Microsimulaciones y políticas públicas: la experiencia EUROMOD

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Seminario Políticas Públicas basadas en Evidencia Empírica

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Contenido

1. Introducción

- Las micro-simulaciones se utilizan para evaluar el **impacto presupuestal** y **distributivo** de políticas de impuestos y transferencias
- Evaluación de políticas **vigentes, pasadas, futuras/hipotéticas** → insumo fundamental para el diseño y evaluación de políticas
- Utilización de **microdatos** permite evaluar impacto para distintos grupos de la población y tomar en cuenta interacciones complejas entre impuestos y transferencias para distintos tipos de hogares e individuos
- Modelos más utilizados: **estáticos no comportamentales**, conectados cada vez más a extensiones comportamentales/dinámicas

2. EUROMOD

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fx DefConst		on
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$SIC_EmReducMT2		2413.00#m
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$SIC_EmHealth		3.55
$SIC_EmDisability		1.15
$SIC_EmUnemployment		0.87
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fx ArithOp		on
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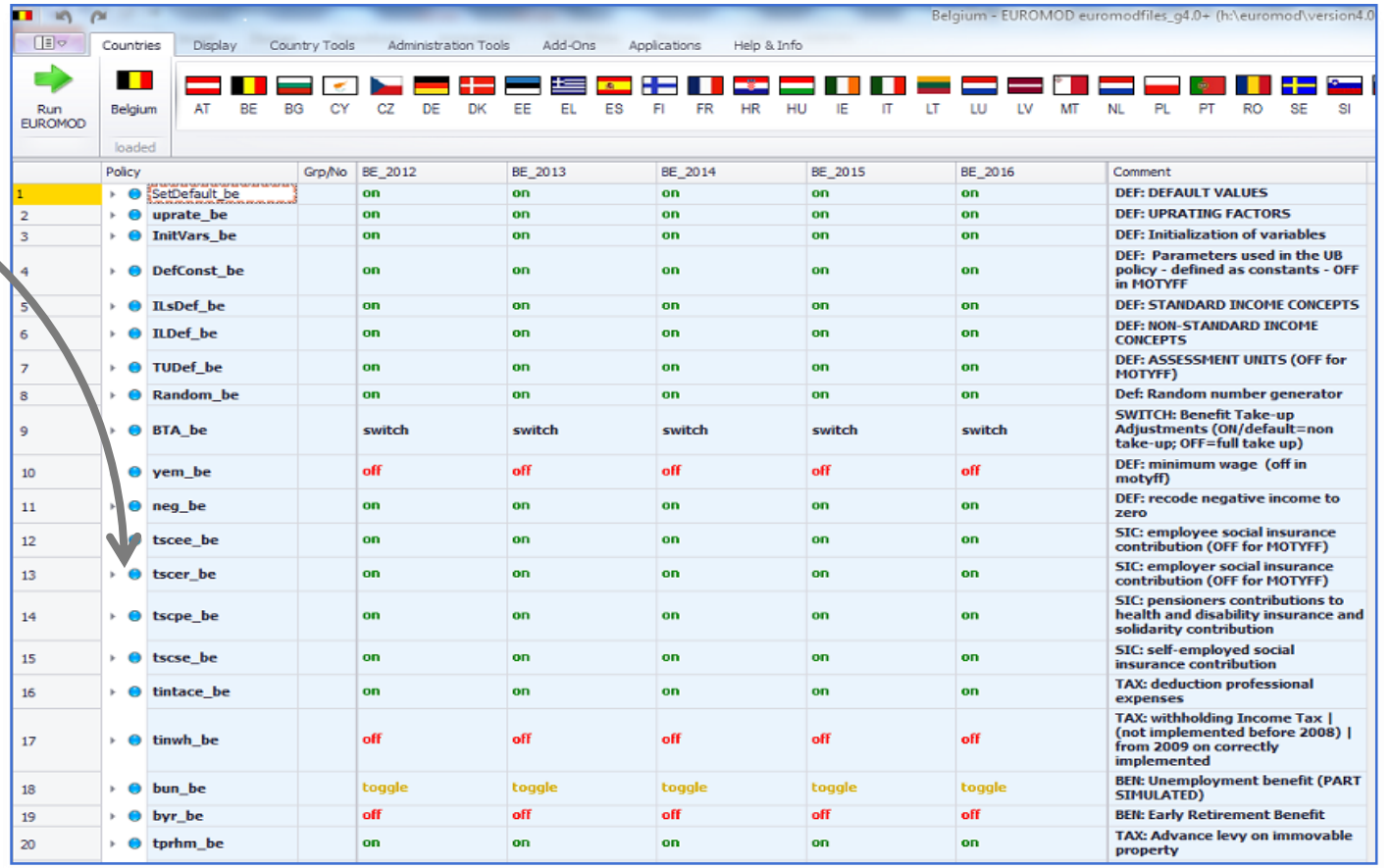
TAX_UNIT		tu_individual_be



	Policy	Grp/No	BE_2012	BE_2013	BE_2014	BE_2015	BE_2016	Comment
1	SetDefault_be		on	on	on	on	on	DEF: DEFAULT VALUES
2	uprate_be		on	on	on	on	on	DEF: UPRATING FACTORS
3	InitVars_be		on	on	on	on	on	DEF: Initialization of variables
4	DefConst_be		on	on	on	on	on	DEF: Parameters used in the UB policy - defined as constants - OFF in MOTYFF
5	ILsDef_be		on	on	on	on	on	DEF: STANDARD INCOME CONCEPTS
6	ILDef_be		on	on	on	on	on	DEF: NON-STANDARD INCOME CONCEPTS
7	TUDef_be		on	on	on	on	on	DEF: ASSESSMENT UNITS (OFF for MOTYFF)
8	Random_be		on	on	on	on	on	Def: Random number generator
9	BTA_be		switch	switch	switch	switch	switch	SWITCH: Benefit Take-up Adjustments (ON/default=non take-up; OFF=full take up)
10	yem_be		off	off	off	off	off	DEF: minimum wage (off in motyff)
11	neg_be		on	on	on	on	on	DEF: recode negative income to zero
12	tscee_be		on	on	on	on	on	SIC: employee social insurance contribution (OFF for MOTYFF)
13	tscer_be		on	on	on	on	on	SIC: employer social insurance contribution (OFF for MOTYFF)
14	tscpe_be		on	on	on	on	on	SIC: pensioners contributions to health and disability insurance and solidarity contribution
15	tscse_be		on	on	on	on	on	SIC: self-employed social insurance contribution
16	tintace_be		on	on	on	on	on	TAX: deduction professional expenses
17	tinwh_be		off	off	off	off	off	TAX: withholding Income Tax | (not implemented before 2008) | from 2009 on correctly implemented
18	bun_be		toggle	toggle	toggle	toggle	toggle	BEN: Unemployment benefit (PART SIMULATED)
19	byr_be		off	off	off	off	off	BEN: Early Retirement Benefit
20	tprhm_be		on	on	on	on	on	TAX: Advance levy on immovable property

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2.1. EUROMOD: características

- Modelo **armonizado** de microsimulaciones para los países de la UE (28)
  - ❑ Dede 1996, EU-15, ISER/Univ.Essex, proyectos financiados por la CE
  - ❑ 2017-2020: **transferencia ISER/Essex → JRC CE**

- Basado en **microdatos**:
  - ❑ EH (**EU SILC**: *EU Survey for the Income and Living Conditions*)
  - ❑ + SILC nacionales y datos administrativos (en algunos casos)

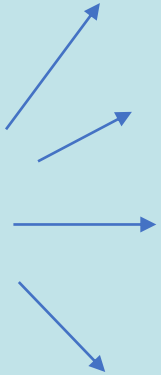
- Trabajo **conjunto, sistemático, transparente y documentado**

- Sistemas **permanentemente actualizados** (max: 2005 – 2019)

