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Enhancing microsimulation analysis of wealth-related policies in EUROMOD

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Abstract While microsimulation techniques have been widely used for the analysis of the distribution of income, this has not been the case for the distribution of wealth. A major reason for this has been the lack of appropriate input data. In Europe this has recently changed among others by the launch of the Eurosystem Household Finance and Consumption Survey (HFCS). In this paper we explain how microsimulation analysis of wealth-related taxes and policies is enhanced by using the HFCS as input data for EUROMOD, the EU-wide tax-benefit microsimulation model. Pilot databases for Belgium and Italy were explored in Kuypers et al. (2016). This paper builds further on that work by extending the coverage to 17 countries and introducing the simulation of new wealth-related policies in EUROMOD. We explain the processes used to build the input data and to code the wealth-related policies in EUROMOD and highlight some important advantages and drawbacks. Finally, we put forward some research questions which may be addressed by using this enhanced model.

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1. Introduction

While microsimulation techniques have been widely used for the analysis of the distribution of income, this has not been the case for the distribution of wealth. Yet, the need for models and tools to study the wealth distribution and the effects of policy intervention have increased substantially over the last decades. Since wealth inequality has been rising in many OECD countries (***Alvaredo et al., 2018***; ***OECD, 2020***) higher wealth taxation has been put forward as a way to decrease inequality and potentially raise government revenues. So far this literature has been largely theoretical. To complement it a microsimulation model including information on the wealth distribution can provide empirical results on the redistributive effects of currently existing wealth taxes as well as ex-ante insights into the potential effects of higher taxation or any other potential reform.

A major reason that such a microsimulation tool for wealth does not yet exist on a large scale is mainly the lack of appropriate input data. In Europe this has recently changed among others by the launch of the Eurosystem Household Finance and Consumption Survey (HFCS) – a comparative survey on households' assets, liabilities, incomes and consumption carried out in the countries of the Euro Area as well as Hungary, Poland (from 2nd wave onwards) and Croatia (from 3rd wave onwards) and which is coordinated at the European Central Bank (ECB). In this paper we explain how microsimulation analysis of wealth-related taxes and policies is enhanced by using the HFCS as input data for EUROMOD, the EU-wide tax-benefit microsimulation model. Pilot databases for Belgium and Italy based on the first HFCS wave were explored in ***Kuypers et al. (2016)***. This paper builds further on that work by extending the coverage to 17 countries based on the second HFCS wave and by introducing the simulation of new wealth-related taxes and policies in EUROMOD. The countries include Belgium and Italy and 15 additional countries: Austria, Cyprus, Estonia, Finland, France, Germany,

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Greece, Hungary, Ireland, Luxembourg, Poland, Portugal, Slovak Republic, Slovenia and Spain. The Netherlands, Malta and Latvia are not included, mainly because of their small sample sizes. We focus on simulating recurrent real property taxation, real property transfer taxation, inheritance and gift taxation and net wealth taxation as they currently exist. Where possible we also improve the simulation of policies which rely on wealth information in some way. This includes for instance the taxation of income from real and financial assets, tax incentives for asset accumulation and asset-testing in determining eligibility for social transfers.

In this paper we explain the processes used to build the input data and to code the wealth-related policies in EUROMOD and highlight some important advantages and drawbacks. The broader scope of countries allows to analyse the effect of wealth-related policies in a larger variety of institutional contexts. Indeed, the current set of countries includes countries with a flat personal income tax (Hungary, Estonia), countries with low social security provisions (Greece, Estonia) and countries which do not tax intergenerational transfers (Austria, Estonia, Slovak Republic). Also the relationship between the distributions of income and net wealth is strong is some countries (e.g. Spain, France) and fairly weak in others (e.g. Poland) (***Kuypers et al., 2021***). This modelling tool will have the potential to analyse current wealth-related taxes and tax reforms and their impact on household income and wealth and inequalities therein in EU countries, covering: (1) analyses of existing wealth tax systems; (2) timely analyses of wealth tax policy reforms that might actually come into force in the years to come; (3) analyses of potential alternative wealth tax policy reforms; (4) analyses of the joint effect of wealth tax policy reforms and other tax-benefit reforms affecting households' disposable income and net wealth.

The remainder of this paper is organised as follows. In Section 2 we provide brief information on the HFCS data and the steps taken to construct a EUROMOD input database from it. The third section then explains which wealth-related taxes and policies are added to the simulations in EUROMOD. A validation of the simulation results is discussed in Section 4. In Section 5 we put forward some research questions which may be addressed by using this enhanced model. The last section concludes.

2. The transformation of HFCS data into a EUROMOD input database

2.1. Background information: the "Eurosystem Household Finance and Consumption Survey"

The Eurosystem Household Finance and Consumption Survey (from now on HFCS) is conducted in a comparative way across the Euro Area by the national banks and some statistical institutes and coordinated at the European Central Bank. It covers detailed household wealth, gross income and consumption information and therefore provides more information on wealth than the current used database in EUROMOD, namely the "European Union Survey of Income and Living Conditions" (EU-SILC). The latter is the standard database used for the analysis of poverty and inequality in the European Union.

A significant advantage of the HFCS is that the wealthy population is oversampled (except in Italy, Ireland and Finland), i.e. households that are situated at the higher end of the income and/or wealth distribution are more accurately covered in the sample. As argued by ***Davies et al. (2011)*** this matters because those households are less likely to participate in surveys and more likely to underreport, in particular when it comes to financial assets. Another interesting feature of the HFCS data is that it uses a multiple imputation technique to deal with selective item non-response. Since EUROMOD requires that there is no missing information, this has the major advantage that missing information does not need to be imputed by researchers themselves. For more information on the oversampling and multiple imputation procedure of the HFCS we refer to ***HFCN (Eurosystem Household Finance and Consumption Network) (2016)***.

There are two main options for constructing a EUROMOD input database including wealth information. The first is to impute wealth information from the HFCS into the existing EU-SILC based EUROMOD dataset, while another option is to build a completely new input dataset fully based on HFCS. Since we want to maintain the strengths of the HFCS in terms of oversampling and multiple imputation and because the HFCS covers in general all other information needed in a EUROMOD input dataset we chose the latter option. Hence, this means that we create an input dataset based on HFCS covering all

Table 1. Overview of income reference periods, HFCS second wave.

Income reference year			
2010	**2012**	**2013**	**2014**
ES	EE, PT, IE	BE, DE, CY, LU, AT, PL, SL, SK, FI, EL	FR, IT, HU

Source: The HFCN (Eurosystem Household Finance and Consumption Network) (2016). *Cross-country metadatainformation. Wave 2,* European Central Bank.

'standard' variables needed for tax-benefit simulations also included in EU-SILC (with a few exceptions) complemented with additional wealth-related variables. In order to utilise the multiple imputation advantage to the fullest, we created five separate input databases, each representing information on one of the five imputations. Each dataset is run through EUROMOD, the results shown in this paper represent the average over the five output datasets. ***Figari et al., 2007*** noted that a database must fulfil certain requirements in order to be used in a sensible way in EUROMOD. As discussed by ***Kuypers et al. (2016)***, the HFCS fulfils the majority of these criteria such that it can be used in a reasonable way as input data in EUROMOD.

2.2. Selection of countries and summary statistics

We constructed a EUROMOD input database based on the HFCS for a selection of 17 out of the 20 countries who participated in the second wave.[1] The Netherlands, Malta and Latvia are not included, mainly because of their small sample sizes. Moreover, given that the Netherlands has administrative wealth data which show a large discrepancy with the HFCS estimates (see ***Salverda, 2015***), it does not seem appropriate to include it. Nevertheless, even without these countries our selection represents a broad range of European countries with various kinds of tax-benefit systems in place. Besides the fact that they differ in the more 'traditional' tax-benefit instruments (i.e. personal income tax, social insurance contributions, social transfers), they also largely differ in the extent and progressivity of wealth-related taxation or the way in which wealth is taken into account in determining eligibility for social transfers (i.e. 'asset-testing'). The broad coverage of countries takes advantage of the harmonised framework of EUROMOD and allows to study the budgetary and redistributive effects of wealth-related taxation and other policies from a cross-country perspective.

