out in five-year intervals.

An important feature of the HFCS data is the top-coding of age information at the value 85+. At the beginning of the projection period, this is not a severe limitation. Still, as the population in the range of 85 to 100 years and above is expected to increase significantly in the course of the coming decades, we gradually lift the restriction and move the upper age limit in three steps from 85+ to 100+ by the year 2035. This approach allows us to use a more granular version of projected mortality rates for the population segment, where mortality rates vary substantially from one age group to the next. Consequently, we arrive at a more accurate estimate of headcounts and deaths, especially for the upper part of the age distribution.

At the other side of the spectrum, the ageing of individuals implies that in every step of the projection period, the lower limit of the age distribution is lifted by one age bracket. Those observations within the age range 20 to 25 in the raw data compose the age group 50 to 55 in the projection period 2050. One way to circumvent this problem would be to actually model future fertility and generate new observations at every step of the projections. However, we would have to model educational achievements, an initial allocation of wealth components as well as the formation of households. However, as the population below the age of 50 years is characterised by very low mortality rates and therefore contributes only a negligible amount to the sum of bequests, we refrain from such an exercise. Although our estimates of wealth transfers and associated inheritance tax revenues remain largely unaffected, this clearly does not apply to the distribution of wealth at the end of the projection period. Since the sample in 2050 consists only of people aged 50 and above, our projected data represent only a subset of the population. Again, for the application of modelling inheritance tax revenues, this seems to be a justifiable simplification. Nonetheless, we account for this characteristic of the model by deriving summary statistics based on the population aged 50 years and above in every stage of the projection period.

6.2.2 Wealth dynamics

In a nutshell, wealth dynamics are influenced by two factors: the valuation of wealth that was accumulated in the past (i.e. stock), and modifications thereof that result from the difference between income and consumption in a specific period (i.e. saving or dissaving). INTAXMOD takes both dimensions into account by considering

- average long-term appreciation rates by asset component net of inflation: default 2%
- age-specific wealth growth rates (including dissaving in old age)

The model assumes that wealth dynamics follow a geometric growth path; hence we estimate the amount of wealth component W_j in period t1, measured in current price levels, as

$$W_{j,t1} = W_{j,t0} * \left(r_j * w_a\right)^{t1-t0}$$

where $W_{j,t0}$ stand for the initial wealth levels, r_j is the long-term rate of return of asset component j, and w_a are the age-specific (dis)saving rates. If the time difference between t1 and t0 exceeds five years, we do these calculations in several steps to account for the change of the age-specific saving rates. This procedure is used separately for three subcomponents of real assets (i.e. household main residence, other real estate, other real assets), for financial and business assets as well as liabilities. Finally, we update our gross and net wealth estimates at the individual level by summing up the corresponding portfolio components.

6.2.3 Population reweighting

This block of the algorithm adjusts the sample weights such that population aggregates stratified by gender and age groups resemble Eurostat's population projection. Aligning the HFCS data to the projected totals increases INTAXMOD's accuracy, but more importantly, the process of ageing individuals in the data without further correction would lead to biased representation of the age distribution in period t. Table 28 provides an illustration by showing the age distribution of Germany according to the raw and reweighted HFCS data for the year 2020 and the corresponding numbers from INTAXMOD for the year 2050. We see that the reweighting step has already some impact at the beginning of the projection window but becomes even more apparent as we move to the end of the projection frame. For the age groups above 70 years, the difference becomes significant and gains importance in later years and for older age groups. The most extreme example is the age group 100+ in the year 2050. Without reweighting, the ageing of individuals that we observe in the raw data would lead to an estimated total of 12.4 million (the number of observations that are aged 70 and above in the raw data), whereas reweighting the data according to Eurostat's population projection leads to an updated headcount of 0.1 million. The main advantage is that thereby INTAXMOD's outcomes in terms of population and expected number of deaths align with Eurostat's projections throughout the projection period. Furthermore, as Eurostat includes estimates of net migration, we are implicitly controlling for population movements in our results. However, the process of reducing the weights of the old households and inflating those of the younger cohorts has a natural limit. As our algorithm is not a dynamic microsimulation model where people are born, we do not observe persons below the age of 50 years in 2050. Applying the same routine for the more distant future would lead to losing wealth and underestimated tax revenues.

Table 28: Projection of German population with and without reweighting

	German population (in million people)					
Age groups	2020		2035		2050	
	Raw HFCS	Reweighted HFCS	Ageing	Ageing + reweighting	Ageing	Ageing + reweighting
20-24	4.2	4.6				
25-29	4.5	5.1				
30-34	5.8	5.5				
35-39	5.3	5.3	4.6	5.0		
40-44	4.9	4.9	5.1	5.2		
45-49	6.1	5.3	5.5	5.5		
50-54	7.2	6.7	5.3	5.3	4.6	5
55-59	5.8	6.7	4.9	4.9	5.1	5.1
60-64	5.1	5.6	5.3	5.0	5.5	5.3
65-69	4.3	4.9	6.7	6.0	5.3	4.9
70-74	3.4	3.7	6.7	5.7	4.9	4.3
75-79	4.7	3.9	5.6	4.5	5.3	4.2
80-84	2.5	3.3	4.9	3.3	6.7	4.5
85-89	1.6	1.6	3.7	1.9	6.7	3.3
90-94			3.9	1.0	5.6	1.5
95-99			3.3	0.3	4.9	0.4
100+			1.6	0.0	12.4	0.1

Source: HFCS 2017 and own calculations using INTAXMOD.

6.2.4 Get tax base

As countries use different provisions for the determination of the tax base, we have to transform the wealth data from fair market values to taxable values. Chapter 2.2 already presented the relevant valuation rules and asset-specific deductions. We observe exemptions associated with two wealth components: the household main residence and business assets.

In Germany and Ireland, the transfer of real estate used as the household main residence is fully exempt. In Italy, residential assets are assessed based on cadastral values raised by 5% and multiplied by a coefficient which differs according to the building type: 110 for household main residence and 120 for other homes (Boone et al. 2019). Fortunately, Boone et al. (2019) also provide an approximation formula for the cadastral values, which are not part of the HFCS questionnaire. The proxy is based on the ratio of the sum of all cadastral values in Italy and the aggregate of the market value of all real estate in Italy. For the year 2010, this ratio amounts to 0.00333434. Based on this value and the factors mentioned above, the taxable value of residential assets is given by the market value multiplied by $0.00333434 \times 1.05 \times 110 = 0.385$. Valuation of other real estate follows a similar rationale; here the corresponding factor is $0.00333434 \times 1.05 \times 120 = 0.42$.

As far as business assets are concerned, Ireland is the only country in our sample where business assets are fully taxable. In Italy, deductions for business assets amount to 90% of the market value, in Germany the deduction is 85%, and France subtracts 75% from the market value. In Finland, the fair market value is replaced by a lower amount according to the valuation law, then 40% of the lower value is taken as the tax base. Ambagtsheer-Pakarinen (2020) provides an example where the market value is first cut in half and then multiplied by 40%, which results in a factor of $0.5 \times 0.4 = 0.2$.

Table 29 shows the default parameters used to convert the appreciated market values (see step 2) to taxable values. This ensures that asset-specific allowances and valuation rules are appropriately taken into account in each period of the projection frame. Deviations from the standard values can be explored comfortably by providing the algorithm with different valuation factors through the configuration file.

Table 29: From market values to taxable valuations

Valuation of	Finland	France	Germany	Ireland	Italy
Household main residence	100%	100%	0%	0%	39%
Other real estate	100%	100%	100%	100%	42%
Remaining real assets	100%	100%	100%	100%	100%
Financial assets	100%	100%	100%	100%	100%
Business assets	20%	25%	15%	100%	10%
Liabilities	100%	100%	100%	100%	100%

Source: Country Tax Guides IBFD and national tax legislation.

6.2.5 Distribute tax base to scenarios of recipients

Current inheritance tax legislations regularly involve quite significant exemption levels for each recipient of the wealth transfer. Especially close relatives like partners and direct offspring benefit from this characteristic of inheritance tax codes. In Germany, the exemption limit for spouses amounts to € 500,000; in Italy it is € 1,000,000; and in France and Ireland, the surviving partner is fully exempt from wealth transfer taxation. These high exemption limits imply that a significant part of wealth transfers is not subject to taxation, irrespective of the actual levels of marginal tax rates. Children's exemption levels are usually set to lower values, but the spread between them is clearly country-specific both in absolute and relative terms. For example, Italy also grants an exemption limit of € 1,000,000 to direct relatives (i.e. there is no difference between spouse and children).

In contrast, the exemption threshold in France is set to comparatively low levels of € 100,000. The lowest exemption thresholds can be observed for other beneficiaries. This category, therefore, has the potential to drive inheritance tax revenues. However, available evidence from the HFCS data suggests that the overwhelming majority of wealth transfers accrue within families.

In order to achieve a reasonable estimate of inheritance tax revenues, it is thus crucial to model the number of recipients accurately. Unfortunately, the HFCS lacks data on the number of children that live outside the household. Modelling the distribution of inheritances, therefore, depends on assumptions and/or external data. We inform the sharing of bequests among recipients by historical fertility data by birth cohorts and educational attainment from 1920 to 2020. These data allow us to derive the respective marginal distribution of children from zero to eight. Additionally, we check if there is a partner within the household. If this is the case, the algorithm assumes he or she receives the portion of the estate that must go to the partner by law.

Table 30 provides an overview of the defaults. These parameters are free model parameters and can be changed in the Excel sheet. They reflect our modelling assumptions and do not necessarily reflect the real and often complex regulations. If we detect a partner in the household, he or she receives the total amount in the scenario of no children, 50% of the estate in the scenario of one offspring and so on. In the case of Italy, the partner receives 33% of the estate in all scenarios with at least two children. The remaining part of the estate is then assumed to be split equally between the corresponding number of children.

Table 30: Partner's share of the estate by the number of children

No. of children	Germany	Finland	France	Ireland	Italy
0	100%	100%	100%	100%	100%
1	50%	50%	50%	50%	50%
2	50%	50%	50%	50%	33%
3	50%	50%	50%	50%	33%
4 to 8	50%	50%	50%	50%	33%

Source: INTAXMOD parameters based on national tax legislation, own representation.

If there is no partner in the household, the estate is split equally between the number of offspring in the respective scenario (i.e. running from one to eight children). For the scenario *no partner* x *no children,* we distribute the estate between two recipients of the tax category "others", i.e. no close relatives.

In total, we end up with nine scenarios of different numbers of recipients that belong to different tax categories based on their assumed degree of relationship to the donor. Ultimately, we work out the distribution of the tax base for all combinations, which are later used to derive actual tax liabilities.