- **Macro validación** con datos administrativos

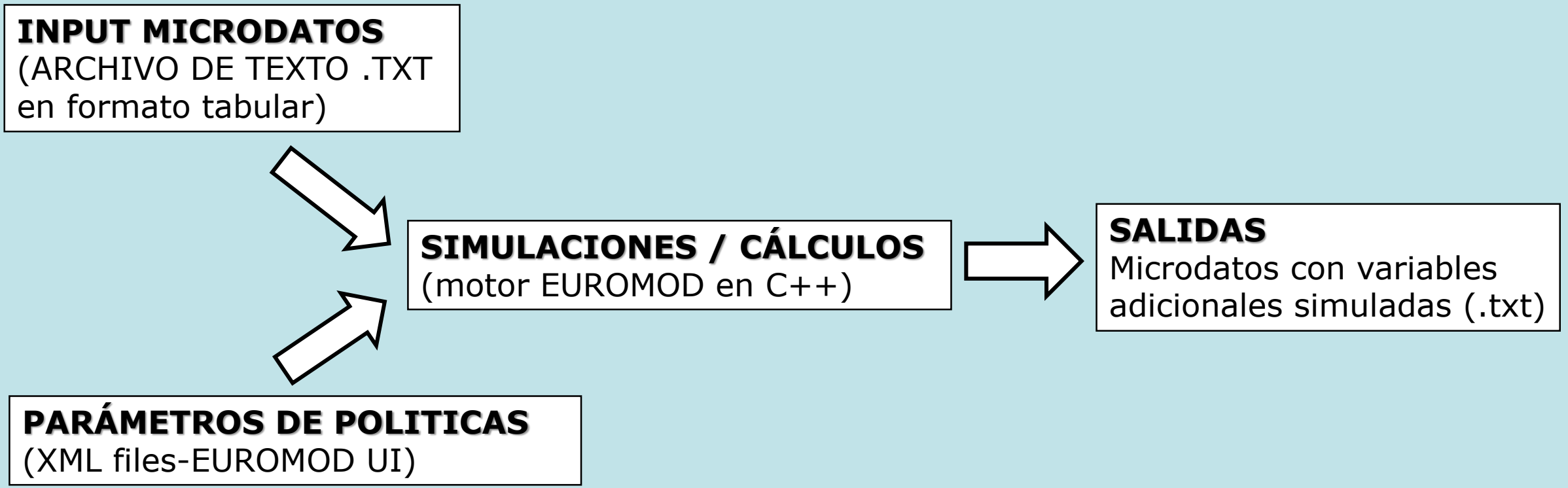
2.1. EUROMOD: características

VENTAJAS / SINGULARIDADES



- **Análisis transversales** para todos los **países de la UE**
- **Visualización y uso amigable** (tipo hoja de cálculo)
- ***Switches*** (off-on políticas, ajustes cobertura, salario mínimo, etc.)
- **Flexibilidad** para incorporación de **nuevas políticas**
- Posibilidad de agregar **aplicaciones y diseñar extensiones**
- Utilización de **distintas bases de datos**
- Trabajo conjunto: genera **transparencia**
- ***Feedback*** por parte de gran número de usuarios

2.2. EUROMOD: cómo funciona



2.3. EUROMOD: quiénes lo usan

Comunidad científica internacional:

- **ISER Working papers EUROMOD**: LINK
- **JRC Working Papers on Taxation and Structural Reforms**:LINK

e.g. JRC WP:

2019-06 Investing in Subsidized Childcare to Reduce Child Poverty: an Adequate Strategy? Tine Hufkens & otros
2018-06 Size and distributional pattern of pension-related tax expenditures in European countries S. Barrios & otros
2018-04 Looking for the missing rich: Tracing the top tail of the wealth distribution S. Bach & otros

e.g EUROMOD WP:

2019-07 A comparison of the fiscal and distributional effects of alternative basic income implementation modes across the EU28 L.Martinelli & otros
2019-06 Recent changes in housing policies and their distributional impact across Europe Francesco Figari & otros

2.3. EUROMOD: quiénes lo usan

Marco: Pacto de Estabilidad y Crecimiento (reglas para políticas fiscales sólidas)

Estados miembro deciden medidas y la CE evalúa el impacto

(SEMESTRE EUROPEO)

Colaboración con EUROSTAT para los *flash estimates* (*nowcasting*)

Proyectos específicos transversales con otras áreas (e.g. **Proyecto "Fairness"**)

Asesoramiento específico a países miembros

(e.g. Grecia)

2.4. EUROMOD: extensiones

- Marginal Effective Tax Rate (MTR)
- Hypothetical Household Tool (HhoT)
- Policy Effects Tool (PET)
- Statistics Presenter

Incorporado a la interfaz de usuario

De uso interno Essex y/o JRC:

- Labour Market Adjustment (LMA) Add-On
- Tax Compliance Adjustment Add-On
- Net Replacement Rate Add-On (p)

EUROMOD JRC web interface

- Indirect Tax Tool (ITT) *Link*
  Household Budget Survey (HBS)
- Wealth Taxation (EWIGE 2) *Link*
  Household Finance and Consumption Survey (HFCS)

Otros datos/encuestas

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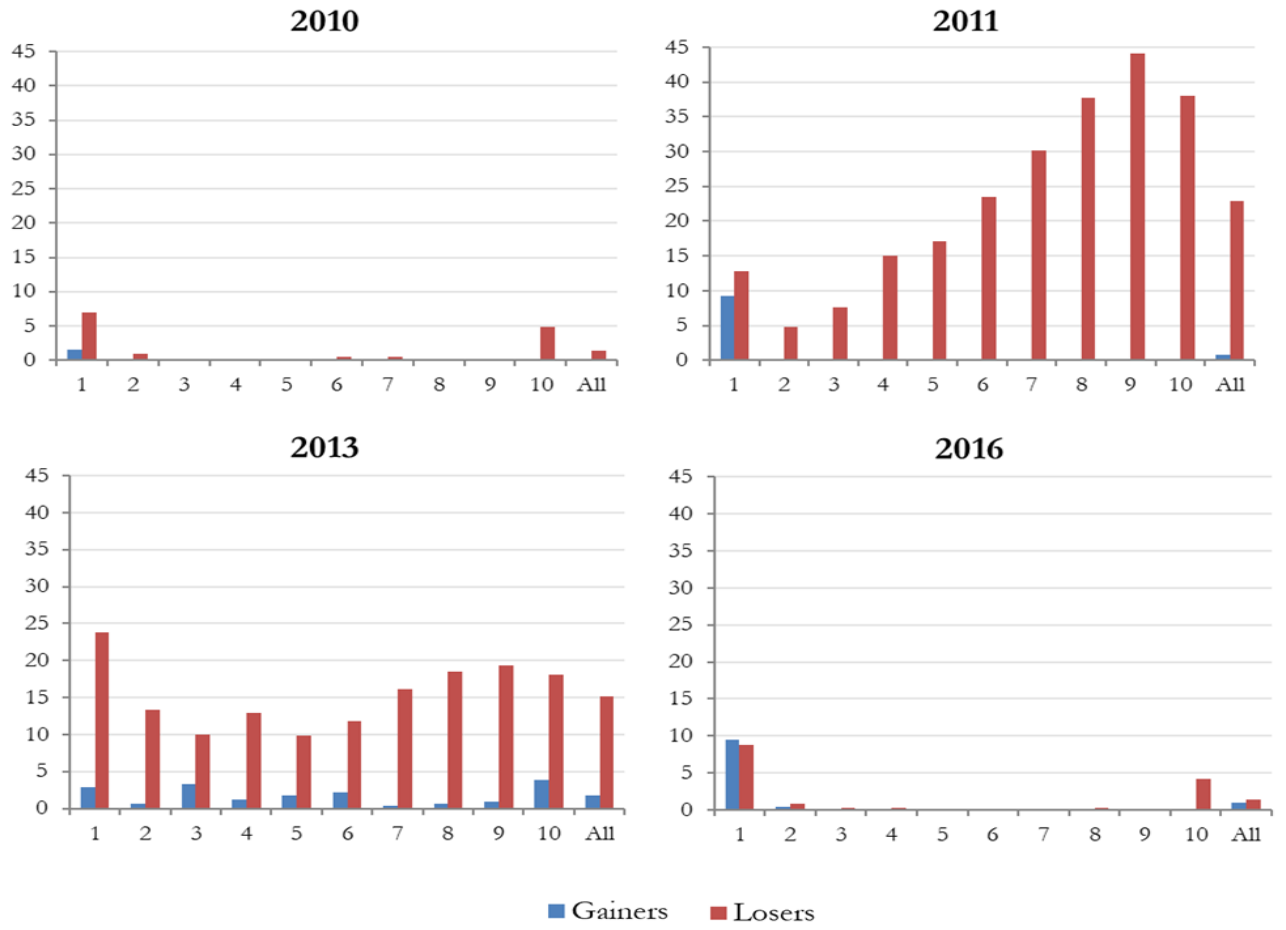
EJEMPLOS a través de trabajos recientes

¿Quiénes fueron los **ganadores y perdedores** de las reformas impositivas en **Grecia** durante la crisis?