Table 1 provides an overview of the income reference years of the input datasets for the respective countries. For most countries it is 2013 or one year before or after. For Spain it is 2010.[2]

In ***Table 2*** we present sample characteristics of the EUROMOD input dataset based on HFCS (called 'EM-HFCS') in comparison with those of the dataset based on EU-SILC (called 'EM-SILC') which is closest to the HFCS income reference period. The sample size of EM-HFCS ranges from 1,289 households (4,223 individuals) in Cyprus to 12,035 households (28,845 individuals) in France. In most countries the sample size of EM-HFCS is (much) smaller than that of EM-SILC, which is also reflected in the higher value of average weights. Exceptions are France and Ireland, where EM-HFCS has a larger sample. In Finland the same set of people are covered in EU-SILC and HFCS. Following common EUROMOD conventions, children that were born after the end of the income reference period are removed from the sample in the input database. We only know the age of the individuals at the time of the interview and not the year in which they were born. Hence, we assume all individuals younger than one year old to be born after the income reference period. The outcomes of applying this procedure to the HFCS input data for each of the separate countries is presented in the column 'Restricted individuals'.

2.3. Common data issues

The EUROMOD input dataset that is constructed based on the HFCS contains both variables which are also included in the EU-SILC database in order to simulate the 'standard' EUROMOD policies, as well as new input variables in order to simulate wealth-related taxes and policies. The required

1. In the first wave 15 countries participated, the recently released third wave took place in 22 countries.
2. In the new release of the HFCS data in March 2020, the Spanish wave with income reference period 2010 was moved to the first wave and replaced by results with income reference period 2014. Our databases were constructed on a previous version of the second wave data.

Table 2. Descriptive statistics of sample and weights, EM-HFCS vs. EM-SILC.

		Households	Original individuals	Restricted individuals	Mean weight
Austria	EM-HFCS	2,997	6,189	6,168	1,335
	EM-SILC	5,909	-	12,945	647
Belgium	EM-HFCS	2,238	5,200	5,187	2,143
	EM-SILC	5,817	-	13,896	781
Cyprus	EM-HFCS	1,289	4,223	4,214	198
	EM-SILC	4,294	-	12,000	71
Estonia	EM-HFCS	2,220	5,709	5,650	225
	EM-SILC	5,433	-	14,210	93
Finland	EM-HFCS	11,030	27,142	27,142	198
	EM-SILC	11,030	-	27,142	198
France	EM-HFCS	12,035	28,845	28,577	2,229
	EM-SILC	11,390	-	26,558	2,342
Germany	EM-HFCS	4,461	10,201	10,160	7,833
	EM-SILC	12,744	-	26,438	3,015
Greece	EM-HFCS	3,003	7,744	7,741	1,386
	EM-SILC	14,096	-	34,380	311
Hungary	EM-HFCS	6,207	14,623	14,473	663
	EM-SILC	7,770	-	18,668	519
Ireland	EM-HFCS	5,419	14,546	14,546	316
	EM-SILC	4,592	-	11,794	386
Italy	EM-HFCS	8,156	19,366	19,290	3,131
	EM-SILC	17,985	-	42,791	1,413
Luxembourg	EM-HFCS	1,601	4,444	4,400	115
	EM-SILC	5,802	-	15,462	32
Poland	EM-HFCS	3,455	9,035	9,035	4,215
	EM-SILC	12,978	-	35,991	1,045
Portugal	EM-HFCS	6,207	16,513	16,404	634
	EM-SILC	6,257	-	15,926	660
Slovakia	EM-HFCS	2,135	5,433	5,378	959
	EM-SILC	5,490	-	15,681	332
Slovenia	EM-HFCS	2,553	7,245	7,204	285
	EM-SILC	9,205	-	28,034	71
Spain	EM-HFCS	6,106	15,852	15,788	2,892
	EM-SILC	13,597	-	36,992	1,244

Source: Own calculations based on EUROMOD and micro-datafrom EM-HFCS and EM-SILC.

Table 3. Ratio cadastral values/market values.

Country	Ratio
Austria	0.105
Belgium	0.004
Finland	0.510
France	0.022 for buildings, 0.105 for land
Germany	0.080
Italy	0.0033 for main residence, 0.0097 for other real estate
Luxembourg	0.005
Portugal	0.809
Spain	0.360

Note: Ratio between the total of cadastral values from administrative data and the total market value of all properties estimated in HFCS, for Belgium between mean cadastral value in EU-SILC and mean market value in HFCS, for Luxembourg ratio was inferred from policy parameters.

variables depend on the design of the specific taxes and policies. In the preparation of these input data several challenges needed to be addressed, mainly because of a lack of information in the original HFCS data. We focus here on issues which are applicable to most (or all) countries, for detailed country-specific issues we refer to ***Boone et al. (2019)***.

2.3.1. Cadastral values

In several countries, the tax base for the calculation of the recurrent real property tax (and the Italian real property transfer tax) is the taxable or cadastral value of the properties. This information is unfortunately not available in the HFCS. To solve this issue we approximate the cadastral values by calculating a ratio between the total of all cadastral values (i.e. at the national level) from external sources and the total market value of properties estimated based on the HFCS. The reported current value of each individual property in the HFCS is then multiplied by this ratio (also taking into account the % ownership of the individual/household). Although there is no reason to assume a link between taxable and market values, it is currently the only available approach and as the validation shows (see Section 4.2) the results are relatively good[3]. For some countries no relevant external information could be found so the ratio could not be calculated; in these cases we approximate the cadastral value in line with policy parameters of the real property tax, e.g. for Luxembourg cadastral values are assumed to be 0.5% of market values (see ***Boone et al., 2019*** for details). ***Table 3*** provides an overview of the applied ratios for the countries where cadastral values are the tax base for the real property tax.

2.3.2. Information on the purchase of the main residence and other properties

Information on the purchase year of a property is needed for the calculation of the real property transfer tax because we only simulate this tax for households who have bought real estate in the year for which the simulations are carried out. HFCS provides information about the purchase year of the main residence but not for other properties. We do, however, have information on the year mortgages are taken out. Thus, for all countries we approximate the purchase year of property other than the main residence by the year in which a household took out a mortgage using other property as collateral (not in case of refinancing a previous mortgage). We assume that a property was not purchased recently if there is no outstanding mortgage or loan. Hence, the real property transfer tax does not apply in these cases. The tax base is usually the purchase price of the real property. In case the value of

3. The validation only provides information on the consistency of the average level of the cadastral values, and hence the total tax base, but not their distribution. By applying the same ratio to all properties we might suppress the variance in the variable used for the simulations compared to reality. Yet, the relationship between market and cadastral values is not straightforward due to the lack of revisions of cadastral values in most countries. Therefore, there is no way of knowing a priori to which extent such distributional bias is actually induced.

real estate at the time of purchase is missing, we use the value at the moment of interview (maximum 2 years later).

2.3.3. Inheritances and gifts

Inheritances and gifts are observed at the household level in the HFCS, while they are taxed at the individual level. In our implementation we assign the inheritance/gift to the household head and in case there are two or more inheritances/gifts received in the same year, the most important one is assigned to the household head, the second one to the partner and so on. In most countries tax rates depend on the relationship between the donor/deceased and the beneficiary. For this purpose information on from whom a gift/inheritance is received is taken from the HFCS. In case this information is missing we assume the inheritance/gift to be received from parents as it is the most common relationship. Finally, many countries grant tax exemptions, deductions or preferential tax rates for certain types of assets such as the family home or business assets. In the HFCS we observe the total amount that each inheritance/gift is worth as well as which types of assets are received, but not the amount for each asset type separately. We impute these amounts based on the information of the stock variables observed in the survey.

2.3.4. Financial income

In several countries not all types of financial income (i.e. interest, rents, dividends…) are treated equally by the tax system. Some countries levy lower tax rates on certain types of financial income (i.e. Belgium, Italy…), while others have a special tax in place on specific financial income (i.e. Cyprus and Luxembourg). In the HFCS only an aggregate amount of financial income is observed (i.e. the sum of interests, dividends, rents, etc.). In contrast, we do observe separate amounts for the stock variables (e.g. value of savings accounts, value of public shares, etc.) from which the different types of financial income are generated. One way to impute the separate amounts of income streams would be to take the share of each stock variable in the total financial asset portfolio and apply these shares to the financial income variable. This approach, however, neglects the fact that publicly traded shares typically generate a larger return than for instance money in savings accounts. Therefore, we apply a slightly different approach consisting of two steps. We first multiply each stock variable containing the value of a financial asset with a national average rate of return taken from administrative data (in case a household does not own the respective financial asset the corresponding income variable is of course equal to zero). We then correct each amount imputed in the first step by the same percentage such that the sum of all imputed variables is equal to the total financial income variable observed in HFCS. We use the same average rate of return for all households. Although evidence suggests that wealthier investors tend to gain higher rates of return than smaller investors (e.g. ***Piketty, 2014***), this kind of information is not available in administrative data.