6.2.6 Derive tax liabilities

Based on the calculations of the previous step, we deduct the corresponding exemption limits and apply the appropriate tax tariffs for every combination of number and type of recipients. For the actual default parameters for tax brackets and marginal rates, please see the related tables in chapter 2.2. The results of this step are then scenarios of actual tax liabilities, which take the differences in tax tariffs by the degree of relationship to the donor and, most importantly, the distribution of estates among the different number of donees appropriately into account.

6.2.7 Expected value of potential inheritance tax

Next, we derive the potential inheritance revenue assuming that an individual would die in period t. We calculate the expected tax revenue as the average across the different fertility scenarios (no children, one child, two children …), weighted by the probability of each fertility scenario. The corresponding weights follow the marginal distribution of offspring stratified by age cohort and achieved level of education. Here the critical assumption is that historical fertility rates provide an unbiased estimate of the number of recipients. If, for example, the distribution of wealth transfers is biased towards the (first) male offspring, our revenue estimates would be biased downwards due to the reduced impact of deducting the exemption threshold multiple times.

6.2.8 Expected value of actual inheritance tax

To obtain the estimates of interest, i.e. the expected number of deaths, expected aggregates of wealth transfers and associated tax revenues, we combine the expected values of potential inheritance tax from step 7 with Eurostat's projection of age- and gender-specific mortality rates and the adjusted sample weights from step 3.

6.2.9 Summarise aggregate and distribution of taxes

The final step of the algorithm is to retain summary statistics of the results of the projections. In terms of aggregates, we derive totals for population, deaths, net wealth, tax base, transferred wealth and inheritance tax revenues by age group of the donor. Moreover, we transform the scenarios about the number and type of recipients into distributional statistics about the share of cases that are actually taxed as well as quantiles and inequality indicators of wealth transfers and corresponding tax liabilities.

7. Projection results

This section presents the results of our simulation exercise for Finland, France, Germany, Ireland and Italy for the period 2020 to 2050. As thoroughly discussed in chapters 6, INTAXMOD's outcomes depend on the assumptions and the parameters that inform the model. In this respect, it seems worthwhile to stress the unavoidable uncertainties associated with the projection of economic and social outcomes over three decades. Nevertheless, our tool offers a flexible framework to explore different pathways of wealth aggregates and transfers in European countries based on diverging assumptions.

The section is divided into two parts. We devote the first part to discussing general patterns and cross-country differences in the development of population growth, the number of deaths and wealth aggregates. These are the main drivers of wealth transfers and allow for a deeper understanding of the underlying mechanisms. The second part is concerned with the revenues of inheritance taxation. We start by comparing our results with the most recent information about actual tax revenues. Then, we present our forecast of the development of inheritance tax revenues based on current legislation from 2020 to 2050. Lastly, we will use INTAXMOD to explore the revenue potential of six alternative tax schemes. All nominal values (i.e. wealth aggregates and tax revenues) are presented at a common price level (of 2020) and thus indicate probable paths, net of inflation.

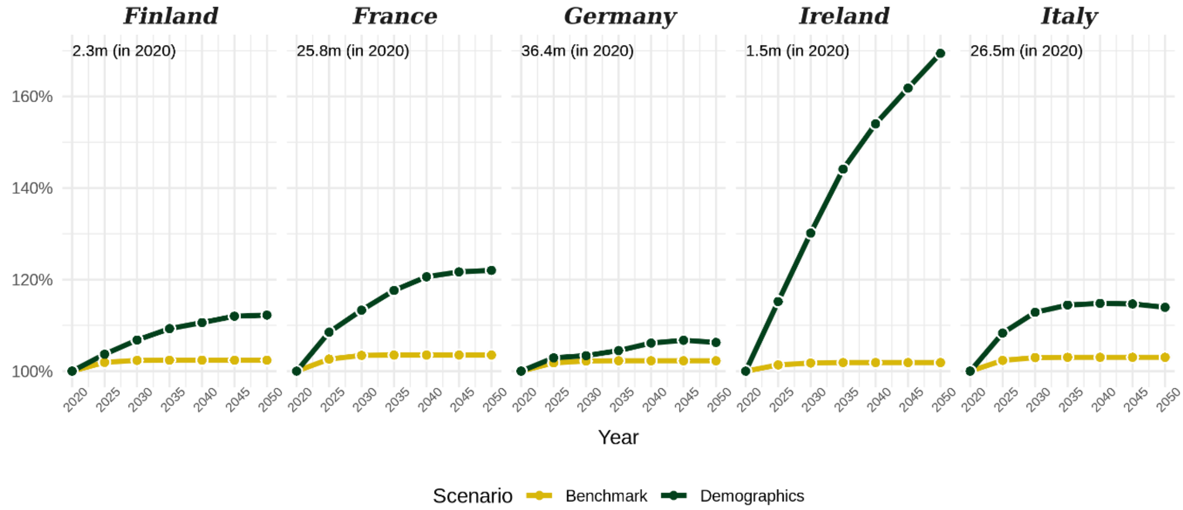
7.1 General patterns: Population and wealth dynamics

7.1.1 Demographics: Population and number of deaths

European countries face decades of significant changes in the demographic composition of the population. This fact is well known (see for example European Commission 2020), and INTAXMOD reproduces this pattern by aligning our data to Eurostat's population projections (Eurostat 2020). Although the main characteristics of these structural shifts apply across all countries, we can identify quantitative and qualitative deviations from the general trend in the five countries of our sample.

Figure 10 shows the projected population growth path in the subsample of people aged 50 years and above from 2020 until 2050. We have Germany at one side of the spectrum, with a small but steady population growth unit 2045. Starting from 36.4 million people aged 50 years and above in 2020, the projection indicates an increase of the population of 8%. In Finland and Italy, we are expecting an increase of around 15%. In France, the increase is somewhat higher with little more than 20% compared to 2020. In Ireland, which initially has a younger population relative to the other countries, we see a rapid demographic expansion. Starting from 1.5 million inhabitants aged 50 years and above, the population will grow by 70% until 2050. In contrast to the other countries, Ireland's population growth also does not seem to stop until the end of the projection frame. We can detect a levelling off in Finland and France at around 2045; in Germany and Italy, we see a slight decrease of people aged 50 years and above at the end of our forecast window.

Figure 10: Projection of population aged > 50 years (2020-2050)

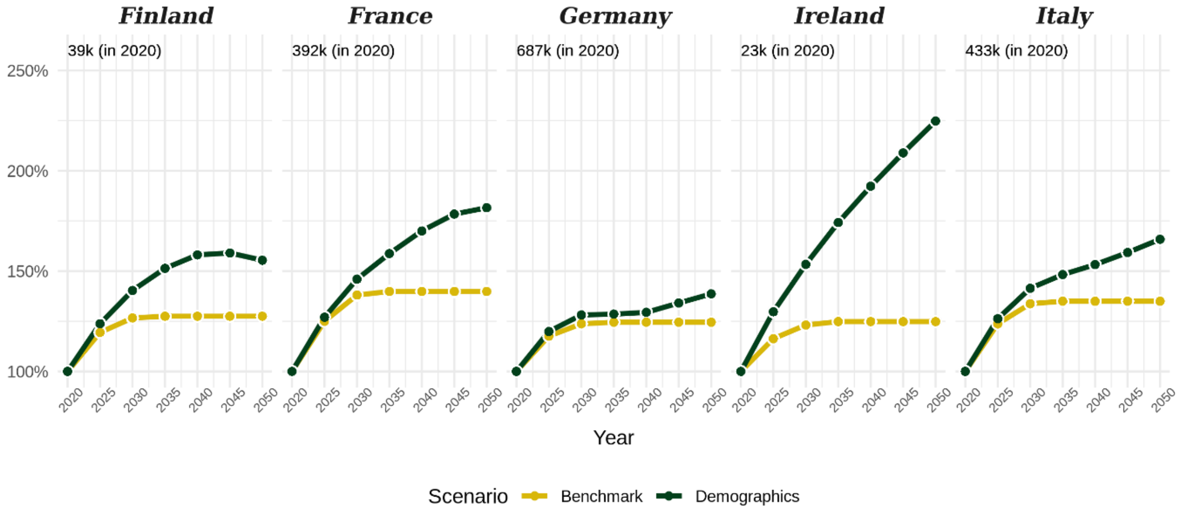


Source: HFCS 2017. Own calculations using INTAXMOD.

Comparing the two scenarios in Figure 10, we see that population growth with demographic dynamics is always above the benchmark scenario, which freezes the demographic composition we observed in 2020. This demonstrates the vital importance of taking demographic change into account. The slight increase of the population in the benchmark scenario of around 1% to 2% is driven by lifting the top coding at age 85+, a limitation of the original HFCS data, in the initial phase of the projection period.

In Figure 11 we show the development of deaths over the next three decades. Although the general patterns look comparable to the previous graph, magnitudes differ markedly. The number of deaths is expected to outpace the growth of the living population aged 50 years and above by a factor of three. This is a direct consequence of the significant change in the demographic composition of European societies in the 21st century. In Germany, we observe around 690,000 deaths in 2020, a number that is projected to grow by 30% until 2040 and by an additional 10% until 2050. Finland and Italy can expect an increase in the range of 60%; in France, this level will be reached in 2035 with further increases until 2050. For Ireland, which today has a much younger population than the other four countries, we observe a population growth of around 70% until 2050; the number of deaths is expected to surge from 23,000 in 2020 to about 50,000 in 2050. As more deaths also lead to more inheritances, these demographic dynamics *ceteris paribus* contribute to a rise in inheritance tax revenues.

