El uso de EUROMOD para la docencia: algunas ideas para el debate

Fidel Picos

JRC - European Commission

XXIX Encuentro de Economía Pública

Madrid, 5-6 de mayo de 2022

Outline

- The basics of EUROMOD
- EUROMOD at a glance
- Options for teaching
- Some examples
- Documentation and links

The basics of EUROMOD

Microsimulation models

Modelling techniques that:

- Operate at the level of **individual units**
  - in EUROMOD: persons in households
- Apply **rules** to simulate (changes in) state or behaviour of these units
  - in EUROMOD: taxes and benefits
- Estimate **distributional outcomes** after applying these rules at the micro level
  - in EUROMOD: distribution of disposable income

Microsimulation models

Types:

- **Dynamic vs. static** → individual characteristics can be adjusted (dynamic) or not (static) over time
  - EUROMOD is static, although it can incorporate dynamic features through add-ons
- **Behavioural vs. non-behavioural** → models may allow individuals to react (behavioural) or not (non-behavioural)
  - EUROMOD is non-behavioural, although it can be linked to behavioural models

Example: static non-behavioural model

Tax-benefit rules: 20% tax, 100 EUR benefit if market income ≤ 1,000

original data		simulations		
id	market income	tax	benefit	disposable income
1	0	0	100	100
2	1,000	200	100	900
3	1,500	300	0	1,200
4	2,000	400	0	1,600
5	5,000	1,000	0	4,000

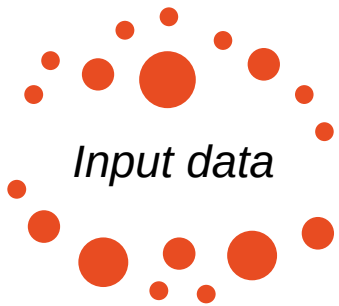
Budgetary impact: revenue = 1,900; expenditure = 200

Distributional impact: Gini = 0.3555; S80/S20 = 40; AROP rate = 20%

Main features of EUROMOD

- Static non-behavioural tax-benefit microsimulation model
- Simulates direct taxes and benefits for the 27 EU member states, from 2005 to 2021
- (Default) input data based on microdata from EU Statistics on Income and Living Conditions (EU-SILC)
- Specifically designed for microsimulation purposes
- Open source, free, flexible, transparent and user-friendly
- Extensive documentation and community of users
- More than 30 years of history, but fully internalised by the EC in 2021

Workflow



+

Tax-benefit policy rules (*Model*)

Calculation of benefit entitlements & tax liabilities (*Software*)

Output data

Calculation of budgetary and distributional indicators (*Software*)

Analysis

European Commission

Input data

- Default datasets: based on survey microdata from European Union Statistics on Income and Living Conditions (**EU-SILC**) [Eurostat authorisation]
- Hypothetical data mimicking EU-SILC-based data:
  - EUROMOD's **Hypothetical Household Tool (HHoT)** allows to generate input files with model households
  - Synthetic **training dataset** included with the model
- Any other data source can be adapted to be used in EUROMOD (e.g. **administrative microdata**), following a specific structure and modelling conventions

Model

Market Income

+ Salaries*
+ Self-employment income*
+ Investment income*
+ Property income*
+ etc.

Disposable income

Taxes and SIC

- Personal Income Tax**
- Employee Social Insurance Contributions**
- etc.

Social transfers

+ Pensions*
+ Unemployment benefits*/**
+ Family benefits**
+ Minimum Income Schemes**
+ etc.

* Usually taken from the input data
** Usually simulated

Software

- **Downloadable** from the EUROMOD website
- Source code distributed as **open source** under EUPL-1.2 License , installer is distributed under an End-user licence agreement
- Programmed mostly in C#
- Used by many other microsimulation models around the world: UKMOD, SOUTHMOD, LATINMOD, etc.
- **Continuous updates** with improvements and new features

EUROMOD at a glance

Policy spine

ES Personal Income Tax

	Policy	Grp/No	ES_2021
37.37	fx SchedCalc		on
37.37.1	Who_Must_...		all
37.37.2	base		tintbit_s
37.37.3	band_uplim	1	$tin_ts_lt1
37.37.4	band_uplim	2	$tin_ts_lt2
37.37.5	band_uplim	3	$tin_ts_lt3
37.37.6	band_uplim	4	$tin_ts_lt4
37.37.7	band_uplim	5	$tin_ts_lt5
37.37.8	band_uplim	6	$tin_ts_lt6
37.37.9	band_rate	1	$tin_ts_rt1
37.37.10	band_rate	2	$tin_ts_rt2
37.37.11	band_rate	3	$tin_ts_rt3
37.37.12	band_rate	4	$tin_ts_rt4
37.37.13	band_rate	5	$tin_ts_rt5
37.37.14	band_rate	6	$tin_ts_rt6
37.37.15	band_rate	7	$tin_ts_rt7
37.37.16	output_var		i_tiningt
37.37.17	TAX_UNIT		tu_individual_es

ES guaranteed mínimum income (IMV)