2.3.5. Net wealth

In EUROMOD we want to simulate wealth taxes payable in the income reference year, such that they align with the taxes and contributions levied on income and the social transfers awarded by the government. For the event wealth taxes (i.e. real property transfer tax, inheritance and gift tax) this is not a problem as the variables covering these events refer to the moment the event takes place and we only simulate the tax for those experiencing the event in the policy year. Recurrent real estate taxes are usually levied on size in square meters or cadastral values which generally do not change from one year to the next. However, in the HFCS the recurrent wealth variables refer to the situation at the time of the interview (for Italy, Hungary and Finland to the last day of the income reference period), while yearly net wealth taxes are usually levied on the first day of the year. Therefore, we need to impute the value of net wealth owned on January 1st of the income reference year based on the value of net wealth observed in HFCS, which is generally one to two years later. We approximate the first value by taking the latter and subtracting the following amounts a) the value of real estate purchased and inheritances/gifts received in both the income reference year and the survey year as

these represent wealth not yet owned by households at the time the wealth tax was levied[4] and b) financial income received in the income reference year as an estimate of the growth of financial assets between the time the wealth tax was levied and the moment wealth was observed.

2.3.6. Social benefits

In the original HFCS dataset all social benefits except pensions and unemployment benefits are taken together in a single variable, surveyed at the household level. In EU-SILC, in contrast, benefits are covered separately, with some surveyed at the household level and others at the individual level. A detailed disaggregation is also beneficial for the accuracy of the simulations in EUROMOD. In principle the HFCS social benefits variable may contain all kinds of social benefits, such as housing benefits, child benefits, parental leave allowances, educational allowances, social assistance, etc. To address this issue we decided to include in the input database a variable containing the amount of the total social benefits as observed in HFCS. In EUROMOD we then simulate those social benefits which can be accurately simulated based on other observed information. These are mostly child benefits and social assistance – which are often the most important benefits – but sometimes also other benefits are simulated. When analysing the output we then use the simulated benefits and the residual benefits from the aggregate variable – if any – to calculate disposable income. In other words, in case the simulated benefits are larger than the observed benefits in HFCS we use the simulated amounts, if they are smaller it points towards the receipt of other non-simulated benefits and then we use the observed amount of benefits. See ***Boone et al. (2019)*** for a list of social benefits which are part of EUROMOD, but which cannot be simulated based on the HFCS data. As these often entail only small benefits received by a limited number of people, the effects on the simulation results are likely to be small.

2.4. Uprating of monetary variables

Survey data are generally available to researchers only after a considerable time lag. In case of the HFCS, data are usually available three years after the interviews take place. Hence, we would like to use the input data both for simulations of the policies as they existed in the income reference year as well as for more recent years. At the moment the most recent coding of the wealth-related taxes and policies in EUROMOD applies to the situation in 2017. To be able to run the input data from the second HFCS wave on the 2017 policies we need to uprate monetary variables to the price levels of 2017. Income components and other variables are uprated using the standard uprating indices included in EUROMOD (for more information on the general uprating procedure see the EUROMOD Country Reports). For monetary variables that are new to the EUROMOD input database we have constructed new uprate indices. As for EU-SILC non-monetary variables are assumed to have stayed the same.

We illustrate in ***Table 4*** the construction of the new uprating indices with the example of Germany for which variables need to be uprated from 2013 to 2017. Detailed information on the uprating procedure for each country can be found in ***Boone et al. (2019)***. First, the main asset variables are uprated based on their respective aggregates in the national accounts[5]. In the case of Germany these were taken from the ***Federal Statistical Office Germany (2018a)***; ***Federal Statistical Office Germany (2018b)*** and the ***Deutsche Bundesbank (2018)***. Although categories of the national accounts and HFCS do not always coincide perfectly (***Kavonius and Honkkila, 2013***; ***Waltl, 2020)***, they are the best available information to take into account the evolution of assets and debt. We try to match the categories as close as possible. For self-employment business assets we used the categories 'machinery & equipment' and 'intellectual property rights' from the national accounts as proxy. For the HFCS asset

4. It is possible that households change their asset portfolio by swapping between different types of assets, such that we may in some cases subtract amounts which were part of net wealth on the first of January in the income reference period. We, however, assume that for the majority of the households buying a house represents a new type of wealth.
5. Since the wealth of those at the top of distribution often increases at a faster pace than at the bottom, uprating the wealth of all households by the same index might reduce the inequality included in the simulations as compared to reality. Yet, by applying different uprating indices to the separate wealth components part of this differential increase is captured as those at the top of the wealth distribution more often invest in financial assets such as listed shares, while those at the bottom own most of their wealth in deposits and value of their main residence.

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Table 4. Overview of uprating indices used for wealth variables in EUROMOD, Germany (in billion euros).

Variables uprated by the index	Value 2013	Value 2017	Ratio value 2017/2013	Source
Wealth from main residence, Wealth from other buildings, Purchase value of main residence, Purchase value of other buildings	7160.3	8328.8	1.16	Gross stock of buildings and structures (1)
Wealth from vehicles	302.2	328.8	1.09	Stock of personal transport equipment (2)
Wealth from valuables	157.9	175.9	1.11	Stock of other durables (2)
Self-employment business wealth	317.3	332.4	1.05	Stock of machinery & equipment and intellectual property products (1)
Wealth from deposits	1798.8	2119.6	1.18	Stock of transferable & other deposits (3)
Wealth from mutual funds, wealth from managed accounts	398.3	576.2	1.45	Stock of investment fund shares (3)
Wealth from bonds	179.0	120.5	0.67	Stock of debt securities (3)
Wealth from private non-self-employment businesses	264.4	314.7	1.19	Stock of unlisted shares and other equity (3)
Wealth from listed shares	223.2	327.4	1.47	Stock of listed shares (domestic & other (3)
Wealth from private pensions and life insurances	1555.6	1826.0	1.17	Stock of life insurance and pension entitlements (3)
Wealth from other assets	328.0	384.8	1.17	Stock of non-life insurance technical reserves and other accounts (3)
Debts	1565.1	1727.5	1.11	Stock of total liabilities (3)
Value of inheritances and components of inheritances	17.3	23.3	1.35	Total amount of inheritances>0 euro (4)
Value of gifts and components of gifts	11.5	11.2	0.97	Total amount of gifts>0 euro (4)
Net wealth	11920.7	13876.7	1.16	Stock of net wealth (sum of fixed assets, consumer durables and financial assets less liabilities) (1,2 and 3)

Note: All stock variables refer to the situation at the end of the year.

Source: (1) National Accounts, Fixed assets by sector (Federal Statistical Office Germany, 2018a); (2) National Wealth Accounts, consumer durables (Federal Statistical Office Germany, 2018b); (3) Financial Accounts (Deutsche Bundesbank, 2018); (4) Finanzen und Steuern, Erbschaft- und Schenkungsteuer (Federal Statistical Office Germany, 2018c).

categories 'managed accounts' and 'money owed to households' there is no information available in the national accounts. For managed accounts we apply the same uprating index as for mutual funds and for money owed to the household we use the EUROMOD default, i.e. the price index. The aggregate wealth variables 'total financial assets', 'total real assets' and 'total assets' are uprated by setting them equal to the sum of their uprated components. The uprate index for the value of real property is also applied to the value of real property at the time of purchase, which is used in the simulation of the real property transfer tax. Cadastral values are not uprated. Furthermore, the monetary variables used in the simulation of the inheritance and gift tax are uprated using administrative information on the total amount of inheritances and gifts larger than 0 euro (***Federal Statistical Office Germany, 2018c***). This information is not available for most countries, so then the uprate index is defined in terms of the evolution in government revenues from inheritance and gift taxation. Since the applicable tax legislation has not significantly changed in the period we are uprating over, it is relatively certain that changes in the tax revenues mainly reflect changes in the amount of wealth that is received or inherited.