Figure 11: Projection of deaths in the population aged > 50 years (2020-2050)



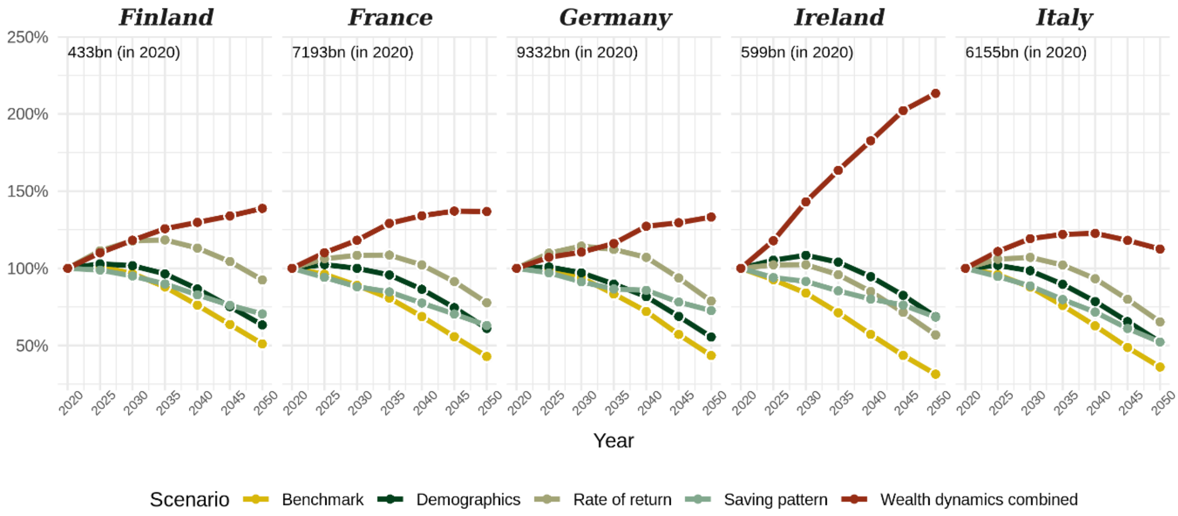
Source: HFCS 2017. Own calculations using INTAXMOD.

7.1.2 Wealth aggregates

After acknowledging the influence of demographic change, we now move to the projected path of wealth aggregates. Figure 12 shows the expected development of total net wealth of people aged 50 years and above. The lines with different colours represent the different configurations of INTAXMOD. The benchmark (yellow) shows the path of total net wealth if the marginal age distribution stays constant, and the long-term rate of returns and saving rates are set to zero (i.e. wealth dynamics are turned-off for). In the following 3 scenarios (demographics, rate of return, and saving pattern), we deviate from the benchmark scenario by changing one modelling component to isolate the impact of that choice. The last scenario “wealth dynamics combined” combines all modelling components (demographics, rate of return, and savings) and.

The demographic scenario (blue) reveals the impact of accounting for the increase of older inhabitants. The scenario where we depart from the benchmark by including the asset-specific rate of returns is depicted in brown. Age-specific saving patterns are represented in green. And finally, the red line pools the influence of demographic change, asset appreciation and saving rates in a scenario of combined wealth dynamics.

Figure 12: Projection of total net wealth in the population aged > 50 years (2020-2050)



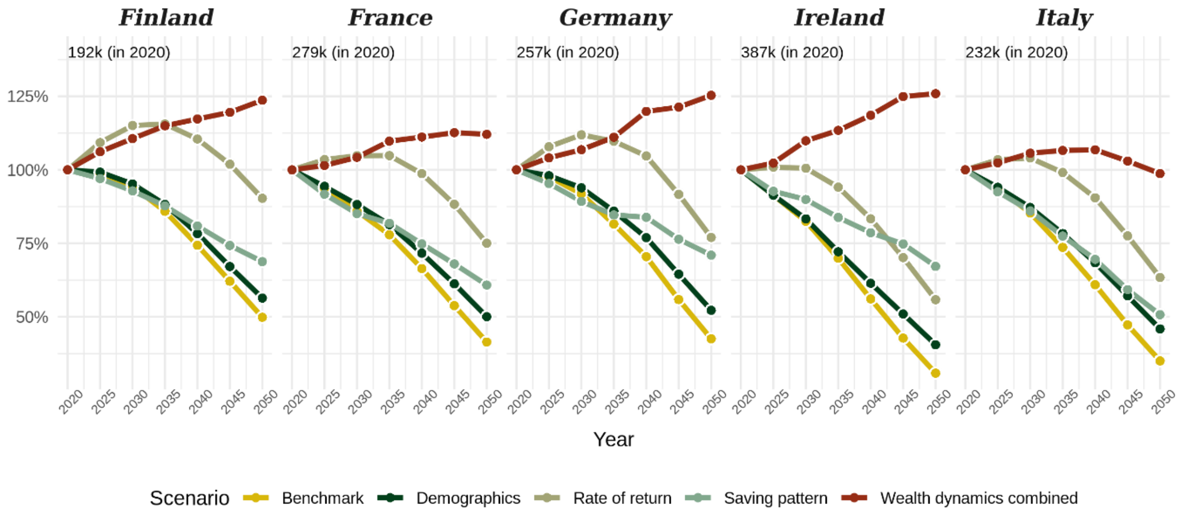
Source: HFCS 2017. Own calculations using INTAXMOD.

The downward sloping trend of the benchmark scenario can be explained by the observed age-wealth profiles (see chapter 5.2, Figure 8). Average wealth by age follows an inverted U-shape, increasing until the age of 60 and declining afterwards. In the benchmark scenario without asset appreciation and wealth accumulation, observations that belong to the age group 20 to 25 in 2020 will belong to the age group 50 to 55 in 2050. Without further modifications, this decline of average wealth in the age groups from 50 to 80 would significantly reduce wealth aggregates. However, the remaining scenarios help us paint a more realistic picture of wealth aggregates and reveal their relative contribution to the scenario of combined wealth dynamics.

We find similar patterns for Finland and Germany on the one hand and France and Italy on the other hand. In Finland and Germany, the impact of demographic adjustments on total wealth aggregates seems somewhat muted. Instead, long-term asset appreciation rates and, and to a lesser extent starting from 2035, saving patterns appear to drive an increase of total net wealth of 30% to 40% until 2050. In France and Italy, the impact of demographics is relatively more important. The blue line lies almost in the middle between the benchmark and the scenario with the isolated rate of returns. In the combined scenario, we observe a steady increase of about 40% for France, whereas the growth of total net wealth in Italy starts to level off at around 25% in 2035 and decreases to 10% in 2050. Ireland again is characterised by a remarkable development. The demographic component is the most critical driver of aggregate wealth, but the impact of asset appreciation and wealth accumulation does not lag far behind. As can be seen in Figure 12, in comparison to the other countries in the sample, in Ireland the difference between the benchmark scenario (yellow line) and the scenario with demographics (blue line) and the saving rates (green line) is especially pronounced. Taken together, the results of the combined scenario suggest an increase in total net wealth from € 600 billion by more than 210% to around € 1,300 billion.

By additionally looking at the average net wealth levels, we can disentangle the rise of the headcount from a simultaneous increase of average wealth levels per unit. Figure 13 suggests that average net wealth in Finland, Germany and Ireland will increase by 25% until 2050. However, it seems important to note the difference in initial values. Whereas Finland starts with a mean of € 193,000, the average net wealth in Ireland is about twice as much at € 388,000. In France, the growth of average net wealth does not extend beyond 12%. In Italy, the development of average wealth stays below 10% at its highest value around 2035 and decreases again to initial levels at the end of the projection frame.

Figure 13: Projection of average net wealth in the population aged > 50 years (2020-2050)



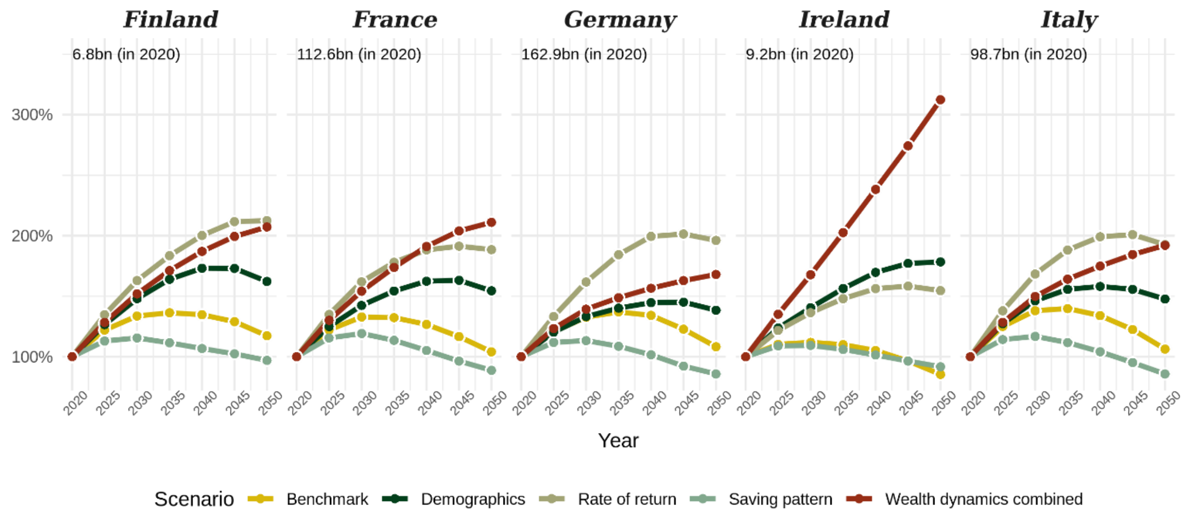
Source: HFCS 2017. Own calculations using INTAXMOD.

7.1.3 Wealth transfers

In Figure 14 we show the results of combining our wealth projections with Eurostat's forecasts regarding the development of age-specific mortality rates. As a general result, wealth transfers will increase significantly over the course of the coming decades. In Germany, we see an increase of about 50% until 2035, then a more modest growth in later years, which ultimately results in a rise of 70% at the end of the projection frame. Finland, France and Italy reach an increase of wealth transfers in the range of 50% in 2030 and add approximately another 50% until 2050. Ireland, however, shows the most dynamic path. Starting from € 9.2 billion, wealth transfers are expected to double by 2035 and reach € 30 billion per year in 2050.

Figure 14 also reveals a notable consequence of the modelling assumption. Based on the discussions in chapter 5.2, the algorithm receives negative saving rates for the age groups above 60 years (i.e. dissaving by the elderly generations). Hence, wealth decumulation in later years dampens the growth path of wealth transfers and lies below the benchmark scenario of zero savings. Only in Ireland does the benchmark and the saving patterns scenario almost align, as we could not detect a significant amount of dissaving of the elderly Irish population in the HFCS data.

Figure 14: Projection of wealth transfers (2020-2050)



Source: HFCS 2017. Own calculations using INTAXMOD.

7.2 Tax revenue

In all tax revenue simulations, we use all modelling components (demographic, rate of return, and savings pattern).

7.2.1 Macro validation of the baseline tax scenario

In Table 31, we compare the estimated inheritance tax revenues for the initial period 2020 with external data from the most recent OECD Revenue Statistics (OECD 2020) and the JRC – EWIGE 2 model (Boone et al. 2019). In contrast to our approach, EWIGE 2 simulates inheritance and gift tax revenue using reported wealth transfers based on the second wave of the HFCS weighted by survey weights. Since the OECD collects the actual tax inheritance revenues from governmental statistics, we use it as the benchmark and derive coverage rates in relation to the numbers we observe in the first column.