47	bsa00_es		on
47.1	fx DefTu		on
47.2	fx DefVar		on
47.3	fx DefIl		on
47.4	fx DefConst		on
47.5	fx Elig		on
47.5.1	elig_cond		(dag >= 23 & dag < 65) | (dag >= 18 & IsParent#1)
47.5.2	#_Level	1	tu_bsa00
47.5.3	TAX_UNIT		tu_individual_es
47.6	fx BenCalc		on
47.6.1	Who_Must_...		one
47.6.2	Comp_Cond	1	(nPersInUnit >= 1)
47.6.3	Comp_perTU	1	$bsa00_basic
47.6.4	Comp_Cond	2	(nPersInUnit>1)
47.6.5	Comp_perTU	2	$bsa00_basic * $bsa00_extra * (nPersInUnit - 1)
47.6.6	Comp_Cond	3	(nPersInUnit>1) & (nAdultsInTu#1 = 1)
47.6.7	#_AgeMin	1	18
47.6.8	Comp_perTU	3	$bsa00_basic * $bsa00_lone
47.6.9	UpLim		$bsa00_basic*$bsa00_max1
47.6.10	Output_Var		i_gmi_00
47.6.11	TAX_UNIT		tu_bsa00

The Statistics Presenter

Mean household income by decile groups and income components

	Disposable Income	Original Income	...of which earnings	Benefits incl. Pub. Pen.	Taxes	Social Ins. Contrib.	Simulated Benefits	Simulated Taxes
Decile 1	1,284.09	441.90	441.90	841.97	-2.28	2.05	95.22 %	100.00 %
Decile 2	1,901.39	866.31	866.31	1,122.96	61.37	26.51	53.70 %	100.00 %
Decile 3	2,579.39	1,465.23	1,465.23	1,256.64	116.76	25.71	59.89 %	100.00 %
Decile 4	2,345.63	1,500.31	1,500.31	1,012.54	136.62	30.60	40.75 %	100.00 %
Decile 5	2,288.60	1,424.31	1,424.31	1,115.21	200.14	50.78	10.71 %	100.00 %
Decile 6	2,828.97	2,227.95	2,227.95	960.39	318.26	41.11	16.06 %	100.00 %
Decile 7	3,330.67	2,671.00	2,671.00	1,110.99	404.47	46.85	17.31 %	100.00 %
Decile 8	3,432.45	2,230.18	2,230.18	1,737.18	450.34	84.57	4.55 %	100.00 %
Decile 9	4,453.23	4,499.85	4,499.85	852.35	863.03	35.94	17.32 %	100.00 %
Decile 10	5,642.11	6,897.73	6,897.73	626.61	1,857.37	24.85	22.24 %	100.00 %
All	**2,900.59**	**2,298.33**	**2,298.33**	**1,054.56**	**416.35**	**35.95**	**33.16 %**	**100.00 %**
Poor	1,186.23	385.49	385.49	798.48	-2.26	0.00	100.00 %	100.00 %

The In-depth Analysis plugin

1.1. Aggregate earnings, government revenue and expenditure (annual)

	Total Partial take-up (Baseline)	Total Full take-up
+ employment income (rendimientos del trabajo por cuenta ajena) (yem)	402,281,101,423	402,281,101,423
+ self-employment income (rendimientos del trabajo por cuenta propia) (yse)	50,294,811,898	50,294,811,898
+ covid-19 compensation paid by the firm [Note: equal to 0 in baseline] (yemmc_s)	0	0
Total earnings (ils_earns)	**452,575,912,654**	**452,575,912,654**
Other original income (ils_origy - ils_earns)	**21,911,390,627**	**21,911,390,627**
+ income tax (IRPF) (tin_s)	81,987,828,353	81,987,828,353
+ Wealth tax (impuesto sobre el patrimonio) (twl)	408,633,709	408,633,709
Total taxes (ils_tax)	**82,396,461,517**	**82,396,461,517**
+ self-employed pension social contribution (cotizacion social del trabajador autonomo - pension) (tscsepi_s)	8,296,951,003	8,296,951,003
+ self-employed health social contribution (cotizacion social del trabajador autonomo - enfermedad) (tscsehl_s)	383,783,381	383,783,381
+ self-employed others: e.g. occupational trainings (formación y cese de actividad) - Compulsory since 2019 (tscseot_s)	270,431,410	270,431,410
+ unemployed social contribution paid by unemployed (cotizacion social del desempleado - pagada por el desempleado) (tscunee_s)	790,454,501	790,454,501
+ [Covid-19] contribution paid by the employee during wage compensation: pension (tscbeeepi_s)	0	0
+ [Covid-19] contribution paid by the employee during wage compensation: unemployment (tscbeeeui_s)	0	0
+ [Covid-19] contribution paid by the employee during wage compensation: other (tscbeeeot_s)	0	0
+ employee pension social contribution (cotizacion social del empleado - pensiones) (tsceepi_s)	18,589,303,601	18,589,303,601
+ employee unemployment social contribution (cotizacion social del empleado - desempleo) (tsceeui_s)	6,130,800,676	6,130,800,676
+ other employee social contribution (cotizacion social del empleado - otras) (tsceeot_s)	389,899,230	389,899,230
Total employees, self-employed and other SIC (ils_sicdy)	**34,851,355,161**	**34,851,355,161**
+ employer pension social contribution (tscerpi_s)	93,048,225,546	93,048,225,546
+ employer unemployment social contribution (tscerui_s)	21,753,417,771	21,753,417,771
+ other employer social contribution (tscerot_s)	3,119,291,191	3,119,291,191
Total employers SIC (ils_sicer)	**117,920,934,376**	**117,920,934,376**
+ unemployed social contribution paid by social security (cotizacion social del desempleado - pagada por el INEM) (tscuner_s)	3,969,059,350	3,969,059,350