Ganadores y perdedores de las reformas
(+-5% ingreso disponible)



Fuente: presentación *The Tax Structure of an Economy in Crisis: Greece 2009-2017* de Chrysa Leventi y Fidel Picos en IMA 7th World Congress (Galway, Junio 2019)

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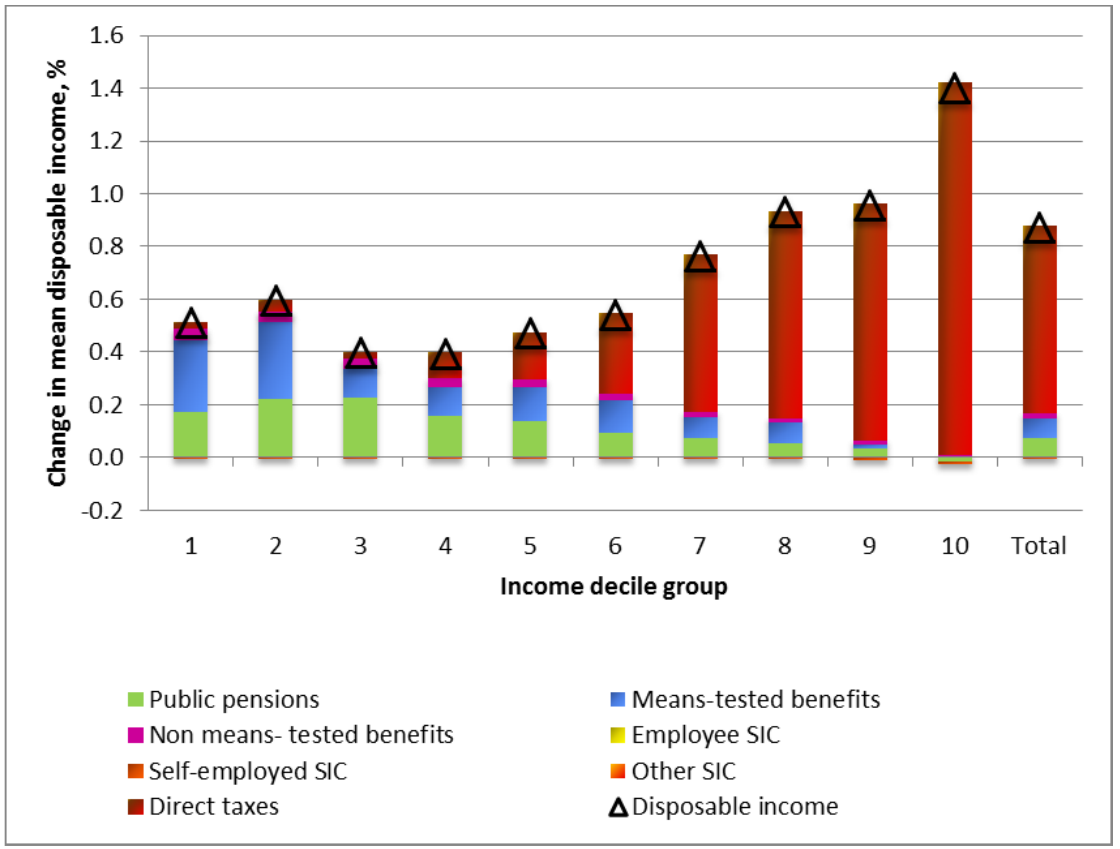
¿Cuál ha sido el impacto de las políticas fiscales en **Portugal** en el último año?

Policy Effects Tool (PET)

Cambio en el ingreso disponible 2017-2018 en PORTUGAL (desagregado por políticas y deciles)



Fuente: *Effects of tax-benefit policy changes across the income distributions of the EU-28 countries: 2017-2018.* EUROMOD Working Paper Series. EM7/19. Marzo 2019.

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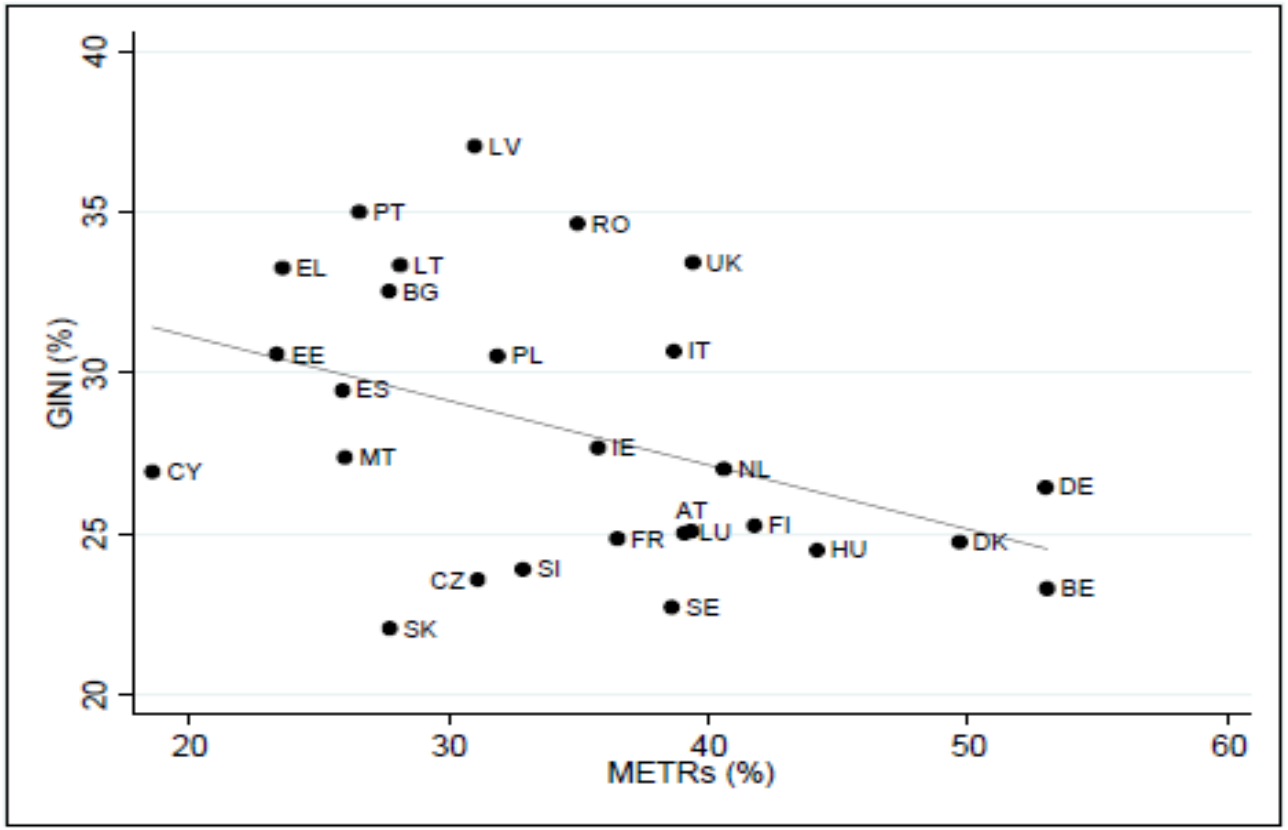
¿Cuáles son los países con más/menos "**incentivos al trabajo**"? ¿Cuál es la relación entre estos incentivos y la distribución del ingreso?

Marginal Effective Tax Rate (MTR)

$$METR_i = 1 - \left(\frac{Y_{HH}^1 - Y_{HH}^0}{E_i^1 - E_i^0} \right)$$

Relación entre desigualdad de ingresos e incentivos al trabajo (2007)



Fuente: Jara, X. y Tumino, A. (2013), *Tax-benefit systems, income distribution and work incentives in the European Union,* *International Journal of Microsimulation*, 2013, vol. 1, issue 6, 27-62

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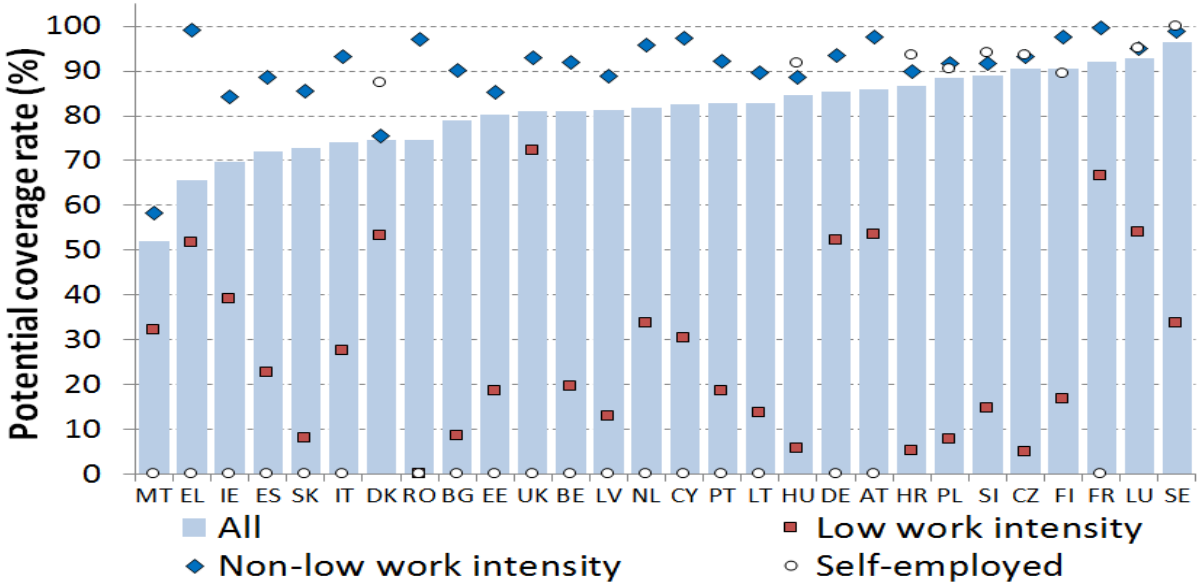
Menos de 60% trabajadores full-time

¿Cuán protegidos están los "**atypical workers**" frente al evento de desempleo en los distintos países de la EU?