As mentioned before we assume non-monetary information to have stayed the same. Yet, we simulate the real property transfer tax and the inheritance & gift tax only for those individuals who have experienced these events in the policy year, i.e. for the first only individuals who have bought a property in the policy year and for the second only indivuals who have received an inheritance or gift in the policy year. In the policy years after the income reference period we keep using the observations from the income reference period. Hence, in practice this means we replace the variable which contains

Table 5. Overview of simulation new wealth-related taxes in EUROMOD, 2017.

	Real property tax	Real property transfer tax	Inheritance tax	Gift tax	General net wealth tax	Specific net wealth tax
Austria	ES	ES	N[1]	N[1]	N	N
Belgium	ES	ES	ES	ES	N	N
Cyprus	ES	ES	ES[2]	ES[2]	N	N
Estonia	ES[3]	N	N	N	N	N
Finland	ES	ENS	ENS	ENS	N	N
France	ES	ES	ES	ES	ES	N
Germany	ES	ES	ES	ES	N	N
Greece	ES	ES	ES	ES	N	N
Hungary	ENS	ES	ES	ES	N	N
Ireland	ES	ES	ES	ES	N	N
Italy	ES	ES	ES	ES	N	ES
Luxembourg	ES	ES	ES	ES	N	N
Poland	ES	ES	ES	ES	N	N
Portugal	ES	ES	ES[4]	ES[4]	N	N
Slovakia	ES	ENS[5]	N	N	N	N
Slovenia	ES	ES	ES	ES	N	N
Spain	ES	ES	ES	ES	ES[6]	N

Note: ES= exists & simulated; ENS= exists & not simulated; N= does not exist. [1]The inheritance & gift tax was abolished in 2008. A provision for inheritances and gifts still exists under the real property transfer tax. [2]Inheritance & gift tax was abolished in 2000 and thereafter included in the legislation of the real property transfer tax. [3]Land tax [4]Inheritance & gift tax was abolished in 2004 and thereafter included in the stamp duty. [5]In Slovakia there is a real property transfer tax provision. We are not able to simulate this provision since it requires specific information. However, the budgetary impact of the tax is very limited. [6]The general net wealth tax was abolished in Spain between 2008 and 2011 and was reintroduced thereafter.

Source: Boone et al. (2019).

information on the year a property is bought or an inheritance/gift is received with 2017 for those for which it is equal to the income reference period (i.e. 2013 is replaced by 2017 in the case of Germany).

3. Extending the EUROMOD policy scope

In this section we provide an overview of the existence of wealth-related taxes and other policies relying on wealth information for the countries covered in the analysis. We discuss some common features of these policies and whether or not these policies are simulated in the respective country in the 2017 policy system (which is generally the same as the simulations for the income reference period).

First, ***Table 5*** focuses on the new wealth-related taxes that have been integrated in the model. We distinguish between four tax categories, (1) recurrent real property taxes, (2) taxes on the transfer of real property, (3) inheritance and gift taxes and (4) general and specific taxes on the ownership of net wealth. We list whether these taxes exist in a given country and were added to EUROMOD (ES), exist in a given country but were not added (ENS) and do not exist in a given country (N). In general, the majority of the taxes shown below were not yet simulated in EUROMOD due to data limitations in EU-SILC, but the HFCS contains sufficient information to allow these simulations. Some taxes, such as the recurrent real property taxes of Belgium, Italy and Greece were already partially simulated on EM-SILC data.

3.1. Real property tax

Ownership of real property is taxed recurrently in all HFCS countries included in the analysis. The tax base differs between the different countries but can be divided into three separate categories. Most countries use the cadastral value of the property as tax base for the calculation of the property tax (Austria, Belgium, Finland, France, Germany, Italy, Luxembourg, Portugal and Spain). Other countries use the market value (Cyprus, Hungary, Ireland and Slovenia) or the property size in m² (e.g. Greece[6], Hungary[7], Poland and Slovakia) as tax base. In some countries there exist exemptions from the real property tax. Note that the Hungarian real property tax cannot be simulated since it requires detailed information at the municipality level that is not available in HFCS.

3.2. Real property transfer tax

Transfers of real property are subject to a transfer tax that is payable by the buyer of the property in all countries. The purchase of immovable property is often preceded by taking out a mortgage, which is in some countries also taxed (Belgium, Italy, Portugal, Spain). With the exception of Italy, all countries levy the transfer tax on the price of the property (i.e. its fair market value), while in Italy the cadastral values are used as tax base. In general, there are no exemptions from this tax, although transfers of properties between lineal heirs or properties held by the government are exempt from taxation in some countries (e.g. Germany, Portugal, Spain …). For Finland and Slovakia, we are not able to simulate the transfer tax. For Finland this is because in HFCS information on wealth transfers is missing as it is based on a combination of register data and a supplementary module added to the EU-SILC survey (***HFCN (Eurosystem Household Finance and Consumption Network), 2016***). In Slovakia the real estate transfer tax was abolished in 2005, but there is still a very small registration fee in place. The simulation of this fee, however, requires information not available in HFCS. Because it consists of only a small fee, the budgetary importance of this is very limited.

3.3. Inheritance & gift tax

Apart from Austria, Estonia and Slovakia inheritances and gifts are subject to taxation in all countries and are due by the beneficiary of the inheritance/gift. Overall, the value of the inheritance/gift is used as tax base. Often tax rates vary according to the kinship between the beneficiary and the deceased/donor with more favourable tax treatment for partners, descendants and ascendants compared to

6. Property size is combined with information on different coefficients (building age coefficient, floor or house coefficient, façade coefficient and incomplete building coefficient) to determine the tax base.
7. In Hungary, either the property size or adjusted market value can be used as tax base, depending on the municipality.

Table 6. Overview of refined wealth-related policies in EUROMOD, 2017.

	Taxation of income from financial assets	Taxation of income from real property	Tax relief for mortgage repayment	Tax relief for contributions made to private pension funds	Asset-test for social benefits	Country specific tax
Austria	ESR[1]	ES	ESR[2]	ESR[3]	ESR	n/a
Belgium	ES	ESR	ESR	ES	ES	ESR[4]
Cyprus	ES	ES	EN[5]	ES	ESR	ESR[6]
Estonia	ESR	ES	ES	ES	EN	n/a
Finland	ES	ES	EN	ES	ES	n/a
France	ESR	ESR	ESR	ES	N	n/a
Germany	ES	ES	ESR	EN	ESR	n/a
Greece	ESR	ESR	N	N	ES	n/a
Hungary	ESR	ES	N	ES	ESR	n/a
Ireland	ES	ESR	ESR	ES	ESR	n/a
Italy	ES	ES	ES	ES	ES	n/a
Luxembourg	ES	ES	ESR	ES	ESR	n/a
Poland	ES	ES	ES	ESR	ES	n/a
Portugal	ES	ES	ESR	ES	ESR	n/a
Slovakia	ES	ES	EN[7]	ES	ES[8]	n/a
Slovenia	ESR	ESR	N	ES	EN	n/a
Spain	N[9]	ES	ESR[10]	ES	ES	n/a

Note: ES = exists & simulated; ESR = exists, simulated & refined; EN = exists & not simulated; N = does not exist. [1]Tax on capital gains. [2]Included under the tax allowance for cost of earnings and tax allowance for exceptional deductions. [3]Included under the tax allowance for exceptional deductions. [4]Tax on long term saving. [5]No specific information was found online such that we cannot implement this tax. [6]Special contribution to defense. [7]Not yet applicable in 2013 and 2017. [8]Social assistance is the only means-tested benefit which is simulated for Slovakia and we did not find any applicable asset-test. [9]Exemption for dividends was abolished in 2015. [10]Since 2013 the mortgage tax credit is no longer in effect for individuals who bought their residences after 1st of January of that year.

other relatives or non-related people. Inheritances and gifts are generally taxed in a progressive way, either through a progressive tax schedule (all countries except Hungary, Ireland, Italy, Luxembourg and Portugal) and/or by granting large allowances of several thousands of euros (Germany, Greece, Ireland, Italy). The inheritance and gift tax of Finland cannot be simulated which is again due to the missing information on wealth transfers mentioned above.