The In-depth Analysis plugin

2.1. Total number of GMI beneficiaries

bsa00_s

	Total Partial take-up (Baseline)	Total Full take-up	Share Partial take-up (Baseline)	Share Full take-up
Region Galicia	13,464	43,806	0.5 %	1.6 %
Region Asturias	7,194	58,035	0.7 %	5.8 %
Region Cantabria	3,743	11,199	0.7 %	2.0 %
Region País Vasco	16,980	45,099	0.8 %	2.1 %
Region Navarra	5,322	8,782	0.8 %	1.4 %
Region La Rioja	1,122	8,190	0.4 %	2.7 %
Region Aragón	8,836	32,064	0.7 %	2.5 %
Region Comunidad de Madrid	30,939	130,068	0.5 %	2.0 %
Region Castilla y León	11,138	35,186	0.5 %	1.5 %
Region Castilla-La Mancha	11,406	51,630	0.6 %	2.6 %
Region Extremadura	14,387	35,370	1.4 %	3.4 %
Region Cataluña	33,374	143,678	0.4 %	1.9 %
Region Comunidad Valenciana	26,653	133,309	0.5 %	2.7 %
Region Islas Baleares	1,135	17,082	0.1 %	1.4 %
Region Andalucía	109,790	315,637	1.3 %	3.8 %
Region Región de Murcia	14,810	32,422	1.0 %	2.2 %
Region Ceuta	1,893	3,497	2.5 %	4.7 %
Region Melilla	1,561	3,796	1.7 %	4.1 %
Region Canarias	11,720	57,419	0.5 %	2.6 %
All	**325,469**	**1,166,270**	**0.7 %**	**2.5 %**