In Germany, inheritance tax revenues amounted to € 6.15 billion in 2019 (see OECD 2020). EWIGE 2 predicted € 2.55 billion, which implies a coverage rate of 41%. Comparing these results with the outcomes of INTAXMOD, we detect significant differences between the predictions based on the original and the enriched HFCS data. Simulations based on raw data result for Germany in an estimate of € 1.61 billion and a coverage of 26%. In contrast, the data including rich list observations and Pareto imputations (HFCS+) gives an estimate of € 7.27 billion and a fairly good coverage rate of 118%. Although the impact is most pronounced in Germany, these conclusions also apply to France, Ireland and Italy. Accounting for missing rich at the top of the wealth distribution makes a significant difference when estimating tax revenues within highly progressive tax schemes.

In Finland, INTAXMOD predicts an aggregate revenue of € 0.53 billion (HFCS+) and € 0.49 billion (original HFCS). In relation to official statistics, these numbers imply a coverage of 85% and 80%. Results for France and Ireland suggest a comparable model fit. EWIGE 2 covers around 70% of actual revenues for both countries; simulations based on raw HFCS data lead to coverage rates of around 40–50%; while predictions based on augmented HFCS data lift the coverage back to 65–75% compared to OECD Revenue Statistics. Finally, Italy raises € 0.8 billion from inheritance taxation. The estimate of EWIGE 2 is € 0.4 billion (50%). Based on raw HFCS data, we get € 0.17 billion (21%) – a number we can increase to € 0.49 billion (61%) by using the adjusted HFCS data.

Table 31: Plausibility check of the estimation with external data

	OECD RevStat	JRC - EWIGE 2		HFCS (raw)		HFCS+ (augmented)	
Country	*bn.€*	*bn.€*	%	*bn.€*	%	*bn.€*	%
Germany	6.15	2.55	41%	1.61	26%	7.27	118%
Finland	0.61	-		0.53	85%	0.49	80%
France	12.23	8.53	70%	6.13	50%	9.18	75%
Ireland	0.46	0.34	74%	0.16	37%	0.30	66%
Italy	0.80	0.4	50%	0.17	21%	0.49	61%

Source: OECD (2020), Boone et al. (2019), own calculations using INTAXMOD.

Overall, Table 31 suggests that INTAXMOD provides a reasonable fit, and its prediction aligns well with actual revenue statistics. Especially the calculations based on the adjusted and augmented HFCS data show a more stable pattern across countries and are in line or even outperform both our simulation based on the raw HFCS data and the predictions from EWIGE 2.

7.2.2 Projected path of inheritance tax revenues

We now move to the discussion of the projected path of inheritance tax revenues. Table 32 shows the simulation results from INTAXMOD for the years 2020, 2025 and 2030 both for original and augmented HFCS data. Looking at the net wealth aggregates in both data sources reminds us of the importance of unit- and item-non-response at the top of the wealth distribution. Neglecting them would result in estimates that are biased downwards by 20% to 30%.

Table 32: INTAXMOD outcomes for 2020, 2025, and 2030 for original and augmented HFCS data

		Net wealth		**Wealth transfers**				**Inheritance tax**			
Country	Year	HFCS	HFCS+	HFCS		HFCS+		HFCS		HFCS+	
		bn. €	bn. €	bn. €	% of wealth	bn. €	% of wealth	bn. €	% of transfers	bn. €	% of transfers
DE	2020	10,240.5	13,383.1	114.0	1.1%	168.6	1.3%	1.6	1.4%	7.3	4.3%
	2025	10,990.8	14,127.8	143.4	1.3%	206.8	1.5%	2.0	1.4%	8.8	4.3%
	2030	11,404.3	14,516.4	164.1	1.4%	233.3	1.6%	2.2	1.3%	9.7	4.2%
FI	2020	584.7	654.5	6.8	1.2%	7.0	1.1%	0.5	7.8%	0.5	6.9%
	2025	614.9	690.8	8.5	1.4%	8.9	1.3%	0.7	7.9%	0.6	7.1%
	2030	631.9	710.7	9.9	1.6%	10.5	1.5%	0.8	7.8%	0.7	7.1%
FR	2020	7,666.6	10,506.8	83.4	1.1%	118.9	1.1%	6.1	7.3%	9.2	7.7%
	2025	8,233.3	11,201.9	108.8	1.3%	153.4	1.4%	8.1	7.4%	12.0	7.8%

	2030	8,561.8	11,576.3	129.3	1.5%	181.0	1.6%	9.1	7.1%	13.9	7.7%
	2020	746.1	931.3	6.8	0.9%	10.0	1.1%	0.2	2.4%	0.3	3.1%
IE	2025	878.5	1,073.2	9.5	1.1%	13.4	1.2%	0.3	2.6%	0.5	3.4%
	2030	996.0	1,197.6	12.3	1.2%	16.5	1.4%	0.3	2.8%	0.6	3.7%
	2020	5,865.1	8,394.2	65.5	1.1%	100.7	1.2%	0.2	0.3%	0.5	0.5%
IT	2025	6,287.9	8,795	83.3	1.3%	128.5	1.5%	0.2	0.2%	0.6	0.5%
	2030	6,558.5	8,947.3	96.2	1.5%	149.3	1.7%	0.2	0.2%	0.7	0.5%

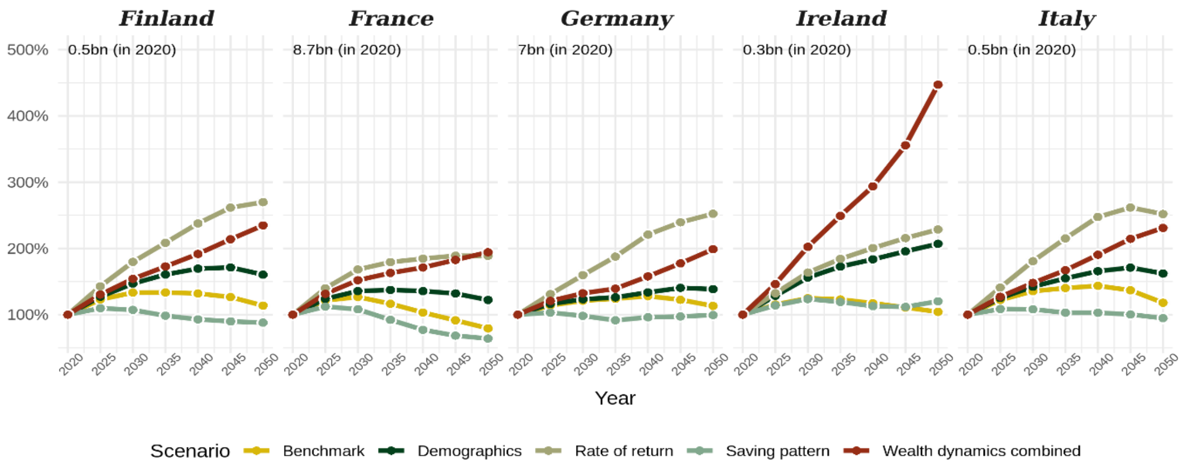
Source: HFCS 2017, own calculations using INTAXMOD

Yearly wealth transfers amount to 1 to 1.7% of the stock of net wealth. In absolute terms, results heavily depend on the underlying data source. In Germany, INTAXMOD which is based on enriched HFCS data predicts an increase of wealth transfers from an annual € 170 billion to € 235 billion in the coming decade. Finland starts at around € 7 billion and is expected to see an increase to over € 10 billion in 2030. In France, wealth transfers will increase from € 120 billion to € 180 billion annually, whereas Ireland is projected to surge from € 10 billion to almost € 17 billion. In Italy, wealth transfers amount to € 100 billion and will likely go up € 150 billion. The importance of wealth transfers in these countries is obviously on the rise, both in absolute and relative terms.

The last four columns of Table 32 depict our medium-term forecast for inheritance tax revenues. Within this time period we can safely assume that our modelling assumptions about demographic change is the main driver of these results, rather than asset and saving dynamicsr. The substantial difference in revenue estimates between HFCS and HFCS+ was already observed in the previous section. Although the ratios of inheritance tax revenues and total wealth transfers are relatively stable in the respective scenarios, we can detect a significant shift in their levels. In Germany, the average effective tax rate jumps from 1.4% to 4.3%, depending on the coverage of high wealth individuals. In other countries we see a similar but somewhat muted picture. Relying on the adjusted HFCS data, revenue estimates are projected to increase in Germany from € 7.3 billion (0.2%/GDP) to € 9.7 billion (0.3%/GDP), in Finland from € 0.5 billion (0.2%/GDP) to € 0.75 billion (0.3%/GDP), in France from € 9.2 billion (0.4%/GDP) to € 14 billion (0.6%/GDP), in Ireland from € 0.3 billion (0.1%/GDP) to € 0.6 billion (0.2%/GDP), and in Italy from € 0.5 billion (0.03%/GDP) to € 0.7 billion (0.04%/GDP)[29]. It seems worthwhile to highlight the difference in average tax rates that we observe in Italy compared to the other countries. Whereas Germany and Ireland range in the area of 3% to 4%, Finland and France at around 7%, the average tax rate in Italy is only about 0.5%.

[29] GDP refers to 2020.

Figure 15: Projection of inheritance tax revenue (2020-2050)



Source: HFCS 2017. Own calculations using INTAXMOD.

Figure 15 extends the analysis until the end of the projection frame. As in the previous graphs, the different lines represent different configurations of INTAXMOD, all being based on the augmented HFCS data. Wealth accumulation and appreciation effects lead to a growth of average wealth levels. The shift of the "baby boomer" generation out of the labour force results in an increase of the older population, both in absolute and relative terms. Eventually, this will lead to a rise in the number of deaths and the number of inheritances. Additionally, historical fertility rates show a decline in the average number of births, which reduces the average number of successors and thereby decreases the importance of exemption thresholds. Taken together, all three factors favour a growing revenue potential for inheritance taxation. We project that inheritance tax revenue in France and Germany will double by 2050. Finland and Italy will reach this threshold in 2040 and can expect an increase by another 40% of today's revenues until 2050. Ireland has shown dynamic developments, both in terms of demographic expansion and wealth accumulation. This results in an even more dynamic path of inheritance tax revenues. Based on the INTAXMOD projections, Ireland is expected to see a doubling of tax revenues until 2030, it will triple around 2040 and reach 450% of today's revenues in 2050.