3.4. General & specific net wealth tax

In the years for which the simulations are carried out, a general net wealth tax only existed in France[8] and Spain[9]. In both countries the tax is levied on the net wealth (i.e. real and financial assets minus liabilities). It is levied on individuals who own a 'high share of net wealth', i.e. at least €1,300,000 in France and €700,000 in Spain (in the latter doubled for couples). Apart from the tax-free threshold, both countries have additional exemptions from the wealth tax included in their tax legislation. For instance, the value of the main residence is partially exempted and works of arts, antiques and retirement savings are fully exempted as well as business assets under certain conditions. Tax rates are progressive in both France and Spain. Italy levies a 'specific net wealth tax', which entails the taxation of bank accounts and financial assets.

8. Replaced by a tax levied only on real estate wealth since 1st of January 2018.
9. Abolished between 2008 and 2011, but thereafter reintroduced.

In the simulation of all the wealth-related taxes we simulate the rules as they apply to residents and the wealth held in the country of residence. Other rules may apply to wealth held in the country by non-residents or the wealth held by residents in other countries.

Table 6 presents an overview of the policies which were already simulated in EUROMOD, but which have often been refined by taking into account (more detailed) wealth information where necessary. Again, we focus on the 2017 policies, but the situation is largely the same for the income reference period. We classify policies as 'exists and simulated' (ES), 'exists, simulated and refined' (ESR), 'exists and not simulated' (EN) and 'does not exists' (N). Taxation of income from financial assets and from real property is for all countries included in EUROMOD. Tax reliefs for mortgage repayments respectively for contributions to private pension funds are also well covered in the refined policies (except for Cyprus, Finland, and Slovakia, resp. for Germany). The same applies for asset tests for social benefits, where the asset test has either been added to the existing policy or the asset test that was coded was refined with additional information (except for Estonia and Slovenia). Country specific taxes are refined for Belgium and Cyprus. For Belgium this entails the 'tax on long-term savings' that is levied once people turn 60 years old, while for Cyprus the 'special contribution to defense' which is levied on income from financial assets is simulated.

4. Validation of EM-HFCS

In this section we show how the outcomes from EM-HFCS and the new policies in EUROMOD compare to other sources. First, we validate the EUROMOD-HFCS outcomes for a number of income concepts at the micro-level by comparing them with those based on the EU-SILC database, for the corresponding income reference year. Next, we turn to the validation of the newly-added wealth policies in EUROMOD and present an overview of the number of potentially liable observations and the number of observed taxpayers for each tax category. Finally, for macro-validation purposes we compare the simulated tax revenues with figures from external sources to assess the accuracy of the simulations.

4.1. Micro-validation against EM-SILC

Table 7 presents summary statistics of original & pension income and disposable income for EM-HFCS and EM-SILC, although we do not claim that one data is better than the other. We show here the results for the income reference year as these directly reflect the underlying databases, but the differences between EM-HFCS and EM-SILC are the same for 2017 as the same uprating indices are applied to the income variables for both datasets. To be able to compare accurately between EM-HFCS and EM-SILC the newly simulated wealth-related taxes are here not subtracted from disposable income. Note that the figures presented below refer to the mean over the five imputations. All figures are calculated based on the annual household disposable income, equivalised by the OECD modified scale and all individuals are included in the calculations.

We highlight the extent of the differences as follows: white cells refer to differences of less than 5%, light grey cells refer to differences of between 5% and 10%, medium grey cells refer to differences of between 10% and 20% and dark grey cells refer to differences of more than 20%. Comparability between the results of EM-HFCS and EM-SILC varies widely across countries. Results are close to each other for Finland, Portugal and Slovakia, while they diverge rather strongly for Austria, Estonia, France and Slovenia. Differences are usually larger for original & pension income than for disposable income and larger for the mean than for the median. The differences mostly reflect higher amounts in EM-HFCS than in EM-SILC, which might be related to the oversampling that is applied in the HFCS (see above). Gini coefficients are often also higher in EM-HFCS than in EM-SILC.

Since the differences between EM-HFCS and EM-SILC are sometimes relatively large and they vary widely across countries, this may potentially lead to different results of simulations of the impact of tax-benefit policies and the country rankings thereof. Nevertheless, the comparison only reveals differences, but not which dataset is closest to reality. Both datasets are household surveys having each important strengths but also suffering from weaknesses. Hence, at this moment there is no way of knowing which dataset provides the 'best' estimates of inequality, poverty and redistribution. Therefore, we argue to consider the datasets as complements rather than substitutes.

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Table 7. Comparison of key EUROMOD equivalised income concepts (in € per year), EM-HFCS vs. EM-SILC, income reference year.

Country	Mean				Median				Gini-coefficients			
	Original income		Disposable income		Original income		Disposable income		Original income		Disposable income	
	HFCS	SILC	HFCS	SILC	HFCS	SILC	HFCS	SILC	HFCS	SILC	HFCS	SILC
Austria	27,274	32,553	21,627	25,185	24,575	28,198	20,174	22,519	0.288	0.364	0.200	0.250
Belgium	30,623	26,686	21,623	21,023	27,227	24,206	19,863	20,038	0.374	0.396	0.250	0.221
Cyprus	16,098	18,652	15,404	19,100	12,600	14,229	12,790	15,115	0.404	0.412	0.324	0.338
Estonia	10,353	8,112	9,345	7,502	7,869	6,727	7,291	6,356	0.468	0.381	0.401	0.317
Finland	31,601	30,329	26,359	25,573	27,736	26,760	23,962	23,211	0.364	0.379	0.233	0.241
France	22,079	28,914	20,033	23,994	19,138	24,485	17,467	20,802	0.401	0.371	0.260	0.276
Germany	31,375	28,600	23,852	22,061	24,222	24,379	19,641	19,526	0.431	0.378	0.318	0.280
Greece	14,339	11,161	12,621	9,886	11,780	8,990	10,511	8,549	0.386	0.409	0.346	0.330
Hungary	6,225	5,889	4,897	4,429	4,998	5,199	4,067	4,030	0.412	0.355	0.329	0.286
Ireland	28,790	22,744	24,531	22,156	21,886	18,134	21,145	19,573	0.493	0.518	0.331	0.275
Italy	20,137	22,020	15,484	22,021	16,290	18,338	13,340	15,557	0.407	0.388	0.340	0.314
Luxembourg	48,971	44,526	39,801	37,874	36,800	37,039	33,225	33,816	0.424	0.385	0.296	0.242
Poland	8,898	7,434	6,978	6,040	7,410	6,309	5,956	5,265	0.378	0.367	0.333	0.304
Portugal	11,693	11,903	10,395	10,501	8,725	8,960	8,582	8,726	0.433	0.438	0.330	0.319
Slovakia	7,841	7,933	6,945	7,026	7,046	7,105	6,277	6,461	0.352	0.322	0.252	0.236
Slovenia	11,436	14,731	9,587	12,648	9,650	12,988	8,580	11,728	0.388	0.363	0.264	0.241
Spain	16,883	15,651	16,495	14,714	13,043	13,067	13,186	13,384	0.451	0.400	0.383	0.313

Notes: White cells refer to differences of less than 5%, light grey cells refer to differences of between 5% and 10%, medium grey cells refer to differences of between 10% and 20% and dark grey cells refer to differences of more than 20%. In case of Hungary amounts in national currency have been converted to euros based on the average exchange rate in 2017 reported by the European Central Bank, namely €1=HUF 309.19. For Poland the exchange rate applied is equal to €1=4.2259 PLN.

Source: Own calculations based on EUROMOD and micro-datafrom EM-HFCS and EM-SILC.

4.2. Macro-validation of new EUROMOD policies

We now turn to the macro-validation of the newly added wealth policies in EUROMOD.

Table 8 summarises for each of the taxes the number of observations in the data which are in theory liable to pay the tax and the final observed number of actual taxpayers. The number of potentially liable observations refers to those observations in the input data that could be theoretically taxed. This number refers to all observations that possess the type of asset or have experienced the type of wealth transfer which is taxed in the respective tax, without taking into account any tax legislation or data constraints. This number does not necessarily correspond to the final number of actual taxpayers since units may not pay a tax for several reasons (e.g. missing input data, exemptions foreseen in tax legislation…). The criteria used to calculate the number of potentially liable observations is the same across all countries:

- Real property tax: households are considered potentially liable if they (partially) own at least one property.
- Real property transfer tax: households are considered potentially liable if they bought at least one property in the policy year.
- Inheritance tax: households are considered potentially liable if they received a positive inheritance in the policy year.
- Gift tax: individuals are considered potentially liable if they received a positive gift in the policy year.
- Mortgage registration duties: households are considered potentially liable if they took out at least one mortgage in the policy year.
- Net wealth tax: individuals are considered potentially liable if they own positive net wealth.