3.5. At-risk-of-poverty rates

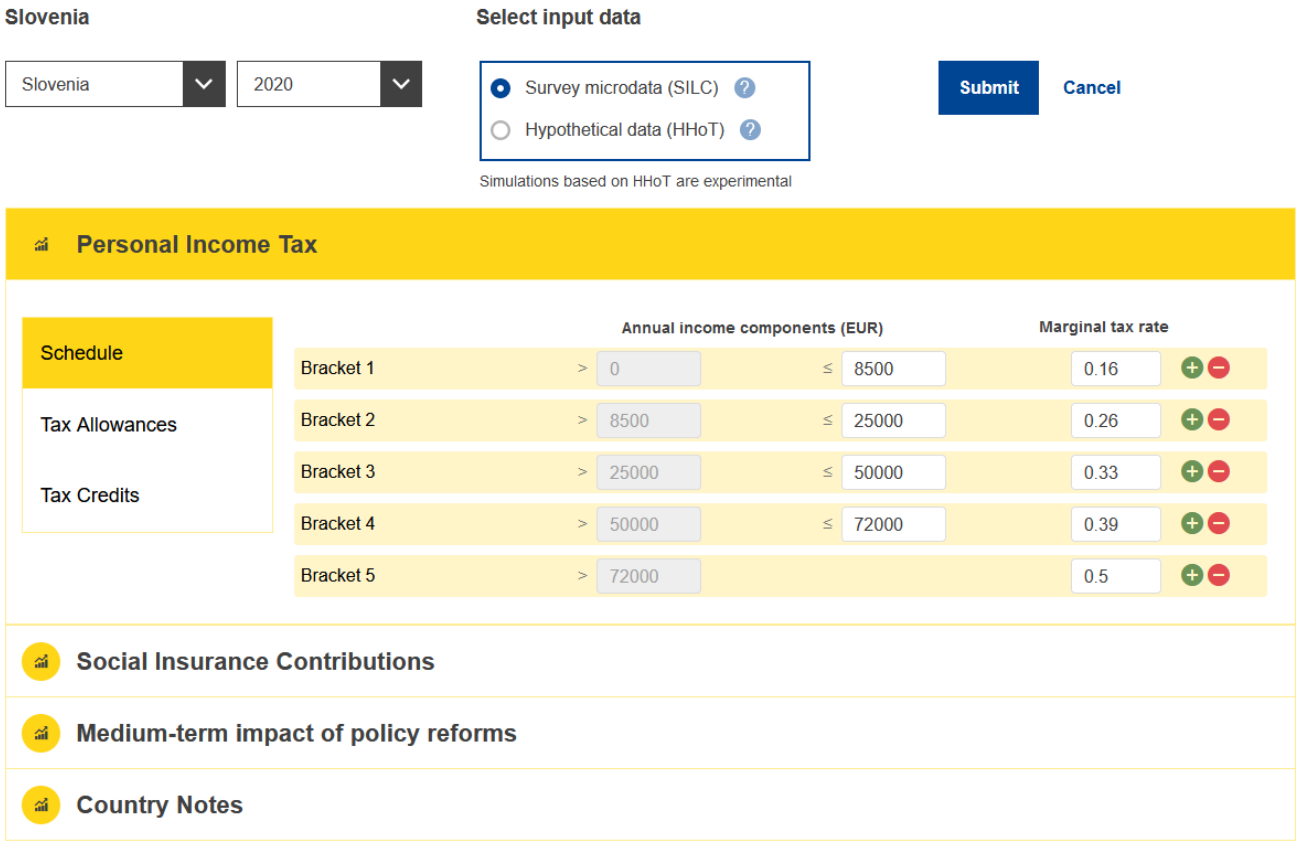
by values of drgn2

	Partial take-up (Baseline)	Full take-up	Full take-up Diff. w.r.t. Baseline
Poverty line 40% of median baseline eq.disp.income	6,053.98	6,053.98	0.00
Galicia	8.0 %	7.6 %	-0.4pp
Asturias	12.5 %	11.7 %	-0.8pp
Cantabria	6.0 %	5.9 %	-0.2pp
País Vasco	2.4 %	2.4 %	0.0pp
Navarra	1.0 %	1.0 %	0.0pp
La Rioja	6.3 %	6.2 %	-0.1pp
Aragón	6.7 %	6.4 %	-0.3pp
Comunidad de Madrid	6.5 %	6.0 %	-0.5pp
Castilla y León	5.1 %	4.9 %	-0.2pp
Castilla-La Mancha	11.8 %	11.5 %	-0.2pp
Extremadura	13.0 %	12.9 %	-0.1pp
Cataluña	6.7 %	6.5 %	-0.2pp
Comunidad Valenciana	8.7 %	8.4 %	-0.3pp
Islas Baleares	4.9 %	4.9 %	0.0pp
Andalucía	14.3 %	14.0 %	-0.3pp
Región de Murcia	8.8 %	8.4 %	-0.4pp
Ceuta	17.9 %	17.6 %	-0.3pp
Melilla	19.2 %	18.9 %	-0.4pp
Canarias	12.7 %	12.5 %	-0.3pp
All	8.8 %	8.5 %	-0.3pp

The Hypothetical Household Tool

Currently viewing: Example Ho	Father	Mother	Kid	kid2
DEMOGRAPHIC				
gender	Male	Female	Male	Female
age	40	30	14	7
father			Father	Father
mother			Mother	Mother
partner	Mother	Father		
education - current status	Not in education	Not in education	Lower Secondary	Primary
education - highest status	Post Secondary	Post Secondary	Lower Secondary	Primary
marital status	Married	Married	Single	Single
LABOUR MARKET				
economic status	Employee	Inactive	Pupil/Student	Pupil/Student
hours worked per week	40	0	0	0
in work : work history (length	200	0	0	0
INCOME				
Main employment income	1000	0	0	0
Main self-employment income	0	0	0	0
employment : previous earning	0	0	0	0
BENEFIT/PENSION				
Main contributory old-age pen	0	0	0	0
ASSETS				
main residence : tenure	Rented	Rented	Rented	Rented
EXPENDITURE				
housing cost : rent	250	0	0	0
housing cost : other	0	0	0	0