7.2.3 Alternative wealth transfer tax scenarios

The discussion of the design elements and policy parameters of inheritance tax legislation in the five selected EU Member States has made clear that the treatment of wealth transfers differs markedly across countries. In the subsequent paragraphs we will explore alternative wealth tax scenarios and apply them homogenously in all five countries.

Table 33 illustrates the combinations of parameters we are considering. More specifically, we combine two marginal rate schedules: (A) a flat rate of 10% versus (B) a directly progressive tax schedule (10% until € 200,000, 15% until € 500,000, 20% for all transfers above); with three settings for exemptions and allowances: (1) plain, tax base is fair market value, (2) a full deduction of household main residences and business assets, and (3) an exemption threshold of € 500,000 for close relatives (children and partner of donor/testator). This results in six alternative simulation scenarios.

Table 33: Scenarios for alternative wealth transfer tax

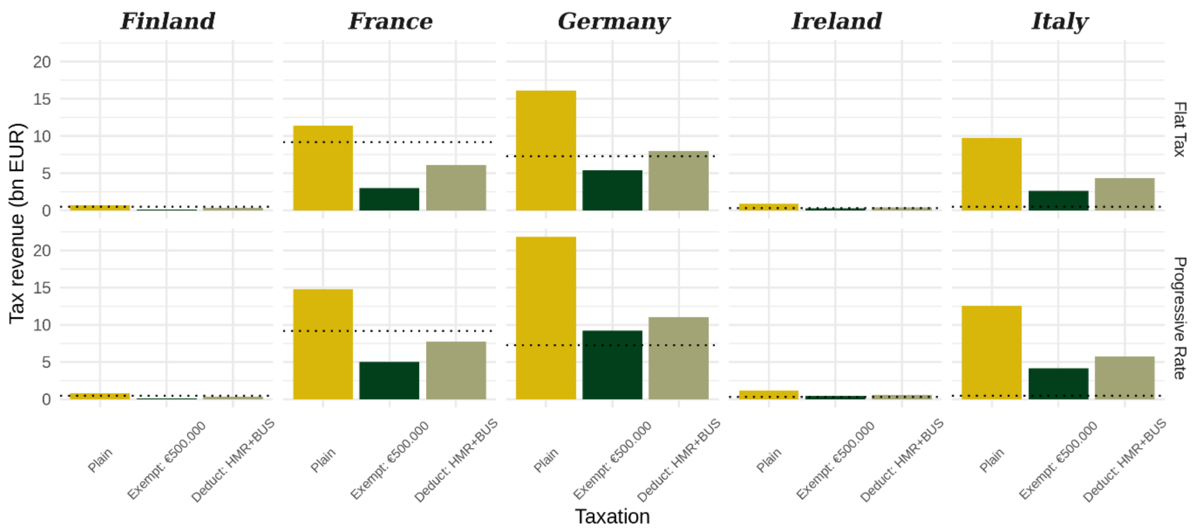
	Flat tax	Progressive tax schedule
1) Plain **2) Deductions from tax base**: Household main residence and business assets **3) Exemptions**: € 500,000 for close relatives	10%	>0€ 10% >200k€ 15% >500k€ 20%

Source: own representation.

Figure 16 displays the revenue estimates of the corresponding simulations for the year 2020. The first row shows the results of the flat tax scenarios, the second row is associated with the progressive rate schedules. The columns in different colours represent the revenue estimate according to the three settings of tax allowances, while the dotted line represents the tax revenues based on the current laws.

The general patterns are the following: Although both the flat tax and the progressive rate operate with comparatively modest marginal tax rates, the revenue estimates for the simple models without allowances and exemption limits lie well above the estimates for the current regime in all five countries. The difference is most pronounced in Germany and Italy. The revenues of the models with a progressive tariff exceed the flat tax models by 10% to 30%, irrespective of the scenario for allowances. Comparing the two variations of adjustment to the tax base, we see that a general exemption limit of € 500,000 for close relatives has a more revenue dampening effect on projected revenues than a complete allowance for the transfers of household main residences and business assets.

Figure 16: Current regime, flat tax and progressive tax rates, tax revenues in billion euro (in 2020)



Source: HFCS 2017. Own calculations using INTAXMOD.

Due to differences in the size of the population and the economy between France, Germany and Italy on the one hand, and Finland and Ireland on the other, results for the smaller countries are not easy to differentiate in Figure 16. Table 34 provides the actual numbers and confirms the previous conclusions for the two less populous countries as well. The alternative scenario of a simple flat tax of 10% without any allowances would increase revenues from inheritance taxation by 40% in Finland and by 25% in France, 130% in Germany and 190% in Ireland. In Italy, revenues would even multiply by a factor of 20, which serves as an impressive reminder of the decisive impact of high exemption thresholds and generous valuation rules on resulting tax revenues.

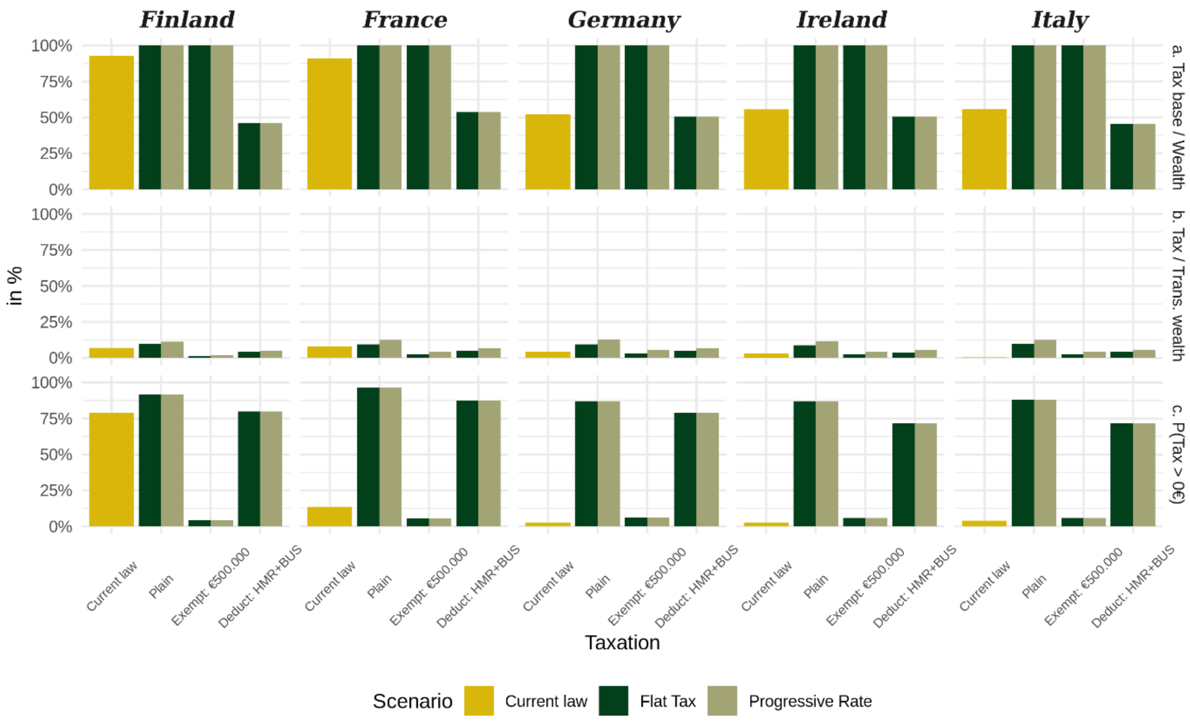
Table 34: Revenue estimates for current law and alternative tax scenarios (2020)

Country	Tax type	Allowances	Revenue (million €)	% of current
Finland	*Current law*		*487.1*	*100%*
	Flat Tax	Plain	691.4	142%
		Deduct: HMR+BUS	315.8	65%
		Exempt: € 500,000	94.3	19%
	Progressive Rate	Plain	784.1	161%
		Deduct: HMR+BUS	351.4	72%
		Exempt: € 500,000	137.2	28%
France	*Current law*		*9,178.4*	*100%*
	Flat Tax	Plain	11,341.8	124%
		Deduct: HMR+BUS	6,107.2	67%
		Exempt: € 500,000	3,002.3	33%
	Progressive Rate	Plain	14,744.7	161%
		Deduct: HMR+BUS	7,745.9	84%
		Exempt: € 500,000	5,009.4	55%
Germany	*Current law*		*7,273.7*	*100%*
	Flat Tax	Plain	16,147.8	222%
		Deduct: HMR+BUS	7,994.0	110%
		Exempt: € 500,000	5,371.9	74%
	Progressive Rate	Plain	21,820.8	300%
		Deduct: HMR+BUS	11,018.3	151%
		Exempt: € 500,000	9,193.1	126%
Ireland	*Current law*		*309*	*100%*
	Flat Tax	Plain	877.1	284%
		Deduct: HMR+BUS	394.8	128%
		Exempt: € 500,000	256.8	83%
	Progressive Rate	Plain	1,147.2	371%
		Deduct: HMR+BUS	542.8	175%
		Exempt: € 500,000	414.0	134%
Italy	*Current law*		*486*	*100%*
	Flat Tax	Plain	9,718.0	2001%
		Deduct: HMR+BUS	4,335.8	893%
		Exempt: € 500,000	2,606.7	537%
	Progressive Rate	Plain	12,575.5	2589%
		Deduct: HMR+BUS	5,728.4	1179%
		Exempt: € 500,000	4,179.1	860%

Source: Own calculations using INTAXMOD. – HMR: household main residence. – BUS: business assets.

Figure 17 sheds more light on the mechanisms of different tax tariffs. Panel a) shows the impact of valuation rules on the tax base of inheritance taxation. According to current legislation, Finland and France grant partial allowances for business assets only, which results in a ratio of the tax base to total transferred market values of around 90%. On the other hand, Germany, Ireland and Italy exempt the household main residence either entirely or in large parts, which leads to a tax base that amounts only to about 50% of total transferred assets. Among our alternative tax scenarios, there are four scenarios where the tax base equals the fair market value. Accordingly, the ratio of the tax base to wealth transfers would match 100% in case of the "Plain" and "Exempt: € 500,000" setups. Finally, the scenario "Deduct: HMR+BUS" implies a tax-free transfer of household main residences and business assets, which reduces the tax base to 50% of transferred assets – in Finland and Italy even below this value.