The final number of observed taxpayers are those cases that eventually pay a positive tax after taking into account the tax rules (weighted population numbers are presented between parentheses).

The number of observations differ strongly between the different wealth-related taxes and countries. In general, the number of potentially liable observations and the number of observed taxpayers is highest for the real property tax. In comparison, the number of observations for the inheritance & gift tax, real property transfer tax and mortgage registration duties are considerably lower. In general, the number of observed taxpayers is the same in 2017 compared to the income reference period as most tax legislation did not change (drastically) over this period. The most important differences are (1) that for Greece the number of payers of the real property tax increased between the income reference year and 2017 because of a reform from an 'emergency property tax' to the property tax as it exists today, (2) that for Italy the number of payers of the real property tax decreased because the main residence has become exempted from taxation since 2016 and (3) that the number of tax payers of the Spanish net wealth tax is zero in the income reference year (2010) since this tax was abolished between 2008 and 2011.

Table 9 presents the comparison of tax revenues for the simulated wealth-related taxes with external figures, mainly derived from the OECD Tax Revenue Database. We show here both the validation for the income reference period as for 2017 because the first shows best how well our simulations perform, while the latter provides some insight in the appropriateness of the uprating. Since the number of observations is highest for the real property tax this tax is on average the most accurately simulated wealth tax. For the other taxes the simulated revenues diverge more from the external figures. There are several reasons for this. First, as ***Table 8*** showed the number of observations in the underlying data are often very low such that the results largely depend on a few cases. When these cases happen to be outliers this has a massive effect on the results. Second, as the results largely depend on the input database, underreporting in the HFCS data may have an effect on the simulation results. Moreover, our simulations are not always completely comparable to the external statistics as the latter are not always available at a detailed level. For instance, we simulate wealth taxes for households, but external figures often do not make a distinction between taxes paid by households versus other economic actors.

5. Applications

Combining EUROMOD with the HFCS data has two major advantages. First, EUROMOD can be used to transform the original gross HFCS incomes into disposable incomes, making the HFCS also a suitable dataset for standard (re)distributive analyses. Second, the increased scope of EUROMOD with

Table 8. Number of observations potentially liable for and actually paying the tax for each of the simulated wealth-related taxes, 2017.

Country	Wealth-related tax	Number of potentially liable observations	Number of observed taxpayers
Austria	Real property tax	1,412	1,412 (2,033,783)
	Real property transfer tax	27	27 (37,195)
Belgium	Real property tax	1,689	1,686 (3,531,695)
	Real property transfer tax	28	25 (68,577)
	Inheritance tax	49	45 (75,363)
	Gift tax	15	14 (45,970)
	Mortgage registration duties	40	40 (119,424)
	Tax on long-term saving	44	44 (66,663)
Cyprus	Real property tax	1,098	1,098 (250,309)
	Real property transfer tax	5	5 (688)
	Mortgage registration duties	77	77 (13,824)
	Gift provision	27	0
Estonia	Real property tax	1,801	0
Finland	Real property tax	8,536	8,536 (1,775,911)
France	Real property tax	8,983	7,355 (13,935,691)
	Real property transfer tax	288	270 (507,207)
	Inheritance & gift tax	436	147 (252,843)
	Net wealth tax	19,262	1,155 (342,915)
Germany	Real property tax	2,895	2,894 (19,830,502)
	Real property transfer tax	92	89 (628,066)
	Inheritance & gift tax	363	27 (119,988)
Greece	Real property tax	3,003	1,793 (3,038,838)
	Emergency property tax	3,003	n/a
	Real property transfer tax	11	11 (3,326)
	Inheritance & gift tax	13	5 (4.134)
Hungary	Real property transfer tax	69	69 (42,300)
	Inheritance tax	47	5 (3,514)
	Gift tax	28	1 (224)
Ireland	Real property tax	3,968	3,917 (1,221,527)
	Real property transfer tax	79	36 (9,153)
	Inheritance & gift tax	96	17 (4,273)
Italy	Real property tax	6,070	1,880 (5,693,335)
	Real property transfer tax	77	77 (300,929)
	Inheritance & gift tax	204	30 (86,236)
	Net wealth tax	8,156	8,156 (24,694,121)
Luxembourg	Real property tax	1,295	1,295 (157,609)
	Real property transfer tax	41	41 (5,700)
	Inheritance tax	37	8 (1,048)

Continued

Table 8. Continued

Country	Wealth-related tax	Number of potentially liable observations	Number of observed taxpayers
	Gift tax	10	1 (76)
Poland	Real property tax	3,436	3,428 (13,375,016)
	Real property transfer tax	51	50 (231,159)
	Inheritance & gift tax	85	1 (1,785)
Portugal	Real property tax	5,269	4,770 (2,704,456)
	Real property transfer tax	25	21 (8,976)
	Inheritance & gift tax (stamp duty)	158	57 (33,037)
	Mortgage registration duties	59	59 (29,484)
Slovakia	Real property tax	1,879	1,863 (1,594,174)
Slovenia	Real property tax	2,066	224 (79,900)
	Real property transfer tax	15	15 (4,350)
	Inheritance & gift tax	49	2 (305)
Spain	Real property tax	5,586	5,586 (15,234,706)
	Real property transfer tax	77	77 (236,799)
	Inheritance tax	150	112 (240,448)
	Net wealth tax	10,150	1,133 (313,698)

Note: Population weighted numbers in brackets.
Source: Own calculations based on EUROMOD and micro-data from EM-HFCS.

wealth-related policies allows for new research questions to be addressed. In what follows, we briefly discuss some interesting examples.

5.1. Standard (re)distributive analyses

The HFCS is by itself not a suitable dataset for (re)distributive analyses as it only covers incomes gross of liabilities for taxes and social insurance contributions. Also, apart from pensions and unemployment benefits, all other social transfers are covered under a single variable. Including the HFCS as an underlying database for EUROMOD allows to simulate these components of the tax-benefit systems for the households covered in the HFCS and to derive disposable incomes. In this way the HFCS becomes an additional source which can be used for research on poverty, inequality and redistribution in Europe, which is currently largely based on EU-SILC and the Luxembourg Income Study (LIS). Moreover, compared to these sources the HFCS has the major advantage that it covers information on both income and wealth such that poverty, inequality and redistribution can be studied both in terms of the distribution of income as well as the distribution of wealth, or a combination of the two.

A first interesting application can be situated in the so-called 'asset-based poverty' literature. In this literature it is argued that financial well-being and precariousness depend on both income and wealth and hence that wealth should be taken into account when determining who is worse off (***Kuypers and Marx, 2019***). Given that the two distributions are not perfectly correlated poverty measures based on income alone tend to overstate poverty rates among households with low income, but median to high net wealth, while they potentially ignore the precarious situation of households with incomes above the poverty threshold, but with very low assets or bearing a large debt burden (***Kuypers and Marx, 2021***). Therefore, two approaches have been proposed to define joint income-wealth poverty indicators. Up until a few years ago this literature was largely US-oriented. The combination of disposable incomes and net wealth in the HFCS now also allows to estimate such indicators for Europe (see for instance ***Kuypers and Marx, 2021*** forthcoming; ***Kuypers and Marx (2018)***).