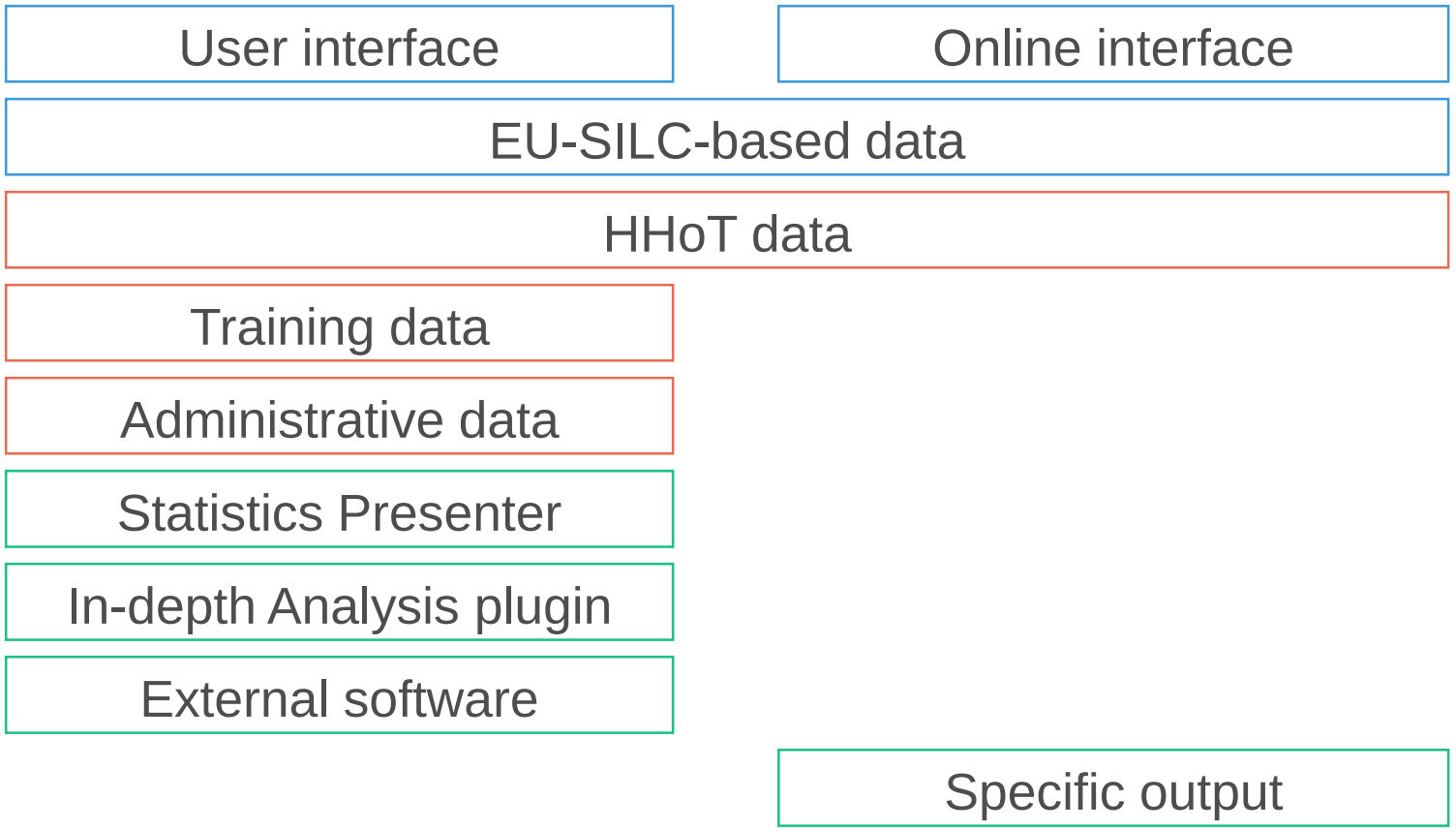
Online interface



European Commission

Options for teaching

Overview



Interface

- **User interface**
  - Full control of all the tax and benefit policies
  - Software freely downloadable, but installation needed
  - Some basic training needed (e.g. a couple of sessions at the beginning of the semester)
- **Online interface**
  - Restricted to direct taxes and social insurance contributions (benefits to be included soon)
  - Only parametrical changes possible, not structural ones
  - Fully online, not need to install anything
  - Access need to be requested to the JRC

Data

- **EU-SILC based data** → used by both interfaces, but individual access based on a research project needed in the user interface (not feasible for students)
- **Data created by the HHoT** → used by both interfaces, ideal for understanding the tax-benefit system
- **Synthetic training data** → only available in user interface, suited for (rough) distributional analysis
- **Data based on administrative registers** (e.g. muestras de IRPF IEF-AEAT) → depends on the legal restrictions to use them, but initial investment to adapt it to be used with the user interface

Output

- **User interface**
  - Statistics Presenter → basic fiscal, inequality and poverty indicators
  - In-depth Analysis plugin → larger set of fully customizable indicators
  - External software → any statistical software can be used to analyse the output (tab-delimited format)
- **Online interface**
  - EU-SILC data → similar to Statistics Presenter, but with confidence intervals (computed with Stata)
  - HHoT data → basic OECD-type indicators for six family types