Net Replacement Rates (Add-On privado)

Cobertura potencial de seguro de desempleo para la EU



Reforma simulada: extensión cobertura de UB a los trabajadores atípicos.

Resultados: reduce riesgo de pobreza frente a evento de desempleo de 25 a 15% a nivel promedio en la EU para los *self-employed* (cuenta propia)

Costo para el gobierno: entre 4% de la mediana del ingreso disponible (Irlanda) y 80% (Bulgaria)

Fuente: Jara, X. y Tumino, A. 2018. *Income protection of atypical workers in the event of unemployment in Europe*. JRC WP on Taxation and Structural Reforms

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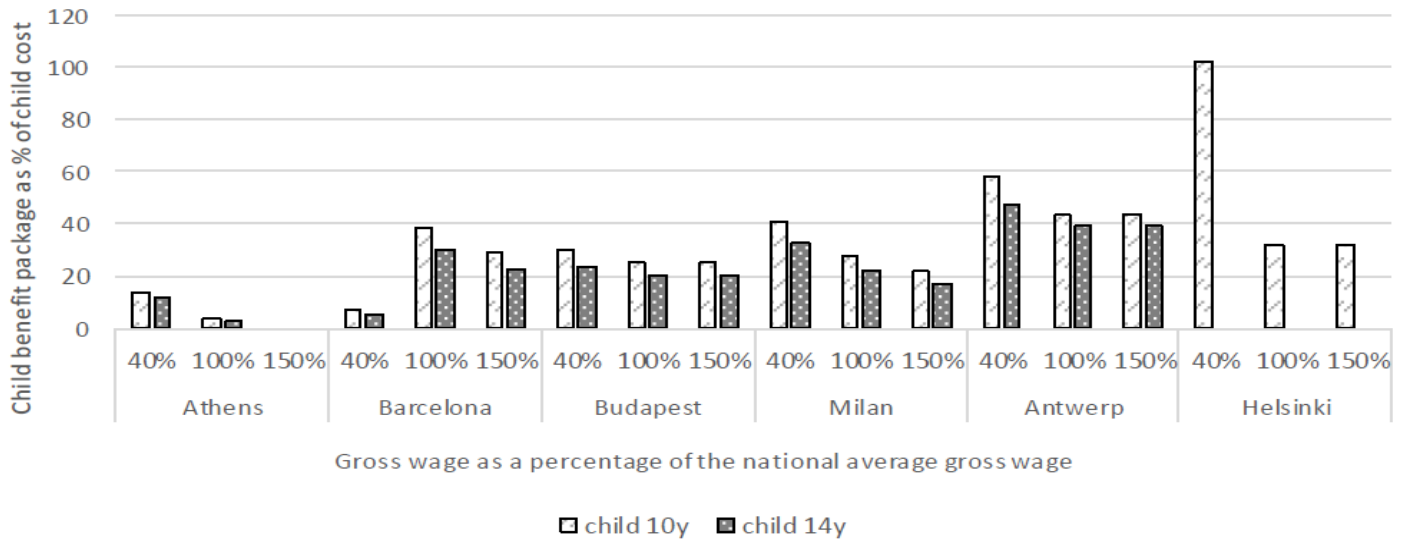
¿Cuánto "cuestan" los/as niños/as y cuánto compensa el Estado?

HhoT (Hypotetical Household Tool)

Transferencias del gobierno a los niños/as como % del costo esencial de 10 y 14 años, en una familia monoparental que alquila vivienda (2014)

Figure 7. The child cost compensation indicator. The child benefit package at several wage levels expressed as a percentage of the essential cost of a child of 10 and 14 years, in a single parent family, private tenant, 2014.



Note: Data on a child of 14 years old are missing for Finland.

Fuente: Penne, T. Hukfens, T. Goedemé, T. y Storms, B. 2018. *To what extent do welfare states compensate for the cost of children? A hypothetical household approach to policy evaluations* JRC Working Papers on Taxation and Structural Reforms No 08/2018

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3. Conexiones con otros modelos

MODELOS DE OFERTA LABORAL

Random utility maximization approach

Bargain, O., Orsini, K., & Peichl, A. (2014)

MODELOS DE EQUILIBRIO GENERAL

Basado en QUEST III

MODELOS DE GENERACIONES SOLAPADAS

OLG: overlapping generations model – EN CONSTRUCCIÓN

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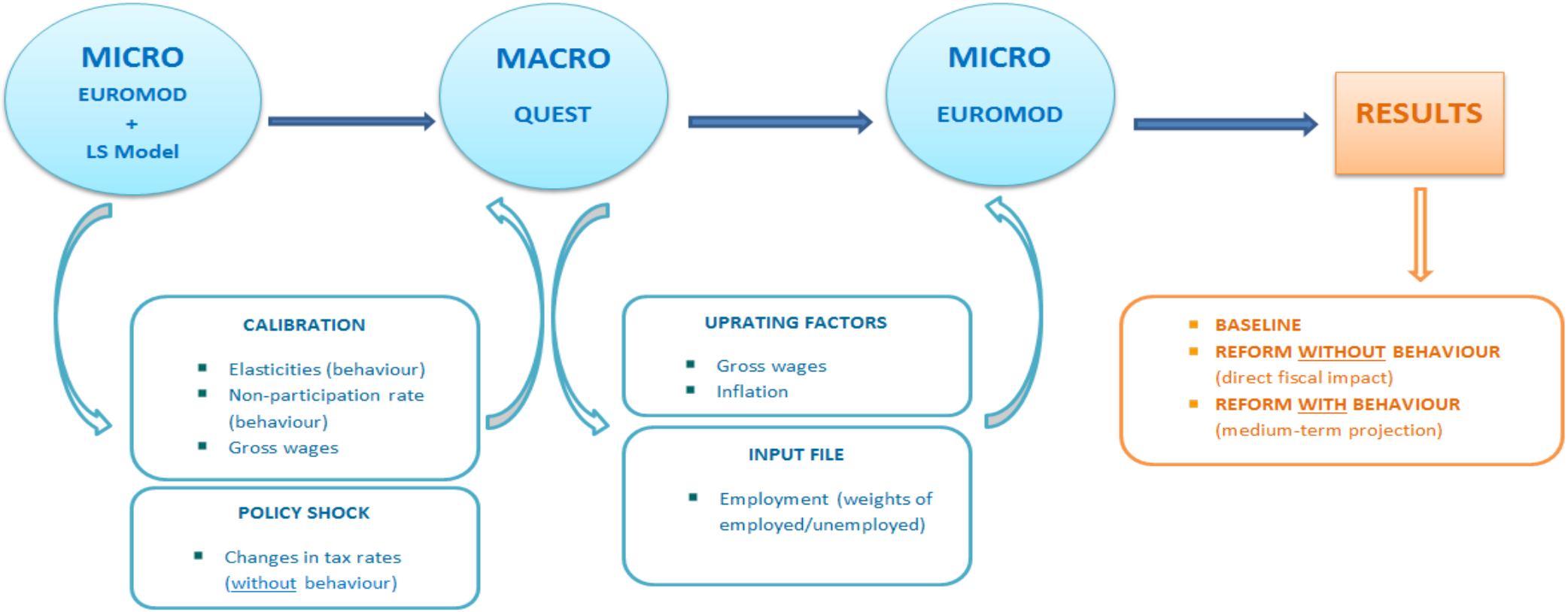
3. Conexiones con otros modelos

Principales supuestos QUEST (*DSGE Model*):

- 3 regiones economía abierta
- Competencia monopolística en el mercado de bienes y trabajo
- Rigideces en la formación de precios y salarios
- 3 grupos de trabajadores: con habilidades bajas, medias y altas
- Restricciones de liquidez en grupo habilidades bajas
- Autoridad fiscal y monetaria con regla de estabilización de políticas