Figure 17: Current regime, flat tax and progressive tax rates, shares in percent

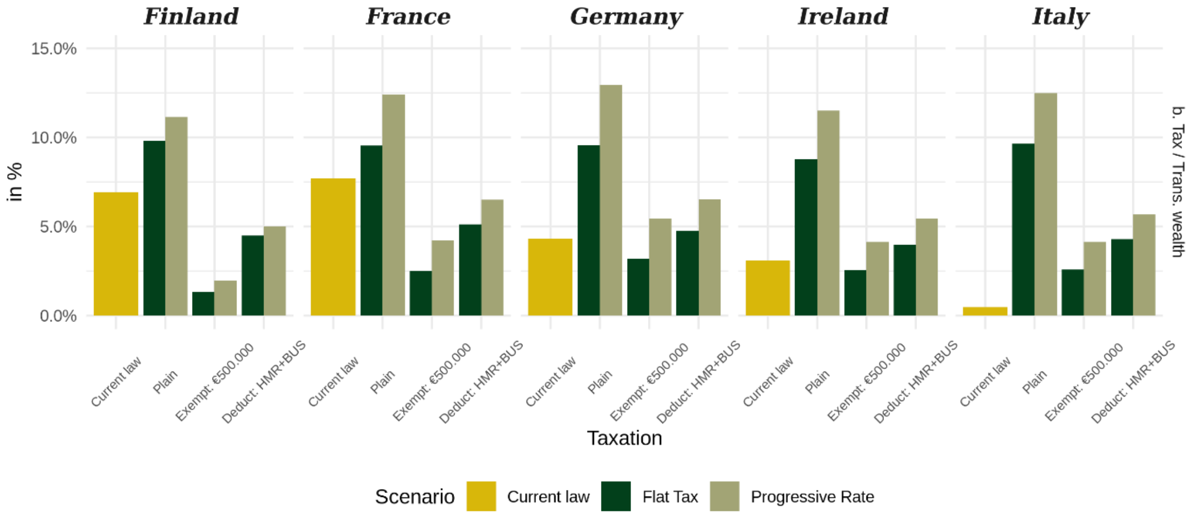


Source: HFCS 2017. Own calculations using INTAXMOD.

Panel b) depicts the average tax rate derived from the ratio of tax revenues compared to the aggregate amount of wealth transfers. By and large, average tax rates are well below 15% in all the considered scenarios. As actual numbers are hard to digest, Figure 18 provides a more detailed representation of these statistics. Average tax rates are around 7% in Finland and France, 4% in Germany, 3% in Ireland and below 1% in Italy. Cross-country heterogeneity diminishes in our alternative scenarios but does not vanish completely. Average rates of the scenarios with a progressive rate are always larger than in the case of the flat tax systems. It seems worthwhile to emphasise the disparity between the average rate of the tax codes without any exemptions and allowances ("Plain") and those that grant exemption thresholds for close relatives or allowances for residential and business assets. Holding all other parameters constant, we can deduce that an exemption limit of € 500,000 reduces average tax rates by approximately three quarters; the deduction of certain assets leads to a decrease of around 50% compared to the "Plain" scenarios.

Going back to Figure 17, Panel c) illustrates the proportions of inheritances that are actually subject to taxation. The main reasons for being relieved from taxation are wealth transfers whose valuation per donee is below the exemption limits, and – in some countries – privileged transfers to partners. According to current legislation, in Germany, Ireland and Italy, more than 95% of wealth transfers are not taxed at all. In France, around 10% of inheritances are connected to a positive tax liability. With 75% of taxed transfers, Finland clearly stands out in this respect. The reason is the unique feature of levying an absolute value of € 100 on all transfers below € 20,000. Comparing the alternative scenarios, "Exempt: € 500,000" results in a markedly different proportion of persons affected by taxation. The variation of results for the "Plain" scenario resembles the share of negative or zero net wealth transfers. Numbers for "Deduct: HMR+BUS" are qualitatively comparable but slightly below the scenarios without any allowances.

Figure 18: Current regime, flat tax and progressive tax rates, in percent



Source: HFCS 2017. Own calculations using INTAXMOD.

8. Behavioural effects of inheritance taxes

Our simulations of the revenue potential of inheritance taxes for five EU Member States do not take into account potential behavioural responses by taxpayers. Based on theoretical considerations, but also on the growing, albeit still rather limited empirical evidence it is plausible to assume that neither taxpayers' decisions nor the tax base are completely inelastic with respect to inheritance taxation. Accounting for behavioural responses would reduce the revenue potential accordingly and, thus, imply that our simulations overestimate potential inheritance tax revenues.

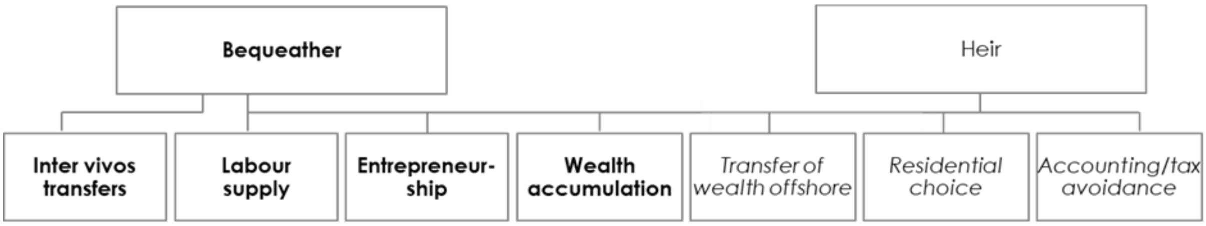
Generally, responses to the taxation of inheritances can be "real", i.e. related to economic decisions, pure "accounting", i.e. related to the declaration of taxable wealth or other tax avoidance reactions without real economic consequences (Brülhart and Schmidheiny 2018). Real responses to inheritance taxation include a number of economic decisions by bequeathers as well as heirs (see, e.g., Joulfaian 2005, Kopczuk 2013A, 2013B; Goupille-Lebret and Infante 2018). Actual revenues of an inheritance tax can, thus, be influenced by a combination of real responses and responses that are related to the declaration of taxable wealth as well as other avoidance responses.

The most important behavioural responses by bequeathers to an inheritance tax include their labour supply, residential choices, accumulation of wealth, transfer of wealth offshore, inter vivos transfers, as well as accounting and other tax avoidance reactions (see Figure 19). On the part of heirs, an inheritance tax may influence labour supply (including retirement decisions) and wealth accumulation. In addition, an inheritance tax may induce heirs to move to no- or low-tax jurisdictions or to transfer inherited wealth to offshore jurisdictions. Moreover, accounting and other avoidance reactions – i.e. the under-declaration of taxable received inheritances for taxing purposes or other timing or shifting responses without real economic consequences – may be the result of such a tax. All these responses can be expected to reduce the revenue potential of an inheritance tax.

While a potential impact of the inheritance tax on heirs' labour supply is irrelevant for its revenue potential, this is obviously not true for the labour supply of bequeathers if a tax-induced change of labour supply influences savings from a bequeather's labour income. Hereby, an increase as well as a decrease of labour supply is theoretically conceivable, depending on the bequeather's inheritance motive. Depending on the bequest motive, the potential impact of an inheritance tax on wealth accumulation by bequeathers may as well be either positive or negative (Gale and Perozek 2001, Joulfaian 2016, OECD 2021). The change of location by bequeathers to jurisdictions levying no or lower inheritance taxes, the transfer of wealth to offshore jurisdictions as well as inter vivos transfers not captured by inheritance taxes negatively impact the revenue potential.

With respect to heirs, the inheritance tax revenue potential is not affected by several real potential behavioural responses: neither heirs' labour supply, entrepreneurship and retirement decisions nor their wealth accumulation decisions have an impact on inheritance tax revenues. A dampening effect on potential revenues of an inheritance tax would result from heirs moving location to no- or low-tax countries, from transferring inherited wealth abroad, or from accounting and other tax avoidance reactions.

Figure 19: Behavioural responses to the taxation of inheritances with an impact on inheritance tax revenue potential



Source: own representation. – bold: impact on inheritance tax revenue potential can be expected from response of bequeather. – italics: impact on inheritance tax revenue potential can be expected from responses of bequeather and heir.

Inheritance taxes may cause further economic effects, which, however, do not have a direct impact on inheritance tax revenues. Examples are the performance of inherited firms (see, e.g., Pérez-Gonzalez 2006), the decision to sell or keep a family business within the family (see, e.g., Tsoutsoura 2015), entrepreneurship (the creation of businesses by heirs or their propensity to become self-employed, see, e.g., Joulfaian 2016, Garbinti and Goupille-Lepret 2018, Bauer, Garbinti and Georges-Kot 2018), charitable bequests and contributions (see Joulfaian 2004, 2005 for references for the US), or educational decisions of heirs (Kindermann et al. 2018). The extent and direction of general and indirect revenue effects of inheritance taxes are uncertain and hard to quantify. They are therefore neglected in the following review of the existing literature. This is not to say that these decisions are irrelevant with regard to tax revenues in general. They may well have an impact on other taxes: if, for example, an inheritance tax influenced entrepreneurship, education decisions or labour supply of heirs, an impact on revenues from business, personal income, and labour taxes can be expected.[30] Inheritance taxes levied today may also indirectly influence tomorrow's inheritance tax revenues: if, for example, heirs increased their labour supply due to an inheritance tax, they could accumulate more wealth and leave higher inheritances, which in turn would increase future inheritance tax revenues.

To date, empirical evidence on taxpayers' reactions to wealth-based taxation in general and to inheritance and gift taxation in particular is still scarce (Kopczuk 2017). Only very recently, a growing, but still small number of empirical analyses have explored various potential behavioural effects of wealth-based taxation. This sub-chapter provides a qualitative assessment of the impact of potential behavioural responses to inheritance taxation on estimated tax revenue based on a survey of the relevant literature. Hereby a particular focus will be placed on the various channels (real ones and those of a more accounting/avoidance nature) via which inheritance taxation may induce behavioural responses. We also compare existing empirical evidence on behavioural responses to inheritance taxation to the results of empirical analyses exploring the behavioural effects of net wealth taxes to shed some more light on the question whether an inheritance tax is more efficient than a net wealth tax. Hereby we focus on those behavioural responses that can influence the revenue potential of inheritance taxes: labour supply, wealth accumulation, inter vivos transfers by bequeathers, offshore transfers of wealth, locational decisions and accounting/avoidance measures by bequeathers and heirs.

8.1 Impact of inheritance taxation on wealth accumulation and entrepreneurship

The empirical literature investigating the impact of taxes on wealth transfers and inheritances, respectively, is still sparse. This is due to a lack of microdata, identification issues

[30] Kindermann et al. (2018) for example demonstrate that an inheritance tax may increase heirs' labour supply and thus labour income tax revenue.