Some examples

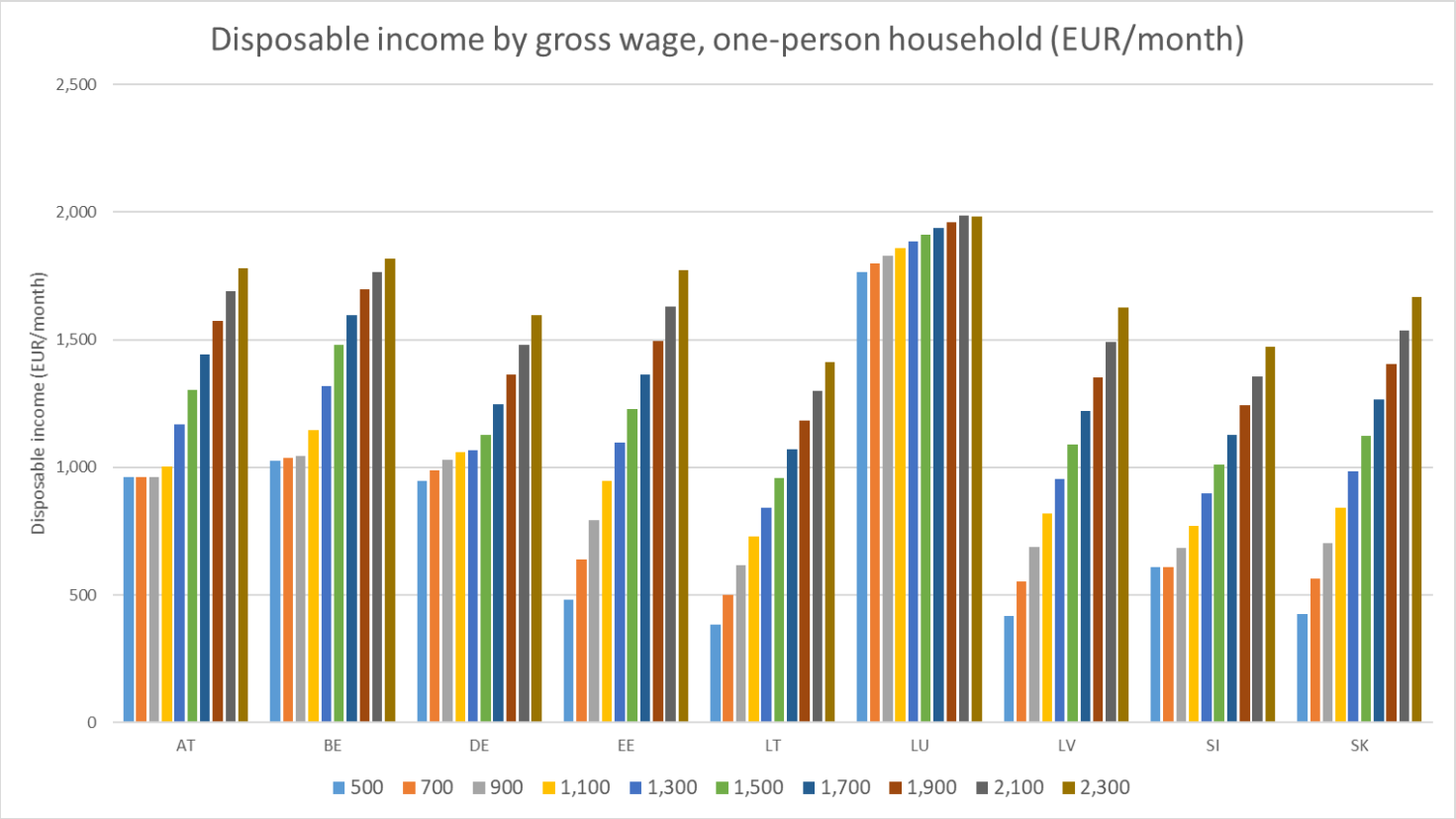
Target subjects

- Economía española/UE/mundial
- Economía pública
- Hacienda pública
- Economía del sector público
- Presupuesto y gasto público
- Economía de la imposición
- Economía del gasto público
- Fiscalidad
- Hacienda Autonómica y Local
- Desigualdad y bienestar social
- Instrumentos de gestión pública y evaluación
- Trabajo fin de grado/master

Baseline analysis

- **Design of tax-benefit policies**: progressive vs. flat taxes, universal vs. targeted benefits, etc.
  - User interface (code) and EUROMOD country reports
- **Baseline statistics**:
  - Budgetary (tax mix, revenue and expenditure as a share of GDP) → online interface with EU-SILC-based data
  - Distributional (inequality, poverty, progressivity, redistribution) → online interface with EU-SILC-based data
  - Other indicators (marginal tax rates, tax wedge) → both interfaces with HHoT