3. Conexiones con otros modelos



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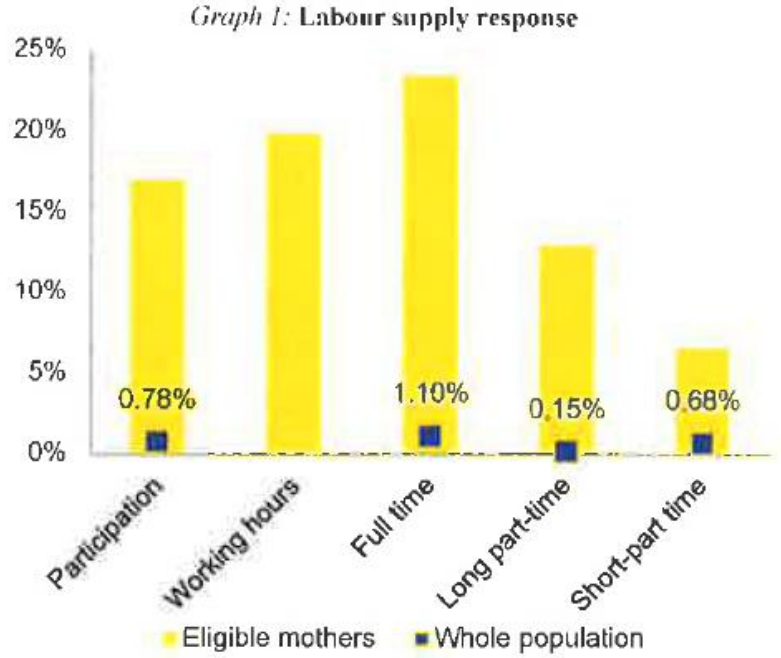
EJEMPLOS a través de trabajos recientes

I. Italia:
Introducción de *in-work benefits* y oferta laboral femenina

Trabajo en el marco del Semestre Europeo:

COMMISSION STAFF WORKING DOCUMENT Country Report Italy 2018 Including an In-Depth Review on the prevention and correction of macroeconomic imbalances

Reforma: reemplazo de bonos familiares (2.3 miles de millones EUR) por ***targeted in-work benefits***



Resultados:

- 700 mil mujeres, un beneficio promedio de 265 EUR
- Aumento de participación laboral 17% (113 mil), aumento extensivo e intensivo
- Impacto marginal en distribución del ingreso
- En QUEST: aumento del PIB de 0.4% en 5 años por el aumento en empleo que genera la reforma

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II. Bélgica: Reformas hipotéticas en contribución social

Artículo publicado:
Dynamic scoring of tax reforms in the European Union**,** *Journal of Policy Analysis and Management in December 2018*

Autores: Salvador Barrios, Mathias Dolls Anamaria Maftei, Andreas Peichl ,Sara Riscado, Janos Varga, Christian Wittneben

Reforma: ↓ 30% contribución a la seguridad social SICee (empleados) vs SICer (empleadores)

1

Policy shock

	REFORMS					
	Employee tax-cut			Employer tax-cut		
	High	Medium	Low	High	Medium	Low
Employee						
Baseline	33.5%	28.8%	27.1%	33.5%	28.8%	27.1%
Reform	31.1%	26.3%	24.5%	33.5%	28.8%	27.1%
Shocks (pp)	-2.35	-2.52	-2.63	0.00	0.00	0.00
Employers						
Baseline	20.3%	25.9%	26.9%	20.3%	25.9%	26.9%
Reform	20.3%	25.9%	26.9%	16.6%	20.7%	21.4%
Shocks (pp)	0.00	0.00	0.00	-3.72	-5.21	-5.54

Recaudación del gobierno – en comparación con estimaciones estáticas

2

(*Revenue feedback effects*)

	3 years after reform	5 years after reform
Employee tax-cut	6.4	12.9
Effect from employment	18.3	23.0
Effect from wages	-11.9	-10.1
Employer tax-cut	48.7	50.3
Effect from employment	13.2	12.5
Effect from wages	35.4	37.8

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II. Bélgica:
Reformas hipotéticas en contribución social

3

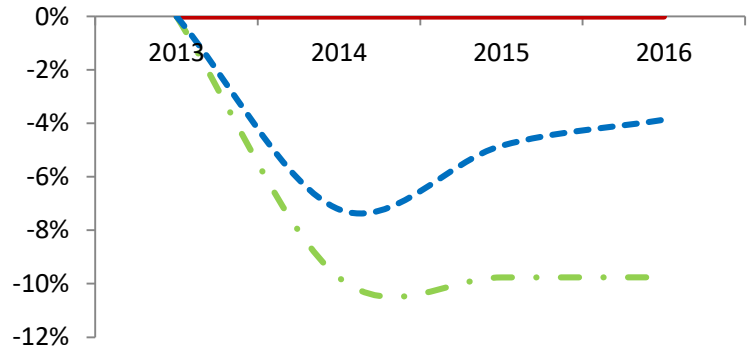
	REFORMS (annualized % deviation from baseline)					
	Employee tax cut			Employer tax cut		
	T+1	T+2	T+3	T+1	T+2	T+3
Price level	-0.043	-0.101	-0.128	-0.096	-0.161	-0.154
Employment						
Low	0.171	0.444	0.739	0.825	1.338	1.445
Medium	0.233	0.556	0.847	0.790	1.292	1.443
High	0.278	0.614	0.874	0.449	0.720	0.868
Gross real wage						
Low	-0.225	-0.437	-0.527	1.379	2.867	3.576
Medium	-0.334	-0.566	-0.619	1.336	2.749	3.370
High	-0.397	-0.628	-0.627	1.143	2.282	2.732

Nuevos inputs para EUROMOD (ingresan como *uprate factors* y cambios en pesos (*weights*) para ajuste en número de empleados/desocupados)

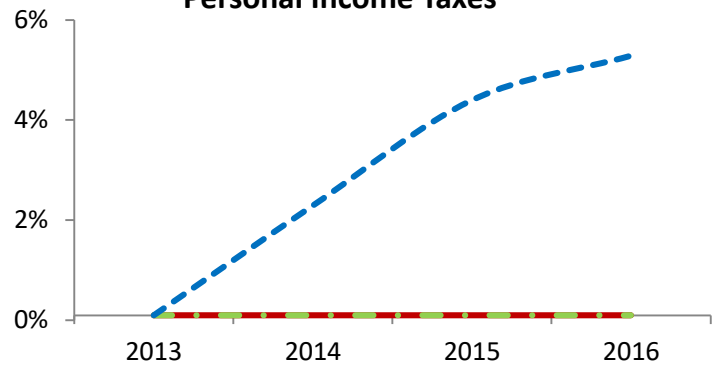
Employer reform

(reducción en contribución seguridad social del empleador)

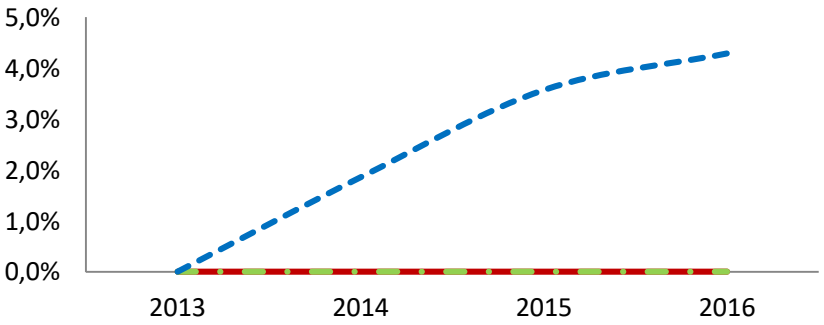
Total net tax revenues



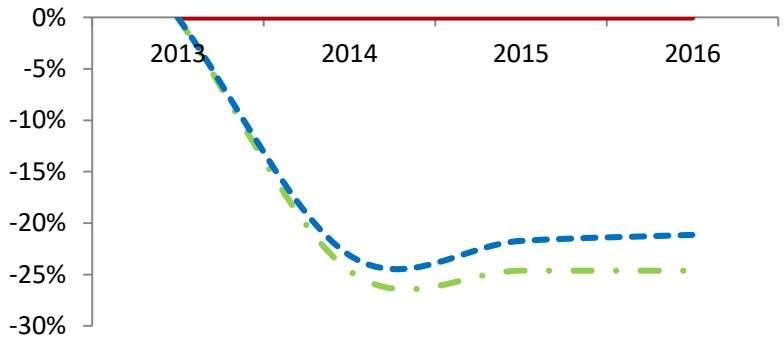
Personal Income Taxes



SIC Employee



SIC Employers



Baseline (no policy change)