(Goupille-Lebret and Infante 2018) and also because changes in existing inheritance tax provisions that can be exploited for empirical research are rather rare (Kopczuk 2013A, 2017). Generally, reported taxable wealth and its elasticity may be determined by real reactions of wealth accumulation to taxation and by accounting/avoidance measures. Hereby, one central challenge faced by empirical studies is to disentangle real and accounting/avoidance responses. Two generations of empirical studies aiming to determine the influence of inheritance taxes on reported wealth may be distinguished (Glogowsky 2021).

A first wave of studies focuses on the US and tries to determine the direction and size of the influence of estate taxes on wealth accumulation by bequeathers, whereby these analyses are unable to distinguish between real and accounting/avoidance responses. Chapman et al. (1996) find a significant negative coefficient of US estate tax revenues during 1958 to 1994 regarding the estate tax rate, indicating an elasticity of estate tax revenues with respect to the marginal estate tax rate of about -2. Holtz-Eakins and Marples (2001) identify a negative correlation between wealth accumulation and state estate tax rates for the US, whereby the very wealthy, who are most affected by the tax, are not included in the study. Also studying the US, Joulfaian (2006) for the period 1951 to 2001 estimates that an increase of the estate tax by 1% decreases wealth by 0.1%. Finally, Kopczuk and Slemrod (2001), based on tax data from the US for selected years in the period 1916 to 1996, show a robust and negative correlation between reported net worth of top estates and estate tax rates. Besides the fact that they do not allow to discern real and accounting/avoidance effects, these earlier studies have been criticised for methodological reasons. As Kopczuk (2017) puts it, these analyses, including his own study with Slemrod from the year 2001, do not meet the "… 'post-credibility' revolution standard". Overall, these early studies find rather moderate responses of wealth accumulation and reported wealth, respectively, to the taxation of inheritances: a review of their results by Kopczuk (2017) yields elasticities of estates to net-of-tax rates between 0.1 and 0.2. Based on these estimates, Piketty and Saez (2013) determine optimal inheritance tax rates between 50% and 60% for France and the US.

Some early work attempts at detecting tax avoidance by comparing the actual tax base to an estimate of the "correct" tax base. The considerable extent of tax avoidance found for the US by Wolff (1996) cannot be confirmed by Poterba (2000). Eller et al. (2001) point out that such estimations are very sensitive towards the assumptions underlying the estimation approach. In their study for the US, the authors find that in 60% of audited cases, assessed estate tax increased after the audit, with changes primarily due to the revaluation of assets; a finding which Eller et al. (2001) take as an indication for tax evasion. Eller and Johnson (1999), also based on the examination of tax audits, show that 10% of tax filers do not fully comply with the inheritance tax law, i.e. use tax planning strategies.

A second wave of studies starting in the mid-2000s benefits from better data and methods, thus being able to investigate wealth accumulation responses regarding certain assets, tax evasion and tax-avoidance schemes.

Focusing on real responses, Niimi (2019) studies the consequences of the reduction of the basic deduction within the Japanese inheritance tax. According to this analysis, only relatively few households intend to decrease their wealth accumulation due to the tax change and increase their consumption instead. The author explains this by the absence of or only weak bequest motives.

Real responses are also in the focus of the paper by Goupille-Lebret and Infante (2018). Based on French life insurance data the authors show that there are real responses of wealth accumulation to inheritance taxes, which, however, are relatively small. They also find that real and shifting responses are larger than timing responses, but moderate altogether. Getting older increases real and shifting responses significantly. The authors suggest that their results may point to myopia and the unwillingness of individuals to confront death and inheritance before having reached a certain age, which may lead them to underuse tax planning options. They thus interpret their findings as contradicting the notion that moderate responses to inheritance taxes are motivated by the wish of bequeathers to retain control over their wealth.

A related aspect with possible implications for the revenue potential of inheritance taxes is their effect on entrepreneurship and firms' development. Holtz-Eakin (1999) shows a negative correlation between estate tax rates and employment growth in firms owned by business owners in New York. Moreover, an increasing probability to be subject to estate taxes dampens entrepreneurial effort. Whether there is a causal relationship cannot be determined, however. Cagetti and DeNardi (2009) find that the estate tax dampens aggregate output and savings of larger firms. Such negative effects resulting from the prospect of having to pay estate or inheritance tax on the transfer of businesses reduce the potential tax base.

Aiming at the identification of tax avoidance reactions by bequeathers to estate taxes, Kopczuk (2007) shows that reported wealth decreases between 10 and 20% for bequeathers diagnosed with a fatal disease compared to those dying instantaneously. The strength of the effect increases with the duration of the remaining life expectancy, which the author interprets as a result of tax avoidance. Moreover, the results suggest that tax planning is used to a significant extent only if a terminal illness reminds bequeathers to apply tax planning strategies. Erixson and Escobar (2020), however, argue that the reduction of wealth in the group of fatally ill bequeathers may also result from real losses in wealth due to the illness. In contrast to Kopczuk (2007), Erixson and Escobar find a positive correlation between terminal illness and wealth accumulation following the repeal of the inheritance tax for spouses in Sweden in 2004. Their results point to a very moderate use of some tax planning tools only, which does not suffice to decrease average tax payments. One limitation of this study is that it only includes spouses, as tax planning activities may be more prevalent regarding more distant heirs.

Building on the study by Kopczuk (2007), Suari-Andreu et al. (2019), based on administrative data for Netherlands for the period 2006 to 2013, show that non-sudden deaths reduce wealth at the time of death compared to sudden deaths, with the effect being strongest for single individuals dying of cancer. The authors interpret this finding as being the result of estate planning induced by a bequest motive[31] pursued by bequeathers. These findings are corroborated by the recent study by Kvaerner (2020) who finds similar evidence for tax planning by terminally ill bequeathers for Norway.

Using a bunching approach, Glogowsky (2021) researches various responses to the German inheritance and gift tax. Altogether, responses are rather moderate. Tax planning, i.e. testament planning, by testators is the dominating response, with an extent comparable to the reaction of inter vivos gifts. Similar to the results of some of the studies reported above, tax planning (in the form of testament planning) is undertaken mostly shortly before death, which is consistent with a death-denial attitude. Also, bequeathers react more strongly to taxes with regard to inheritances intended for close relatives. Altogether the impact on tax revenue collection is modest, with short-run net-of-tax elasticities of taxable wealth transfers below 0.1. The authors do not find evidence for illegal underreporting of inheritances by heirs. Similarly, Sommer (2017) also finds only a small response to the German inheritance tax in the form of tax planning, which is almost exclusively limited to donors (rather than recipients) of wealth transfers.

The study by Escobar (2017) yields larger tax planning responses for the Swedish inheritance tax with regard to bequests of spouses. The author finds a considerable extent of underreporting of taxable bequests caused by tax planning before the abolishment of the tax for spouses, regarding the size as well as the number of estates liable for taxation. According to his estimates, inheritance tax revenues were reduced by up to 55% as a consequence of underreporting. Also Ohlsson et al. (2020) identify a rather sizeable extent of avoidance for Sweden, where the authors find that the tax-assessed inheritance tax base (Elinder et al. 2018) is only 10% of the macro-implemented tax base. Similarly, investigating

[31] For bequest motives and their distribution in the US see Kopczuk and Lupton (2007).

the repeal of the Catalan inheritance tax for close relatives, Mas Montserrat (2019) finds that the tax reform mainly impacted reporting of taxable wealth transfers, rather than resulting in real responses. To sum up, most of the still few empirical analyses suggest that responses of taxable wealth transfers to inheritance taxation are negative, but rather small. Moreover, tax planning/accounting responses appear to be more important than real responses. Inheritance taxes therefore should only moderately impact wealth accumulation, so that in the long run the taxable base should be rather stable. The comparatively larger, but according to the majority of studies overall modest accounting/avoidance responses can be limited by tax enforcement measures and a design of inheritance taxes which does not offer tax loopholes that can be used for tax planning strategies. Hereby it should be noted, however, that limiting options for tax avoidance may well lead to an increase of real responses.

8.2 Impact of an inheritance tax on inter vivos transfers

Inter vivos transfers, as a measure to avoid or reduce inheritance taxes, have been another focus of empirical studies since the mid-2000s, however with inconclusive results. In a study for the US, Joulfaian (2004) shows that estate and gift taxes have an effect on lifetime wealth transfers. According to another study by the author (Joulfaian 2005), the responsiveness of lifetime gifts to variations in the rates of gift taxes is considerable. Also, for the US, Bernheim et al. (2004) show that the timing of gifts is responsive to estate and gift tax rates. For the Swedish inheritance tax, Escobar et al. (2019) show that inter vivos transfers are very sensitive to taxation. A strong increase of inter vivos transfers before the introduction of the Swedish inheritance tax in 1948 is found by Ohlsson (2011). More modest responses of inter vivos transfers are identified by several recent studies. According to the study by Glogowsky (2021) for Germany, elasticities of taxable inter vivos gifts are small (below 0.1), as well as the influence on tax revenues. This result confirms several earlier studies for the US suggesting that the option of inter vivos gifts as a tax planning tool is only moderately used (Joulfaian and McGarry 2004; McGarry 1999, 2000, 2001, 2013; Poterba 2001A, 2001B). For Japan, Niimi (2019) finds that the strength of the reaction of inter vivos transfers to increases in inheritance taxation is dependent on the motive of the bequest. Parents who have an altruistic bequest motive tend to shift taxable wealth to inter vivos transfers to a larger degree compared to parents with no or only a weak bequest motive. In his analysis of the German inheritance tax, Sommer (2017) finds evidence for tax planning based on inter vivos gifts, whereby the response is altogether only moderate and increases with the closeness of the relationship between bequeather and heir and the size of the bequest. The empirical study by Arrondel and Laferrère (2001) for France suggests that tax sensitivity of gifts is higher in wealthier households.

Explanations for the limited tax sensitivity of inter vivos transfers offered in the literature include the denial of death by bequeathers and a desire to keep control over their wealth and over their prospective heirs, respectively (Erixson and Escobar 2018). Kopczuk (2007) mentions an exchange motive as a potential reason; Niimi and Horioka (2019) suggest a precautionary motive.

Altogether, the available empirical evidence confirms the expectation that inter vivos transfers are somewhat sensitive to taxation. At the same time, inter vivos transfers as a tax planning tool appear to be underutilised, so that their tax responsiveness is limited. Again, as Escobar et al. (2019) point out, the sensitivity of inter vivos transfers with respect to taxation points to the importance of the design of wealth transfer taxes to protect revenue collection.