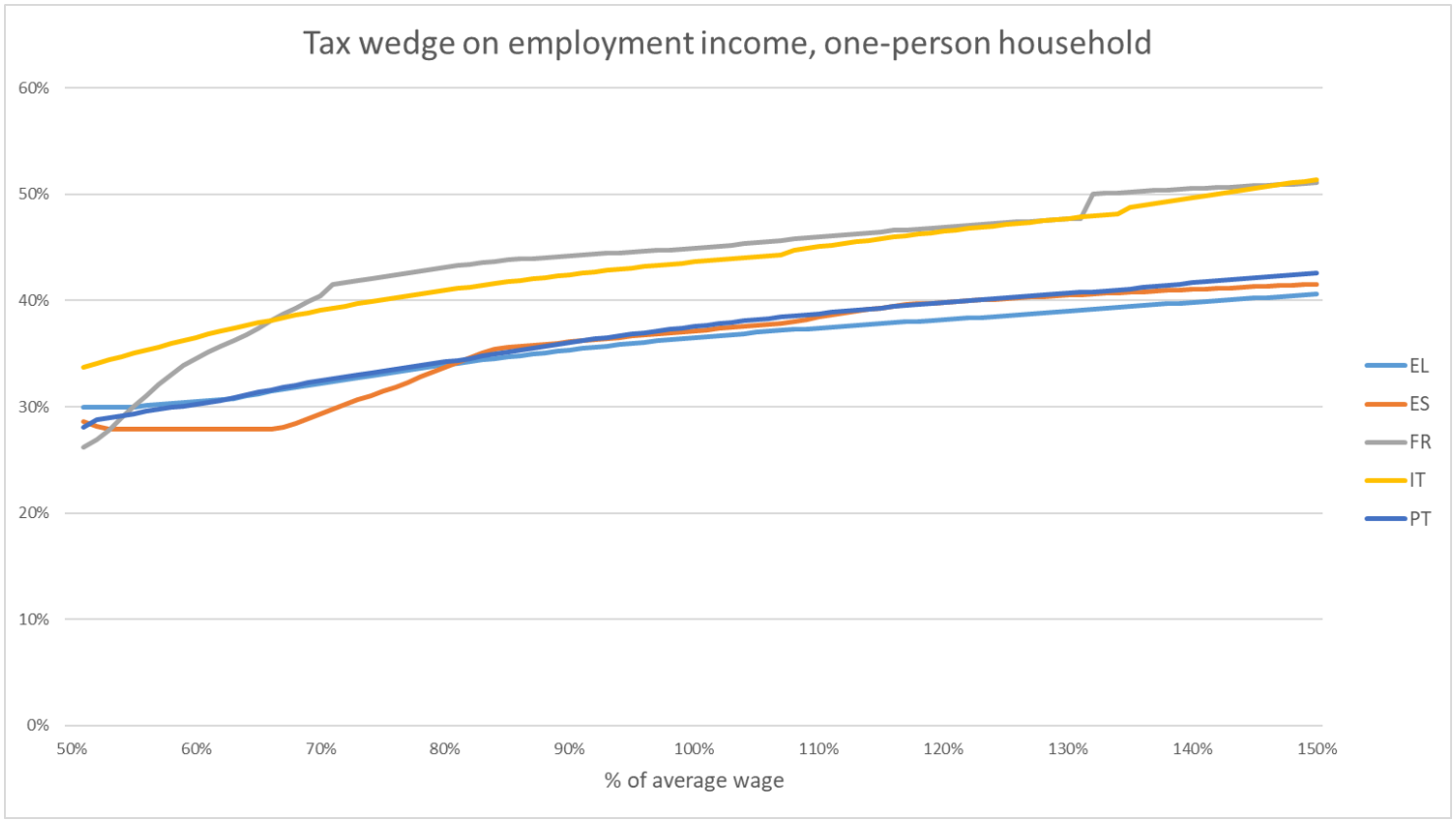
Baseline analysis



User interface with HHoT
In-depth Analysis plugin + Excel

European Commission

Baseline analysis



User interface with HHoT
In-depth Analysis plugin + Excel

European Commission

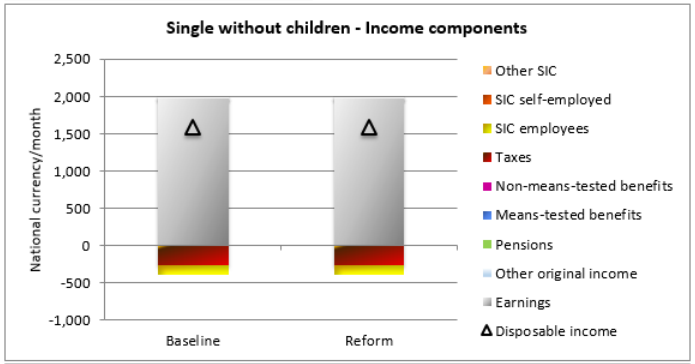
Impact of tax-benefit reforms

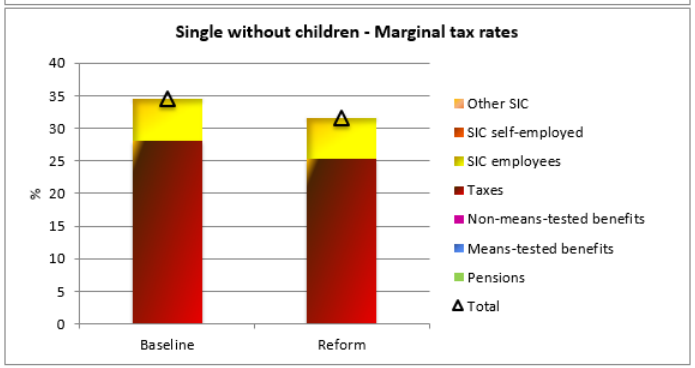
- **Impact of parametrical changes of personal income tax and social insurance contributions** (rates, allowances, tax credits)
  - Same options as for baseline statistics
- **Impact of structural changes**: assessment units, eligibility conditions, new taxes and benefits, etc.
  - Impact on specific households → user interface with HHoT
  - (Proxies of) impact on inequality, poverty, progressivity and redistribution → user interface with training data

Impact of tax-benefit reforms

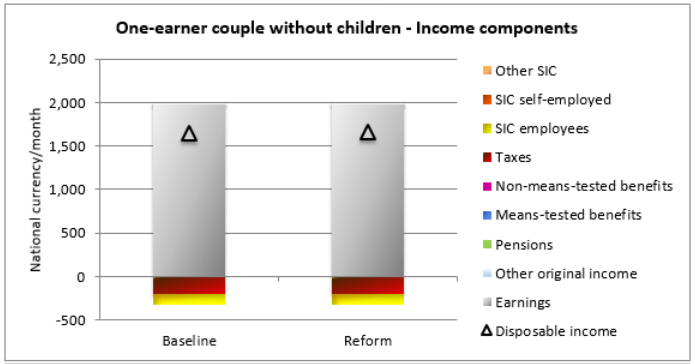
Impact of adjusting the ES PIT schedule for inflation (10%)

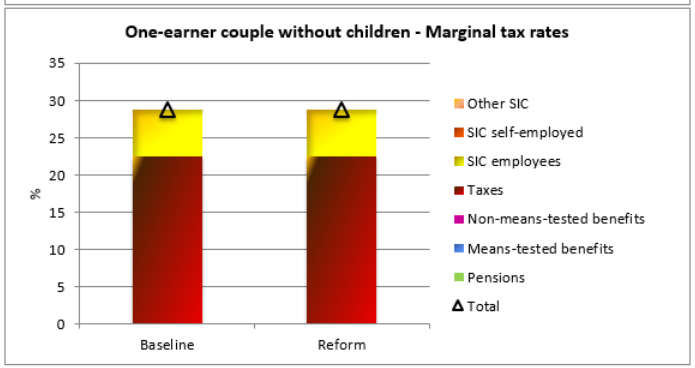
Single without children





One-earner couple without children





Online interface with HHoT data
Automatic Excel output

European Commission

Impact of tax-benefit reforms

Impact of adjusting the ES PIT schedule for inflation (10%)

Table 1.1. Aggregate revenue and expenditure (EUR)