Tax policy change, no behavioural reaction

Tax policy change, including behavioural reaction

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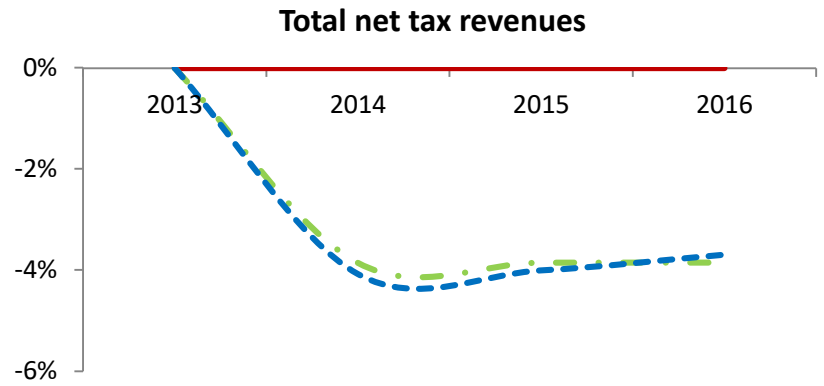
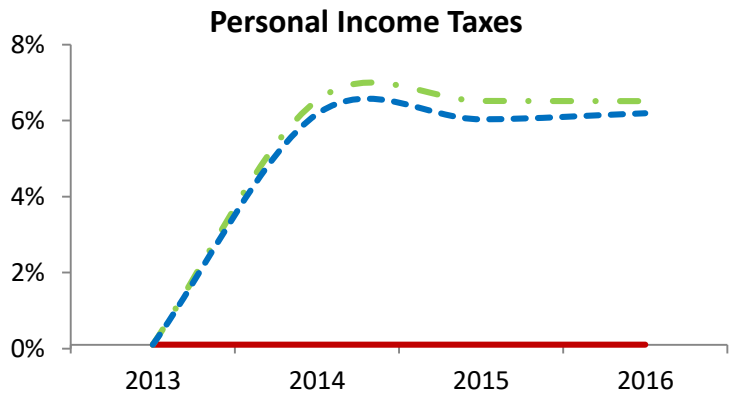
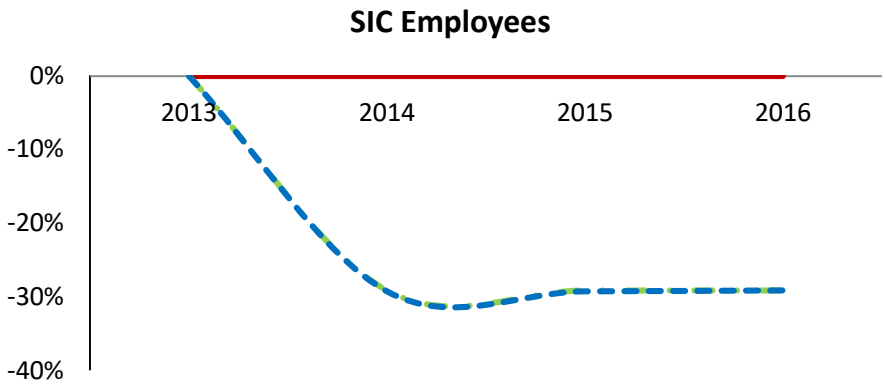
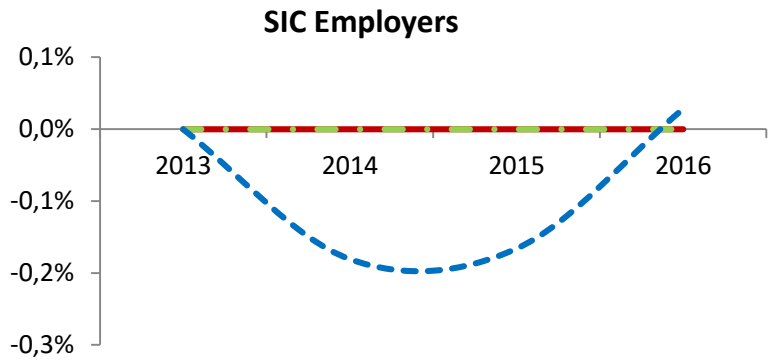
Employee reform

(reducción en contribución seguridad social del empleado)









Baseline (no policy change)

Tax policy change, no behavioural reaction

Tax policy change, including behavioural reaction

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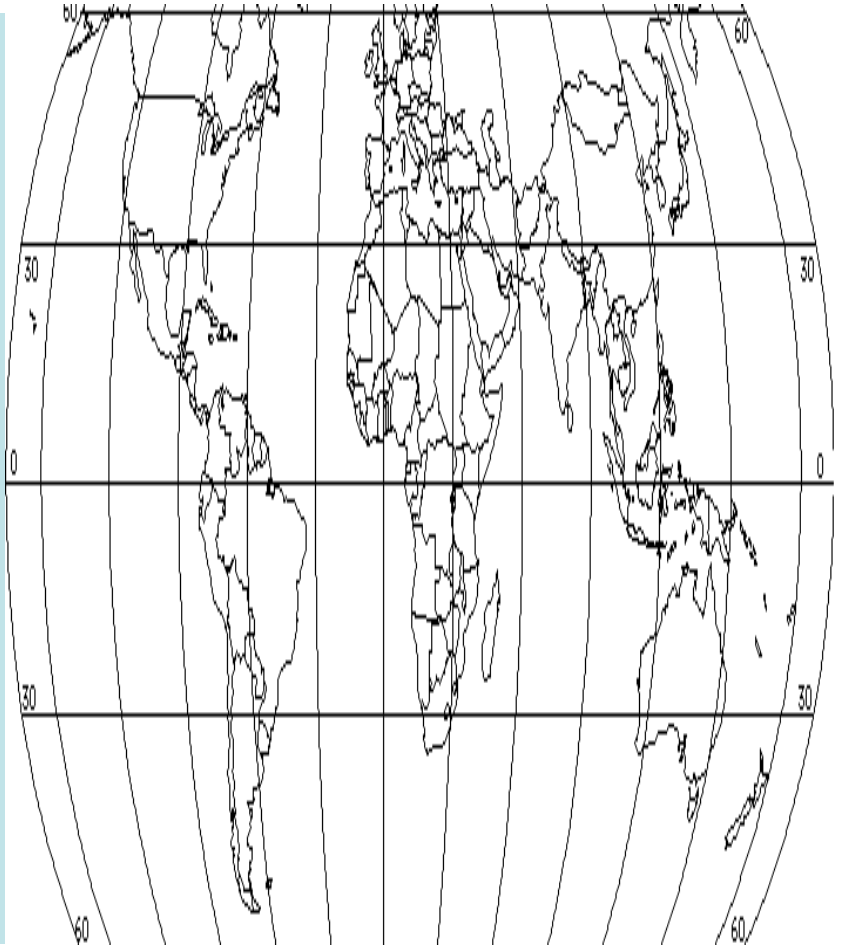
4. Iniciativas en otras regiones

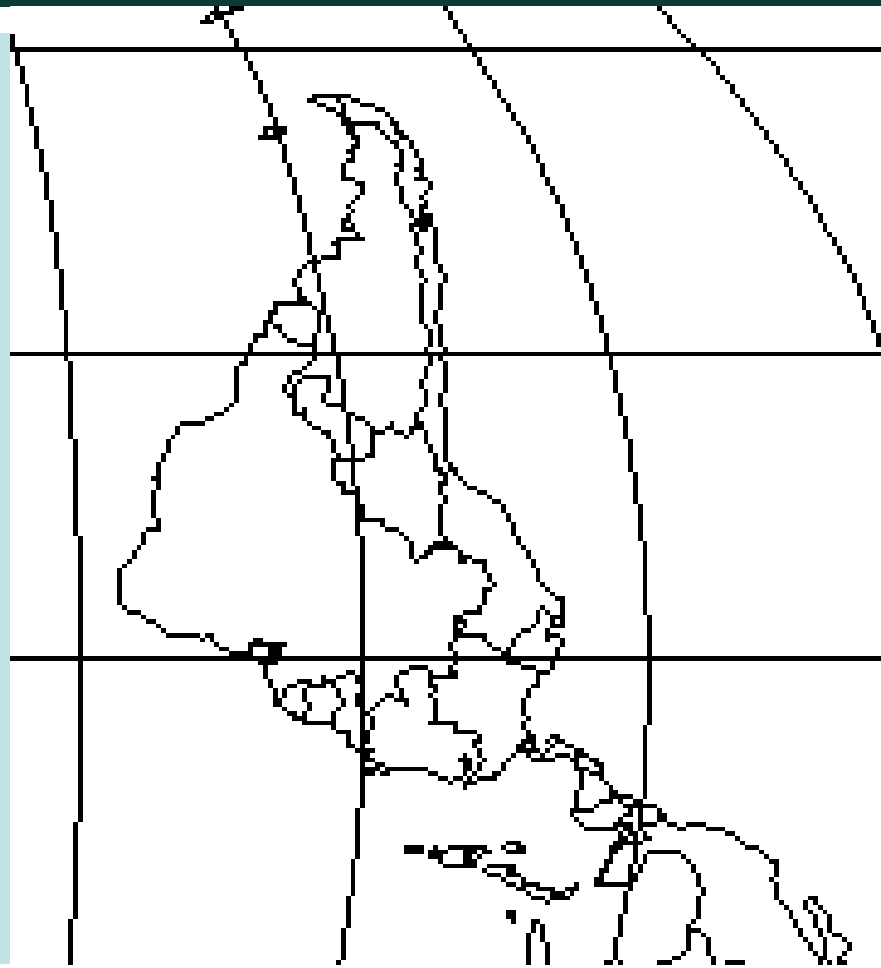
- Dos web interfaces que usan EUROMOD: **Austria** (SORESI) y Bélgica **(Flanders)** (FLEMOSI)
- Otros: **Australia** (ATM), **Rusia** (RUSMOD), **Macedonia** (MAKMOD), **Serbia**(SRMOD), **Italy (Trento)** (TREMOD) and **Croatia** (miCROmod)
- Proyecto **SOUTHMOD**, financiado por UNU-WIDER: **Ghana**, **Ethiopia**, **Zambia**, **Tanzania**, **Mozambique**, **Ecuador** y **Vietnam**
- Se combinarán pronto con **South Africa** (SAMOD) y **Namibia** (NAMOD), a cargo de Southern African Social Policy Research Insights (SASPRI)