8.3 Impact of an inheritance tax on location decisions

Empirical evidence regarding the influence of the taxation of inheritances on location decisions is slim and mainly refers to intra-national migration. For wealth taxes in general, empirical research on their impact on mobility is very scarce (Kleven et al., 2020). Perret (2020) concludes that most evidence on the impact of wealth taxation on locational decisions is anecdotal; this is also true regarding the respective impact of taxes on inheritances and estates. Based on data for the US states for the period 1965 to 1988, Bakija and Slemrod (2004) show that high state estate taxes result in the relocation of wealthy persons to states with low inheritance taxes, albeit to a modest extent only. Very small effects of estate or inheritance taxes on locational decisions by elderly taxpayers are found also by Brülhart and Parchet (2014) for Switzerland and by Smith Conway and Rork (2006) for the United States. According to the study by Moretti and Wilson (2020), there is significant mobility of billionaires responding to differences in estate taxation in US states, which increases with age, pointing to higher tax sensitivity of the very wealthy. Brülhart et al. (2021) find evidence for significant mobility of taxpayers across Swiss cantons with regard to the net wealth tax. Similarly, Agrawal et al. (2020) show migration responses by wealthy taxpayers within Spain to the net wealth tax which was re-introduced in 2011. This recent evidence for Switzerland and Spain suggests that location decisions are more sensitive to a recurrent net wealth tax compared to an inheritance tax (OECD 2021).

To our knowledge, there are no empirical studies investigating the influence of the taxation of estates or inheritances on international migration decisions. Considering the modest intra-national tax responsiveness regarding locational decisions, it seems plausible to assume that the influence of international inheritance tax differentials on migration decisions is even smaller. This assumption is supported by a recent study for France by Bach et al. (2020). The authors find that the French wealth tax led only 1% of retired business owners to migrate in order to avoid the wealth tax that would be levied upon the sale of their businesses. This small percentage corresponds to that observed for other pensioners with similar income levels.

8.4 Impact of an inheritance tax on offshore transfers of wealth

There is increasing empirical evidence that a considerable amount of offshore wealth is hidden in tax havens (see, e.g., Zucman 2015, Alstadsæter et al. 2018, Bastani and Waldenström 2020). Alstadsæter, Johannesen and Zucman (2019) show that particularly the very wealthy tend to hide their wealth offshore. However, there is practically no empirical research exploring the relationship between taxes on wealth transfers and offshore transfers of wealth. To our knowledge, the only relevant analysis is the study by Brülhart and Parchet (2014) who do not find any evidence for wealth transfers between Swiss cantons due to inheritance tax differentials. Little is therefore known about the composition, magnitude and distribution of wealth transferred to offshore tax havens to be hidden from inheritance taxation.

8.5 Behavioural responses to inheritance taxation in comparison to wealth taxation

Finally, it is of interest how taxpayers' responses to inheritance taxation compare to those induced by a net wealth tax, as an alternative option to tax large fortunes. Although there is more empirical evidence on responses to and the economic effects of a net wealth tax compared to the taxation of inheritances, it is also rather scant (Brülhart et al. 2021, Bastani and Waldenström 2020). As indicated above, there is increasing evidence of offshore tax evasion by the wealthy; however, empirical evidence on the effect of wealth taxation – be it in the form of a net wealth tax or of taxes on estates and inheritances – on offshore tax evasion is practically non-existent (Advani and Tarrant 2020). There are a few case studies corroborating the theoretical expectation that wealth taxes cause (illicit) offshore transfers of assets. After the abandonment of all foreign exchange controls in Sweden in 1989, for example, an outflow of large fortunes to tax havens like Switzerland or Luxemburg could be observed, providing one strong motivation for the government to discontinue the net wealth tax in 2007 (Henrekson and Du Rietz 2014). Pichet (2007) finds a considerable volume of capital flight out of France since the introduction of the French net wealth tax. Whether inheritance and estate taxes may cause similar capital flight reactions has not been investigated empirically up to now.

Generally, it can be stated that a net wealth tax – similar to a tax on inheritances – seems to induce larger pure accounting/avoidance reactions than real responses (Thoresen et al.

2021).[32] Furthermore, as Advani and Tarrant (2020) and Scheuer and Slemrod (2021) conclude, recent empirical evidence suggests that responses to a net wealth tax, though lying within a rather broad range for methodological reasons, design features, contextual factors, data bases, and due to different time spans and countries analysed, are rather substantial. The few estimates on the elasticities of taxable wealth with the respect to the net-of-tax return find that these reach a sizeable order of magnitude: For a large wealth tax reform in Denmark, Jakobsen et al. (2020) identify elasticities between 0.7 and 1. According to Jakobsen et al. (2018), the effect of the Danish net wealth accumulation was largest for top wealth holders. In the Swiss context, Brülhart et al. (2016) find that an increase of the tax rate on net wealth of 1 percentage point leads to a decrease of the tax base by 35%. For the Dutch reform of the capital income tax, which was substituted by a de facto financial wealth tax of 1.2%, Zoutman (2018) estimates an overall wealth elasticity of 13.8. Advani and Tarrant (2020), based on back-of-the-envelope calculations, estimate that a well-designed net wealth tax of 1% would reduce the tax base by 7% to 17% in the UK. Overall, the existing empirical evidence suggests that a net wealth tax can be expected to induce larger responses compared to taxes on estates and inheritances that seem to cause rather modest responses only (Advani and Tarrant 2020, OECD 2018, 2021).

These differences may *inter alia* be caused by the denial of death phenomenon addressed above, leading to smaller responses to inheritance taxation compared to a net wealth tax, which, in addition, may be more salient for taxpayers due to the yearly payment obligations.

9. Conclusions

Demographic developments taking place in all European countries lead to ageing societies and a decrease of the labour force, which may depress the labour share in total income. One option to secure the long-term sufficiency and sustainability of European tax systems is the taxation of inheritances. To demonstrate the potential of inheritance taxation as one pillar of future-proof tax systems, we estimate the revenue potential of the taxation of inheritances for five selected EU Member States (Finland, France, Germany, Ireland and Italy) for a projection period of 30 years. Hereby the focus of the report is on the revenue potential and not on the distributional consequences of inheritance taxes, which cannot be estimated using INTAXMOD.

Our results indicate that multiple factors favour a growing revenue potential of inheritance taxation in the medium-term. Wealth accumulation and appreciation lead to higher average wealth levels. The shift of the baby boomer generation out of the labour force results in an increase of the older population both in absolute and relative terms. Eventually, this will lead to a rise in the number of deaths and of inheritances. Additionally, low fertility rates reduce the average number of births, thus decreasing the average number of successors and thereby the importance of exemption thresholds.

We project that inheritance tax revenues of 2020 in France and Germany will double by 2050. Finland and Italy will reach this mark in 2040 and an increase by another 40% of today's revenues until 2050. In Ireland, demographic expansion coincides with dynamic wealth accumulation, which results in an even more dynamic path of inheritance tax revenues. According to our projections, Ireland is expected to see a doubling of inheritance tax revenues until 2030, which will triple around 2040 and reach 450% of today's revenues in 2050. Overall, our simulations show that the future revenue potential of inheritance taxes may be substantial. In practice, it can be expected that the theoretical revenue potential demonstrated by our simulations will be reduced by tax avoidance, real responses and general equilibrium effects on other taxes. We leave their quantification to derive reasonable estimates for the net revenue potential of inheritance taxes to future research.

[32] See, e.g. Brülhart and Schmidheiny (2018) for Switzerland, Seim (2017) for Sweden, or Jakobsen et al. (2018) for Denmark; see also OECD (2018) for a brief and Advani and Tarrant (2020) for a more extensive survey of recent empirical studies.

Besides the considerable revenue potential, there are various arguments speaking in favour of strengthening the taxation of inheritances.[33] In view of the considerably unequal distribution of wealth and wealth transfers in developed countries, which can be expected to deepen further in the future, inheritance taxes can be an effective tool to reduce inequality and to improve equality of opportunity – especially if they specifically address high transfers of wealth.[34] In addition, an inheritance tax is easier to enforce compared to a net wealth tax, and it generates lower efficiency losses.

Currently, a majority of EU Member States tax inheritances and gifts. However, revenues are negligible. In the five selected EU Member States, they range between 0.11% (Italy) and 1.18% (France) of overall tax revenues. Revenues are limited due to generous tax exemptions particularly for close relatives (especially for spouses/partners and children) and for business assets as well as for certain other assets (e.g., main residences). These exemptions reduce effective tax rates considerably even in those countries applying highly progressive tax schedules. Future-proof inheritance tax regimes aiming at equitable and efficient taxation of inheritances should therefore aim at reducing regressive tax exemptions for high wealth transfers, while exempting low-value inheritances and applying progressive inheritance tax schedules. Moreover, better coordination of the taxation of inheritances and gifts, inter alia by applying a lifetime perspective on wealth transfers regardless whether they are gifts or inheritances, and by removing tax privileges for inter vivos transfers, would eliminate possibilities for tax avoidance (OECD 2021).

A particular challenge for any attempt to reinforce inheritance taxation is in most countries the low public support for the taxation of inheritances.[35] Therefore, reforms strengthening the effectiveness of inheritance taxation as well as initiatives to adopt inheritance taxes in the minority of countries that have never levied one or to re-introduce inheritance taxes in those countries that have abolished them[36] need to be embedded in measures enhancing public acceptability of inheritance taxes. Recent empirical evidence suggests that particularly information extending public knowledge on salience[37] and level of inheritance taxes appears to be crucial. For Sweden, Bastani and Waldenström (2019) find that information on the salience of inheritance taxes is an effective measure to increase their popularity. Several empirical analyses show that misinformation of the public regarding the effects of inheritance taxes is substantial. For example, Kuziemko et al. (2015) find that people greatly over-estimate the share of households affected by the US estate tax. Grégoire-Marchand (2018) shows that the inheritance tax level is substantially over-rated in France. Overall, if the role of inheritance taxes is to be strengthened in European tax systems, crucial success factors are design issues and the provision of information on the distribution of wealth and wealth transfers as well as the distributional effects of inheritance taxes.

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[33] See OECD (2021) and the literature cited therein.

[34] It is disputed in the literature whether and to what extent inheritances and inheritance taxes contribute to wealth (in)equality; see Black et al. (2022) and the references cited therein.

[35] See, e.g. Henrekson and Waldenström (2016) for Sweden.

[36] Tax Foundation (2015) finds that since 2000, five European countries and 13 countries worldwide have abolished their inheritance or estate taxes. According to OECD (2021), five further OECD countries repealed their inheritance or estate taxes before 2000, and two OECD countries have never such a tax in the first place.

[37] Tax salience refers to how the presentation of tax costs affects the behavior of taxpayers.

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