Another possible application is to study the redistributive effects of taxes and benefits. ***Table 10***, for instance, shows the absolute and relative redistributive effect achieved by income taxes and social

Table 9. Simulated wealth tax revenues (in million euro per year), income reference year and 2017

Country	Wealth tax	Income reference year			2017		
		Simulated revenue	External figure	Ratio	Simulated revenue	External figure	Ratio
Austria	Real property tax	617.10	736.0 (1)	83.85%	617.10	771.0 (1)	80.04%
	Real property transfer tax	272.20	790.0 (1)	34.46%	142.40	1,118 (1)	12.74%
Belgium	Real property tax	3,218	3,478 (1)	92.52%	3,254	3,775 (1)	86.20%
	Real property transfer tax	1,987	3,452 (3)	56.10%	1,977	4,065 (3)	48.63%
	Inheritance tax	1,142	2,634 (3)	43.36%	1,035	2,365 (3)	43.76%
	Gift tax	103.8	463.0 (3)	22.42%	83.49	567.0 (3)	43.76%
	Mortgage registration duties	241	244.0 (4)	98.77%	233	122.0 (4)	190.98%
	Tax on long-term saving	197.7	207.0 (3)	95.51%	158.2	382.0 (3)	41.41%
Cyprus	Real property tax	94.49	100.8 (2)	93.74%	22.52	16.50 (2)	136.48%
	Real property transfer tax, gift provision and mortgage registration duties	39.93	79.70 (2)	50.10%	22.28	99.0 (2)	22.51%
Estonia	Real property tax	0	59.0 (1)	0%	0	59.0 (1)	0%
Finland	Real property tax	718.40	623.0 (1)	115.31%	858.20	811.0 (1)	105.82%
France	Real property tax	14,390	17,003 (1)	84.63%	15,470	18,465 (1)	83.78%
	Real property transfer tax	6,088	10,143 (1)	60.0%	5,916	12,644 (1)	46.79%
	Inheritance & gift tax	6,644	10,300 (1)	64.50%	8,533	12,188 (1)	70.01%
	Net wealth tax	6,807	5,377 (1)	126.59%	8,148	4,837 (1)	168.45%
Germany	Real property tax	6,795	4,951 (1)	137.2%	7,199	5,586 (1)	128.9%
	Real property transfer tax	5,181	8,394 (1)	61.7%	6,899	13,139 (1)	52.5%
	Inheritance & gift tax	1,496	4,633 (1)	32.3%	2,548	6,114 (1)	41.7%
Greece	Real property tax & Emergency property tax	415.93	2,619 (2)	15.88%	1,042	3,095 (2)	33.67%
	Real property transfer tax	37.77	275.0 (2)	13.73%	50.92	181.0 (2)	28.13%
	Inheritance & gift tax	2.53	99.0 (2)	2.56%	6.63	115.0 (2)	5.77%
Hungary	Real property transfer tax	54.52	265.23 (1)	20.56%	73.87	419.91 (1)	17.59%
	Inheritance tax	4.49	16.14 (1)	27.82%	6.27	26.40 (1)	23.75%
	Gift tax	0.13	3.87 (1)	3.36%	0.13	3.97 (1)	3.27%
Ireland	Real property tax	172.6	1,478 (1)	11.70%	483.9	463.0 (2)	98.03%
	Real property transfer tax	56.6	105.0 (2)	53.90%	68.8	301.0 (2)	22.86%
	Inheritance & gift tax	191.4	282.0 (1)	67.87%	341.1	411.0 (1)	82.99%
Italy	Real property tax	19,113	17,900 (5)	106.77%	15,675	14,400 (5)	108.85%
	Real property transfer tax	504	n/a	n/a	507	n/a	n/a
	Inheritance & gift tax	398	622 (5)	63.98%	404	557 (5)	72.53%
	Net wealth tax	1,402	2,743 (5)	51.11%	1,412	2,743 (5)	51.47%
Luxembourg	Real property tax	15.62	33.0 (1)	47.33%	15.62	38.0 (1)	41.11%
	Real property transfer tax	72.97	164.0 (1)	44.49%	89.90	319.0 (1)	28.18%
	Inheritance & gift tax	17.62	71.80 (2)	24.54%	22.96	85.90 (2)	26.73%
Poland	Real property tax	1,578	4,428 (2)	35.64%	1,583	4,916 (2)	32.2%
	Real property transfer tax	232	115 (2)	201.74%	238	101 (2)	235.64%
	Inheritance & gift tax	167	1,093 (1)	15.3%	178	1,183 (1)	15.05%

Continued

Table 9. Continued

Country	Wealth tax	Income reference year			2017		
		Simulated revenue	External figure	Ratio	Simulated revenue	External figure	Ratio
Portugal	Real property tax	1,452	1,140 (1)	127.37%	1,443	1,630 (1)	88.53%
	Real property transfer tax	69.44	417.0 (1)	16.65%	68.98	841.0 (1)	8.20%
	Inheritance & gift tax (stamp duty)	100.90	1,407 (2)	7.17%	320.40	1,430 (2)	22.41%
	Mortgage registration duties	14.95	31.80 (1)	47.01%	14.95	32.28 (1)	46.31%
Slovakia	Real property tax	39.96	105.0 (1)	38.06%	36.31	115.0 (1)	31.57%
Slovenia	Real property tax	38.56	199.0 (1)	19.38%	41.86	211.0 (1)	19.84%
	Real property transfer tax	34.98	23.0 (1)	152.09%	34.96	32.0 (1)	109.25%
	Inheritance & gift tax	0.86	7.0 (1)	12.29%	0.94	8.0 (1)	11.75%
Spain	Real property tax	10,780	9,685 (1)	111.31%	10,780	13,045 (1)	82.64%
	Real property transfer tax	2,979	8,228 (1)	36.21%	4,826	8,585 (1)	56.21%
	Inheritance tax	3,237	2,425 (1)	133.48%	3,732	2,709 (1)	137.76%
	Net wealth tax	n/a	n/a	n/a	1,490	1,348 (1)	110.53%

Source: Own calculations based on EUROMOD and micro-data from EM-HFCS. (1) Tax Revenue Database (OECD (2017)); (2) Taxes in Europe Database (European Commission (2018)); (3) Received taxes and actual social insurance contributions by type (National Bank of Belgium (2017)); (4) Recent figures concerning the federally collected tax revenues (Federal Public Service Finance, 2017); (5) Italian Ministry of Economy and Finance, various sources. In case of Hungary amounts in national currency have been converted to euros based on the average exchange rate in 2017 reported by the European Central Bank, namely €1=HUF 309.19. For Poland the exchange rate applied is equal to €1=4.2259 PLN.

insurance contributions (SIC). The absolute redistributive effect is given by the difference between the Gini coefficient of the income distribution before and after income taxes and social insurance contributions are taken into account. The relative redistributive effect than expresses this absolute redistributive effect as a percentage of the Gini coefficient before income taxes and social insurance contributions are taken into account. A positive redistributive effect means inequality is reduced through taxes and SIC, while a negative sign indicates an increase in inequality. We find that income taxes and social insurance contributions reduce inequality by between 1.5% in Poland and 21.6% in Austria. The last two columns in ***Table 10*** show the two building blocks of the redistributive effect of taxes and SIC, namely their size (average tax rate) and their progressivity (Kakwani index). The average tax rates vary between 10% in Spain and 35% in Belgium. The Kakwani index shows that the total of income taxes and social insurance contributions is progressive, most strongly so in Ireland and less so in Poland and Hungary.

5.2. New research questions

In second instance, the EUROMOD-HFCS tool also provides the possibility to study new research questions. First, due to broader policy scope we cannot only study the redistributive effect of the 'traditional' tax-benefit instruments, but also see how redistributive wealth taxation currently is. It is possible to evaluate the redistributive effects of wealth taxation against the income distribution (see ***Table 10***), against the wealth distribution or from a joint income-wealth perspective (for the latter two see ***Kuypers et al., 2020***). Irrespective of the framework chosen, we find that in their current form wealth-related taxes are hardly redistributive. While ***Table 10*** shows that wealth taxes are often regressive when assessed against the distribution of income (i.e. the Kakwani index is negative), they are more progressive when assessed against the (joint) distribution of wealth (and income). However, even when the latter perspectives are taken wealth-related taxes do not achieve any significant redistribution as a consequence of their very small size (***Kuypers et al., 2020***). The analysis of the wealth taxes can be combined with the standard redistributive analyses as described above. The whole tax-benefit system can then be evaluated against the joint distribution of income and wealth as is done in ***Kuypers et al. (2019)***; ***Kuypers et al. (2021)***. This exercise shows that European welfare states are not as redistributive as they are generally believed to be as most efforts go towards reducing income inequalities, while wealth inequalities remain largely unaddressed. Besides studying current wealth tax