Concept	EUROMOD variable	Baseline	Reform	Difference (EUR)			
		Total	Total	Total	Standard error	95% confidence interval	
						Lower bound	Upper bound
Income tax (IRPF)	tin_s	85,990,403,313	84,551,572,906	-1,438,830,407	38,309,645	-1,513,956,799	-1,363,704,015
Wealth tax (Impuesto sobre el Patrimonio)	tpr	436,766,463	436,766,463	0	-	-	-
Total taxes	**ils_tax**	**86,427,169,776**	**84,988,339,368**	**-1,438,830,407**	**38,309,645**	**-1,513,956,799**	**-1,363,704,015**
SIC employees	ils_sicee	25,385,378,313	25,385,378,313	0	-	-	-
SIC employers	ils_sicer	119,135,194,491	119,135,194,491	0	-	-	-
SIC self-employed	ils_sicse	9,013,590,677	9,013,590,677	0	-	-	-
SIC others	ils_sicot	763,466,074	763,466,074	0	-	-	-
Total SIC	**[sum]**	**154,297,629,556**	**154,297,629,556**	**0**	-	-	-
Contributory disability benefit (prestacion por	pdi00	12,897,694,656	12,897,694,656	0	-	-	-
Contributory old-age pension (pension por vejez	poa00	98,817,872,186	98,817,872,186	0	-	-	-
Other old-age benefits (otras prestaciones por vejez)	poaot	0	0	0	-	-	-
Contributory widow pension (pension por viudedad	psuwd00	19,995,766,329	19,995,766,329	0	-	-	-
Other survivor pension (otra pension de	psuot	2,207,021,166	2,207,021,166	0	-	-	-
Total pensions	**ils_pen**	**133,918,354,338**	**133,918,354,338**	**0**	-	-	-
Child benefit (prestacion por menores a cargo)	bch00_s	340,773,394	340,773,394	0	-	-	-
National means tested child benefit for birth or	bchbamtna_s	31,354,896	31,354,896	0	-	-	-
Regional means-tested child benefit (prestación	bchmtrg_s	16,606,443	16,606,443	0	-	-	-
Regional means-tested child benefit for	bchbamtrg_s	25,642,347	25,642,347	0	-	-	-
Regional means-tested large family benefit	bchlgmtrg_s	26,624,946	26,624,946	0	-	-	-
Unemployment assistance (prestacion por desempleo	bunne_s	4,719,974,796	4,719,974,796	0			

Online interface with EU-SILC-based data
Automatic Excel output

Impact of tax-benefit reforms

Impact of adjusting the ES PIT schedule for inflation (10%)

Table 3.1. Inequality and redistributive effect of the tax-benefit system

		Baseline	Reform	Difference			
						95% confidence interval	
		Value	Value	Value	Standard error	Lower bound	Upper bound
Gini	A = original income	0.5136	0.5136	0.0000	-	-	-
	B = A - taxes and social insurance contributions (EQ_INC23)	0.5187	0.5187	0.0000	0.0000	-0.0001	0.0000
	C = B + pensions (EQ_INC22)	0.3651	0.3659	0.0008	0.0000	0.0007	0.0008
	D = C + other benefits (disposable income, EQ_INC20)	0.3151	0.3160	0.0008	0.0000	0.0008	0.0009
Redistribution index = Gini A - Gini D		0.1985	0.1977	-0.0008	n/a	n/a	n/a
Social welfare index = mean eq. disp. Income * (1-D)		987	988	1	n/a	n/a	n/a
Income quantile share ratio = S80/S20		5.2324	5.2550	0.0226	n/a	n/a	n/a
Inter-decile ratio = D5/D1		2.3603	2.3649	0.0046	n/a	n/a	n/a

Online interface with EU-SILC-based data
Automatic Excel output

Impact of tax-benefit reforms

Impact of adjusting the ES PIT schedule for inflation (10%)

Summary Statistics - Baseline vs Reforms

Results for Spain: ES_2021 vs ES_2021_defl

Basic Inequality Indices

	Gini ES_2021	S80/S20 ES_2021	Gini ES_2021_defl	Diff. Gini ES_2021_defl/ ES_2021	S80/S20 ES_2021_defl	Diff. S80/S20 ES_2021_defl/ ES_2021
Original Income	0.4788	6.5333	0.4788	0.0000	6.5333	0.0000
Original Income after Taxes/SIC	0.4715	5.8285	0.4717	0.0002	5.8533	0.0248
Original Income incl. Public Pensions after Tax	0.3360	7.5567	0.3365	0.0005	7.5819	0.0252
Disposable Income	0.3133	5.5801	0.3139	0.0005	5.5997	0.0196

User interface with training data
Statistics presenter saved to Excel

Impact of tax-benefit reforms

Impact of a child benefit of 100EUR/month to all families

Fiscal Overview | Poverty | Inequality | Mean household income | Mean income (equ)

Basic Poverty Indices

	Poverty Risk for ES_2021 (base)	Poverty Risk for ES_2021_child	Difference to base
Population	25.24 %	22.22 %	-3.02pp
Children	24.90 %	17.90 %	-7.00pp
Working Age	31.17 %	28.80 %	-2.37pp
Working Age Economically Active	20.04 %	18.15 %	-1.89pp
Elderly	1.99 %	1.49 %	-0.50pp
Fixed Poverty Line	939.71		

User interface with training data
Statistics presenter on screen

Documentation and links

Documentation

- EUROMOD website: https://euromod-web.jrc.ec.europa.eu/
- Access to the model: https://euromod-web.jrc.ec.europa.eu/access-euromod
- Online interface: https://euromod-web.jrc.ec.europa.eu/euromod-jrc-interface
- Model documentation: https://euromod-web.jrc.ec.europa.eu/resources/model-documentation

Documentation

- Country Reports: https://euromod-web.jrc.ec.europa.eu/using-euromod/country-reports
- Training material (Creative Commons): https://euromod-web.jrc.ec.europa.eu/resources/training
- Projects and publications using EUROMOD: https://euromod-web.jrc.ec.europa.eu/research
- Newsletter: https://euromod-web.jrc.ec.europa.eu/news-and-events/newsletters

Thank you

European Commission