4. Iniciativas en otras regiones

- **ECUAMOD:** parte de SOUTHMOD (UNU-WIDER) → Web
- **COLMOD:** desarrollado por David Rodriguez en su tesis doctoral (david.rodriguez@essex.ac.uk). Actualmente el modelo está en la Facultad de Economía (Externado, Colombia). Disponible pronto (Ago 2019) →Web
- **LATINMOD:** Argentina, Bolivia, México, Paraguay, **Uruguay** y Venezuela, desarrollado por CELAG → Web
  - en búsqueda de financiamiento, personas de contacto: Nicolás Oliva (nicolasolivap@gmail.com) & H. Xavier Jara (hxjara@essex.ac.uk)]
- Essex, Universidad del Pacífico (Peru) y CELAG: trabajo de consultoría con el BID (aumento de capacidad fiscal del estado en Bolivia, Colombia, Ecuador, Perú and Venezuela)

(*) Agradezco a Xavier Jara (ISER/Universidad de Essex: (hxjara@essex.ac.uk)
por la información compartida respecto al estado actual de estos proyectos en América Latina



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5. Reflexiones

Importancia de una herramienta armonizada como EUROMOD para pensar y discutir políticas a nivel de la Unión Europea

Insumo fundamental para planes de convergencia e integración regional

Múltiples países y equipos técnicos involucrados genera transparencia y sinergías

Requiere planificación, recursos, capacitación y marco institucional

5. Reflexiones

¿Cómo se posiciona Uruguay en este sentido?

Gracias

Preguntas/comentarios:

sofia.maier@ec.europa.eu & sofia.maier@gmail.com

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Referencias y apéndice

Referencias

Modelos de oferta laboral:

McFadden, D. (1974): “Conditional logit analysis of qualitative choice behavior,” in Frontiers in Econometrics, ed. by P. Zarembka, pp. 105–142. New York: Academic Press.

Bargain, O., Orsini, K., & Peichl, A. (2014). ”Comparing labor supply elasticities in Europe and the United States: New results.” *Journal of Human Resources*, **49**, 723– 838.

QUEST:

Ratto, M., Roeger, W., & in 't Veld, J. (2009). ”QUEST III: An estimated open-economy DSGE model of the euro area with fiscal and monetary policy.” *Economic Modelling*, **26**, 222– 233.

Referencias

EUROMOD + QUEST

- Barrios, S. , Dolls, M. , Maftei, A. , Peichl, A. , Riscado, S. , Varga, J. and Wittneben, C. (2019), DYNAMIC SCORING OF TAX REFORMS IN THE EUROPEAN UNION. J. Pol. Anal. Manage., 38: 239-262. Disponible aquí: https://onlinelibrary.wiley.com/doi/full/10.1002/pam.22105

Evasión de impuestos y sub-declaraciones

- Agúndez-Garcia, A., & Picos, F. (2019), "The fiscal and social cost of tax evasion: the impact of underreporting of income by the self-employed", *Science for Policy Brief*, European Commission.
- Kukk M., A. Paulus & K. Staehr (2018), "Income underreporting by the self-employed in Europe: A cross-country comparative study", *Eesti Pank Working Paper Series, 4/2018*.

Referencias

HHOT(Hypothetical Household Tool) papers:

- The Hypothetical Household Tool (HHoT) in EUROMOD: a new instrument for comparative research on tax-benefit policies in Europe – Link Paper
- Using HHoT to generate institutional minimum income protection indicators – Link Paper
- To what extent do welfare states compensate for the cost of children? A hypothetical household approach to policy evaluations - Link Paper
- The use of hypothetical household data for policy learning – EUROMOD HHoT baseline indicators -Link Paper

Referencias

FAIRNESS POLICY BRIEFS:

Link

Ver, por ejemplo:

- Increasing progressivity in flat-tax countries: potential positive equity and efficiency impacts
- The fiscal and social cost of tax evasion: the impact of underreporting of income by the self-employed
- Old welfare in new labour markets? The social protection of atypical workers
- The budgetary and redistributive effects of wealth-related taxes

Apéndice

Grecia: reformas impositivas en período de crisis

2009-2013: ⬇ casi 30% en PIB

	2009 system	2010 reform	2011 reform	2013 reform	2016 reform
personal income tax bands	5	9	8	different for various income sources	4
maximum tax rate	40% (for annual incomes over €75,000)	45% (for annual incomes over €100,000)	no change	different for various income sources	45% (for annual incomes over €40,000)
zero tax bracket	€12,000 for employees and pensioners; €10,500 for all others	€12,000 for all	€9,000 for persons aged below 30/ above 65; €5,000 for all others	abolished	n/a
increase in zero tax bracket due to children	1st child: €1,000 2nd child: €2,000 3rd child: €10,000	1st child: €1,500 2nd child: €3,000 3rd child: €11,500	1st child: €2,000 2nd child: €4,000 3rd child: €7,000	abolished	n/a
increase in zero tax bracket due to disability	€2,400	no change	no change	turned into tax credit	no change

Fuente: presentación "The Tax Structure of an Economy in Crisis: Greece 2009-2017" de Chrysa Leventi y Fidel Picos en IMA 7th World Congress (Galway, Junio 2019)

European Commission

Grecia: reformas impositivas en período de crisis

Fuente: presentación "The Tax Structure of an Economy in Crisis: Greece 2009-2017" de Chrysa Leventi y Fidel Picos en IMA 7th World Congress (Galway, Junio 2019)

	2009 system	2010 reform	2011 reform	2013 reform	2016 reform
tax allowances (TA) / tax credits (TC)	spending on private insurance, installation of eco-friendly energy systems: eligible for TA social insurance contributions (SIC): fully deducted from taxable income	spending on private insurance, installation of eco-friendly energy systems: eligible for TC SIC: no change	TCs: 50% reduced TAs: abolished SIC for self-employed: provided as a 10% TC	most TCs: abolished; introduction of employment & pensions income TC SIC: fully deducted from taxable income	changes in employment & pensions income TC SIC: no change
solidarity contribution	n/a	paid by individuals with annual taxable incomes above €12,000	no change	no change	reformed
self-employed & liberal professions' contribution	n/a	€300 per year	€500 per year	no change	no change
pensioners' solidarity contributions	n/a	main pensions exceeding €1,400 per month taxed from 3% to 14%	reformed & also applied to supplementary pensions	no change	no change