Table 10. Redistributive effect of income and wealth taxes

Country	Type of taxes	Absolute redistributive effect	Relative redistributive effect	Average tax rate	Kakwani progressivity index
Austria	Income taxes + SIC	0.055	21.6%	25.4%	0.172
	Wealth-related taxes	0.000	0.0%	0.6%	0.049
Belgium	Income taxes + SIC	0.067	21.1%	35.0%	0.138
	Wealth-related taxes	-0.015	-4.7%	2.8%	-0.095
Cyprus	Income taxes + SIC	0.030	8.5%	11.2%	0.247
	Wealth-related taxes	-0.002	-0.6%	1.5%	-0.102
Estonia	Income taxes + SIC	0.024	5.6%	15.8%	0.133
	Wealth-related taxes	-0.011	-2.7%	3.5%	-0.227
Finland	Income taxes + SIC	0.051	18.0%	26.4%	0.150
	Wealth-related taxes	0.000	0.0%	0.5%	-0.040
France	Income taxes + SIC	0.042	15.2%	21.0%	0.171
	Wealth-related taxes	-0.002	-0.7%	3.0%	0.199
Germany	Income taxes + SIC	0.057	14.4%	29.3%	0.149
	Wealth-related taxes	0.000	0.0%	0.7%	0.121
Greece	Income taxes + SIC	0.015	4.2%	15.1%	0.104
	Wealth-related taxes	-0.001	-0.3%	0.4%	-0.188
Hungary	Income taxes + SIC	0.028	7.8%	28.5%	0.089
	Wealth-related taxes	-0.001	-0.3%	0.1%	-0.051
Ireland	Income taxes + SIC	0.081	19.7%	23.1%	0.279
	Wealth-related taxes	-0.003	-0.7%	0.5%	-0.065
Italy	Income taxes + SIC	0.048	14.1%	24.8%	0.148
	Wealth-related taxes	0.002	0.6%	2.5%	0.090
Luxembourg	Income taxes + SIC	0.067	18.5%	25.6%	0.200
	Wealth-related taxes	-0.001	-0.3%	0.5%	0.117
Poland	Income taxes + SIC	0.005	1.5%	26.3%	0.025
	Wealth-related taxes	-0.004	-1.2%	0.9%	-0.074
Portugal	Income taxes + SIC	0.049	12.9%	17.0%	0.251
	Wealth-related taxes	-0.002	-0.5%	1.8%	-0.081
Slovakia	Income taxes + SIC	0.037	12.8%	20.4%	0.180
	Wealth-related taxes	0.000	0.0%	0.1%	-0.245
Slovenia	Income taxes + SIC	0.060	18.5%	22.3%	0.225
	Wealth-related taxes	-0.001	-0.3%	0.5%	-0.033
Spain	Income taxes + SIC	0.014	3.5%	10.0%	0.134
	Wealth-related taxes	-0.007	-1.8%	2.9%	-0.045

Note: SIC= social insurance contributions.
Source: Boone et al. (2019).

systems, it is also possible to simulate the budgetary and (re)distributive effects of recent wealth tax proposals, or explore the prospects of radical new ideas (for instance taxing a wealth annuity in the

personal income tax, see ***Kuypers et al., 2020***). Also, it allows to study these reforms in accordance with other tax-benefit instruments.

Another new research question is related to how wealth is taken into account in determining the eligibility conditions for means-tested benefits. Many European countries have such asset tests in place. Analysing the asset test in minimum income protection schemes in EU member states ***Marchal et al. (2021)*** distinguish between two main types of asset tests. The first and most prevalent type applies a disqualification threshold, i.e. when assets are above a certain threshold applicants become immediately ineligible. The second type takes assets into account in a given percentage or at a fictional rate of return which is added to the income in the means-test, such that applicants are eligible to lower minimum income benefits as more assets are available (and eventually at high asset levels also become fully ineligible). Yet, this rate of return is usually higher than actual returns received so in practice assets often also need to be realised. The combination of HFCS with EUROMOD allows to simulate benefit eligibility with and without taking into account the asset test. Hence, it shows the effect of asset testing on eligibility rates, poverty rates and budgets and whether these are different for the two types of asset tests (***Marchal et al., 2021***).

A final example relates to public encouragement of wealth accumulation. Many countries across Europe have put in place tax expenditures for instance for mortgage interests, private pension savings and financial income. Using the HFCS data and EUROMOD we can analyse who benefits from these tax expenditures and its cost in terms of forgone tax revenues. Results indicate that these tax expenditures are regressive instruments. Poor households hardly benefit because they do not have the means to invest in the types of assets that are encouraged, because they do not pay sufficient taxes to be able to benefit from a deduction/credit and/or because they are discouraged to save because of asset testing. The EUROMOD-HFCS tool then also allows to simulate new proposed policies, for instance, subsidising wealth accumulation among the poor (see ***Kuypers, 2018***).

6. Conclusion

In this paper we explain how microsimulation analysis of wealth-related taxes and policies is enhanced by using the HFCS as input data for EUROMOD. This paper builds further on the work of ***Kuypers et al. (2016)*** by extending the coverage to 17 countries and introducing the simulation of new wealth-related policies. We explain the processes used to build the input data and to code the wealth-related policies in EUROMOD. Using the HFCS as the underlying database for EUROMOD is interesting as it contains much more detailed information on assets and liabilities than EU-SILC. However, some data issues needed to be addressed in building the input data, such as the approximation of the cadastral values for the real property taxation, the disaggregation of certain variables based on imputation and the adaptations to net wealth from the value at the moment of observation to the value at the moment of taxation. In general, the majority of the wealth-related taxes can be simulated based on the HFCS, while this was often not possible based on EU-SILC. New uprating indices have been constructed based on national account information to be able to use the input data for simulations of more recent policy years. Although HFCS is more equipped to simulate wealth-related taxes and policies, possibly together with income-based taxes and transfers, EU-SILC is still considered to be most suitable dataset for research questions specifically focused at social transfers or at the situation of specific vulnerable groups. Given the strengths and weaknesses of each dataset and the sometimes relatively large differences between them (***Table 7***), the two datasets must be regarded as complements, rather than substitutes.

Our results have been extensively validated both at the micro and macro level. Micro-level comparisons between EM-HFCS and EM-SILC show that comparability varies widely across countries. Results are close to each other for Finland, Portugal and Slovakia, while they diverge strongly for Austria, Estonia, France and Slovenia. The differences mostly reflect higher amounts and larger inequalities in EM-HFCS than in EM-SILC, which might be related to the HFCS oversampling. The macro-level validation of tax revenues indicated that the recurrent real property tax can be relatively accurately simulated, while other taxes are often more difficult to simulate properly because of few number of cases in the underlying input data. Differences in the macro-validation can, however, also be partly attributed to the fact that external statistics do not always exist at the same level as we simulate them.

We also briefly discussed some research questions which may be addressed by using this enhanced model. Combining EUROMOD with the HFCS data has two major advantages. First, EUROMOD can

be used to transform the original gross HFCS incomes into disposable incomes, making the HFCS also a suitable dataset for standard (re)distributive analyses. Second, the increased scope of EUROMOD with wealth-related policies allows for new research questions to be addressed, such as a better understanding of the joint distribution of income and wealth and the redistributive impact of wealth taxation.

Nevertheless, there remain several opportunities for interesting extensions to further improve our understanding of inequality, poverty and redistribution taking into account the distribution of both income and wealth. One would be to broaden the definition of wealth. At the moment HFCS and thus our simulations take into account the distribution of private wealth, that is the wealth owned by private households and which can be used and traded on markets as they wish. A more comprehensive view would, however, also take into account entitlements to public pensions and other social security benefits, known as 'augmented wealth'. Including this information would make it more straightforward to compare countries with differing pension and welfare systems. A second potentially interesting future extension would be to consider behavioural responses to wealth-related taxation and policies. In previous research EUROMOD has been linked to labour supply models to study the effect of policy changes on individuals' labour supply. A similar effort could be considered for effects on decisions in relation to investment and asset portfolio allocation.

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Conflict of Interest

No competing interests reported.

Data and Code Availability

The analysis builds on data from the second wave of the Eurosystem Household Finance and Consumption Survey (HFCS) available for scientific research upon registration through the European Central Bank and the EU-wide micro-simulation model EUROMOD (version H1.0). Details of policy codes are available from the authors upon request.

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