European Commission

Apéndice: EUROMOD + LS + QUEST

HOUSEHOLD PROBLEM

- Non constrained households: optimal decisions on consumption, labour supply, purchases of investment goods and government bonds, and renting of physical capital

$$\max_{\{C_{i,t},L_{i,s,t},B_{i,t},J_{i,t},K_{i,t}\}_{t=0}^{\infty}} V_{i,0} = E_0 \sum_{t=0}^{\infty} \beta^t \left(U(C_{i,t}) + \sum_s V(1 - L_{i,s,t}) \right)$$

$$-E_0 \sum_{t=0}^{\infty} \lambda_{i,t} \frac{\beta^t}{P_t} \begin{pmatrix} (1 + t_{c,t}) P_{C,t} C_{i,t} + B_{i,t} + P_{I,t} \left(J_{i,t} + \Gamma^j (J_{i,t}) \right) - (1 + i_{t-1}) B_{i,t-1} \\ - \sum_s (1 - t_{W,s,t}) W_{s,t} L_{i,s,t} - bW_{s,t} (1 - NPART_{i,s,t} - L_{i,s,t}) \\ -(1 - t_K)(i_{K,t-1} - rp_K) P_{I,t-1} K_{i,t-1} - t_K \delta_K P_{I,t-1} K_{i,t-1} - TR_{i,j} - PR_{fin,i,t} \end{pmatrix}$$

$$-E_0 \sum_{t=0}^{\infty} \lambda_{i,t} \xi_{i,t} \beta^t (K_{i,t} - J_{i,t} - (1 - \delta_K) K_{i,t-1})$$

- Constrained households: consume their current income (wages, transfers and benefits) in each period

$$(1 + t_{C,t}) P_{C,t} C_{L,t} = (1 - t_{W,L,t}) W_{L,t} L_{L,t} + bW_{L,t} (1 - NPART_{L,t} - L_{L,t}) + TR_{L,t}$$

Apéndice: EUROMOD + LS + QUEST

FIRM PROBLEM

- Each firm produces a variety j of the final good, which is an imperfect substitute for the varieties of the other firms, and in a symmetric equilibrium:

$$P_{j,t} = \frac{1}{\eta_{j,t}} MC_{j,t}$$

- Each firm maximizes the present discounted value of profits, given a Cobb-Douglas production function and adjustment costs:

$$PR_{j,t} = P_{j,t}Y_{j,t} - \sum_{s}(1 + t_{SIC,s,t})W_{j,s,t}L_{j,s,t} - i_{K,t}P_{I,j,t}K_{j,t} - \left(\Gamma^{P}(P_{j,t}) + \Gamma^{L}(L_{j,L,t}, L_{j,M,t}, L_{j,H,t}) + \Gamma^{u}(u_{j,t})\right)$$

where

$$Y_{j,t} = \left(L_{j,t} - FC_{j,L}\right)^{\alpha}\left(u_{j,t}K_{j,t}\right)^{1-\alpha} - FC_{j,Y}$$

and

$$L_{j,t} = \left(\Lambda_{L}^{\frac{1}{\mu}}(\chi_{L}L_{j,L,t})^{\frac{\mu-1}{\mu}} + \Lambda_{M}^{\frac{1}{\mu}}(\chi_{M}L_{j,M,t})^{\frac{\mu-1}{\mu}} + \Lambda_{H}^{\frac{1}{\mu}}(\chi_{H}L_{j,H,t})^{\frac{\mu-1}{\mu}}\right)^{\frac{\mu}{\mu-1}}$$

Apéndice: EUROMOD + LS + QUEST

FISCAL ENVIRONMENT

- Expenditure side: the government consumes (G_t), invests (IG_t), pay transfers (TR_t) and unemployment benefits (BEN_t) to households, where:

$$BEN_t = \sum_s bW_{s,t}\left(1 - NPART_{s,t} - L_{s,t}\right), s \in \{L, M, H\}$$

- Revenue side (${R_t}^G$): the government taxes consumption (t_C), capital (t_K) and labour (t_W, t_{SIC})

$${R_t}^G = t_{c,t}P_{c,t}C_{i,t} + \sum_s \left(t_{W,s,t} + t_{SIC,s,t}\right)W_{s,t}L_{s,t} + t_K i_{k,t-1}P_{I,t-1}K_{i,t-1} - t_K \delta_{k,t-1}P_{I,t-1}K_{i,t-1}$$

- Government debt evolves according to

$$B_t = (1 + i_t)B_{t-1} + G_t + IG_t + TR_t + BEN_t - {R_t}^G$$

- Debt stabilization rule: the tax on workers income is used to control the debt to GDP ratio, according to a debt target indicator

$$\Delta t_W = \tau_B \left(\frac{B_{t-1}}{Y_{t-1}} - b^T\right) + \tau_{DEF}\Delta\left(\frac{B_t}{Y_t}\right)$$

Apéndice: EUROMOD + LS + QUEST

LABOUR MARKET

Discrete choice labour supply model

- Assumes households maximize utility, facing the standard consumption-leisure trade-off

$$V_{ij} = U_{ij} + \epsilon_{ij}$$

where

$$U_{ij} = \alpha_{ci} C_{ij} + \alpha_{cc} C_{ij}^2 + \alpha_{h_f i} H_{ij}^f + \alpha_{h_m i} H_{ij}^m + \alpha_{h_f f} (H_{ij}^f)^2 + \alpha_{h_{mm}} (H_{ij}^m)^2$$
$$+\alpha_{ch_f} C_{ij} H_{ij}^f + \alpha_{ch_m} C_{ij} H_{ij}^m + \alpha_{h_m h_f} H_{ij}^f H_{ij}^m - \eta_j^f \cdot 1(H_{ij}^f > 0) - \eta_j^m \cdot 1(H_{ij}^m > 0)$$

and

$$C_{ij} = d(w_i^f H_{ij}^f, w_i^m H_{ij}^m, y_i, X_i)$$

- Workers choose from a set of discrete labour hours alternatives: non-participation (zero hours), part-time (20 hours), full-time (40 hours) or over-time (60 hours), for a fixed wage rate

$$p_{ij} = \frac{e^{U_{ij}}}{\sum_{k=1}^{J} e^{U_{ik}}}$$

Apéndice: EUROMOD + LS + QUEST

- Labour supply (from FOCs of household):

$$\frac{V_{1-L,h,s,t}}{U_{C,h,s,t}}\frac{1}{\eta_{s,t}} = \frac{W_{s,t}\left(1 - t_{W,s,t} - b\right)}{P_{C,t}\left(1 + t_{C,t}\right)}$$

- Labour demand (from FOCs of firm):

$$P_{j,t}Y_{L,s,t}\eta_{j,t} = \left(1 + t_{SIC,s,t}\right)W_{s,t} + \Gamma^{L}_{L,s,t}$$

- In equilibrium:

$$\left(L^{*}_{s,t}, W^{*}_{s,t}\right), s \in \{L, M, H\}$$

Apéndice: EUROMOD + LS + QUEST

- **LABOUR SUPPLY ELASTICITY**
- In QUEST the explicit labour supply function is: $L_{i,s,t} = 1 - \left(\frac{\omega_s}{\eta_{s,t}(1-habc)} \frac{P_{C,t}(1+t_{C,t})(C_{i,t}-habcC_{t-1})}{W_{s,t}(1-t_{W,s,t}-b)}\right)^{\frac{1}{\kappa}}$
- From which we can derive the Frisch elasticity: $\varepsilon^F_{L,W} = \frac{1}{\kappa}\left(\frac{1-L_{i,s,t}}{L_{i,s,t}}\right)$
- From the labour supply discrete choice model we can estimate $\varepsilon^F_{L,W}$ and obtain parameter κ as: $\kappa = \frac{1}{\varepsilon^F_{L,W}}\left(\frac{1-L_{i,s,t}}{L_{i,s,t}}\right)$
- **NON PARTICIPATION RATE**
- In QUEST unemployment is defined as: $UNEMP_t = 1 - NPART_{L,t} - L_{L,t}$, where $NPART_{L,t}$ is the proportion of inactive in total population
- From the labour supply discrete choice model, the expected number of individuals supplying 0 hours (not participating in the labour market) is: $L_0 = Prob_{i0} * N = \left(\frac{e^{U_{i0}}}{\sum_{h\epsilon\{0,20,40,60\}} e^{U_{ih}}}\right) * N$,which is used to calibrate the $NPART_{L,t}$ rate

Apéndice: EUROMOD + LS + QUEST

TAX INCIDENCE

- Change in gross wage:

$$\widehat{W} = \frac{\varepsilon_{LS}}{\varepsilon_{LS} - \varepsilon_{LD}} \widehat{t_W} + \frac{\varepsilon_{LD}}{\varepsilon_{LS} - \varepsilon_{LD}} \widehat{t_{SIC}}$$

- Change in net wage $NW = W(1 - t_W)$ given total change in taxes on labour:

$$\frac{\widehat{NW}}{(\widehat{t_W} + \widehat{t_{SIC}})} = \frac{\varepsilon_{LD}}{\varepsilon_{LS} - \varepsilon_{LD}} < 0$$

- Change in total compensation of employees $TC = W(1 + t_{SIC})$ given total change in taxes on labour:

$$\frac{\widehat{TC}}{(\widehat{t_W} + \widehat{t_{SIC}})} = \frac{\varepsilon_{LS}}{\varepsilon_{LS} - \varepsilon_{LD}} > 0$$