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Abstract

This paper provides an update for 2019 on the parametric function estimates of the Spanish personal income tax carried out by García-Miralles, Guner and Ramos (2019), which pertained to 2015 for individual taxpayers and to 2013 for households. Thus, the new estimates summarise personal income tax prior to the pandemic and, in particular, they include the 2015 tax reform in the case of households. These functions are useful for calibrating general equilibrium macroeconomic models to simulate tax reforms and to compute after-tax income in surveys where information is collected solely in gross terms.

Keywords: personal income tax, tax functions.

JEL classification: E62, H24, H31.

Resumen

Este artículo ofrece una actualización para el año 2019 de las estimaciones de funciones paramétricas del impuesto sobre la renta de las personas físicas, llevadas a cabo por García-Miralles, Guner y Ramos (2019), que se circunscribían a 2015, para el caso de los contribuyentes individuales y a 2013, para el caso de los hogares. De este modo, se proporcionan las estimaciones que sintetizarían dicho impuesto en la situación previa a la pandemia y, en particular, incluirían, para el caso de los hogares, la reforma del impuesto sobre la renta del año 2015. Estas funciones son útiles a la hora de calibrar modelos macroeconómicos de equilibrio general con el fin de simular reformas tributarias o de computar la renta después de impuestos en encuestas cuya información se recoge solo en términos brutos.

Palabras clave: impuesto sobre la renta, funciones paramétricas.

Códigos JEL: E62, H24, H31.

Contents

1 Introduction

This article aims to present an estimate of a set of parametric functions for the Spanish personal income tax that link, at individual and household level, declared gross income to the effective rate paid (the latter being defined as the tax liability as a proportion of gross income). These functions are very useful when calibrating macroeconomic general equilibrium models or calculating after-tax income in surveys that do not seek such information, since they capture, in one or more simple functions, the progressivity of the tax and the variation in effective rates across taxpayers with a similar level of income.[1]

The paper thus updates the estimates made in García-Miralles, Guner and Ramos (2019) with data to 2019, as that article took data pertaining to 2015 for individuals and to 2013 for households. In the case of the latter, a new aspect to the analysis is the use of a recently available database that makes it possible to aggregate the tax returns of all members of a household. Conversely, García-Miralles, Guner and Ramos (2019) lacked such data, and drew on data from returns from both spouses. As such, the updated estimates allow for a more precise characterisation of the effective rates paid at this level of aggregation. Estimates for 2019 for households also make it possible to incorporate the income tax reform of 2015, which resulted in a significant fall in effective rates, as described in Section 4.[2]

The rest of this article is structured as follows. Section 2 describes the data sources used and defines the variables under analysis. Section 3 illustrates the progressivity and heterogeneity in effective income tax rates. Lastly, Section 4 presents the parametric estimates.

1 Examples where a parametric personal income tax function has been used to assess tax reforms in the Spanish context using general equilibrium models are: Fuster (2022), Serrano-Puente (2020) and Guner, López-Segovia and Ramos (2020). An example of these functions used to calculate after-tax income in the Spanish Survey of Household Finances can be found in Anghel et al. (2018).

2 The 2015 reform, enacted by Law 26/2014 of 27 November 2014 amending Law 35/2006 of 28 November 2006 on personal income tax, the recast Law on Non-Resident Income Tax, enacted by Royal Legislative Decree 5/2004 of 5 March 2004, and other tax legislation, introduced a number of changes to personal income tax, including the following: 1) the establishment of various new rates applicable to general and savings taxable income (lowering marginal rates) and the partial reversion of the complementary tax introduced in 2012; 2) the raising of minimum personal allowances; 3) the introduction of new tax credits; 4) the revision of the labour income deduction; 5) the removal of the dividend tax exemption; 6) the lowering of the percentage deduction applicable to income generated over a period of more than two years or earned manifestly irregularly over time; 7) the establishment of new limits on tax deductions for contributions and payments into pension schemes; and 8) the modification of other deductions (e.g. for contributions to political parties, donations or payments into a "cuenta ahorro-empresa" (a savings account in which money deposited is earmarked for setting up a new company)).

2 Data sources and definition of variables

The analyses in this paper are based on two sources that compile microdata on 2019 personal income tax declarations taken from random samples of individuals and households. The first database comes from the State tax revenue service (AEAT by its Spanish initialism) and the Institute of Fiscal Studies (IEF by its Spanish initialism), while the second, more recently published, is the fruit of the joint collaboration of these institutions and the National Statistics Institute.[3] The sample of individual taxpayers contains 3.3 million personal income tax assessments, 15.8% of the total. The sample of households contains 1.1 million assessments carried out by a set of 650,000 households, comprising a representative sample of 4.9% of all household taxpayers. To calculate the variables at household level, as mentioned in the introduction, the items in the personal income tax declarations for all members are added together.[4]

The variables under consideration in this paper are constructed as follows. Gross income (before tax) is the sum of income from employment, capital, real estate, economic activities, special schemes and capital gains and losses.[5] The after-tax income is calculated by subtracting the personal income tax liability from gross income, where this liability is calculated as the amount resulting from the self-assessment less any credits (e.g. maternity allowance, childcare expenses and large family credit). The effective rate is calculated as the ratio of the tax liability to gross income (if that ratio is positive) and takes a value of zero otherwise.

In constructing the parametric estimates of the tax, effective rates on general income and savings income are also calculated, as is the value of tax credits, in order to estimate functions reflecting the dual structure of the personal income tax, under which different types of income are taxed at different rates (e.g. labour income is taxed at higher rates than some forms of capital income). Specifically, general income includes the items of gross income that constitute, after any applicable deductions have been made, general taxable income. Savings income, meanwhile, incorporates items of gross income that constitute savings taxable income.[6] The effective general rate is calculated as the ratio of the tax liabilities corresponding to the general taxable income (State and regional) to general income, while the effective savings rate is calculated as the ratio of the tax liabilities corresponding to the savings taxable income to savings income. Lastly, tax credits applicable to the gross liability

3 The sample of individual declarations is called the “Personal Income Tax Samples IEF-AEAT Taxpayers”, while the sample of households is the “Complete Household Panel”. These can be viewed at https://www.ief.es/Investigacion/Est_muestras.vbhtml and https://www.ief.es/Investigacion/Est_panelHogares.vbhtml, respectively.

4 The data show that close to 9% of households have at least three personal income taxpayers, highlighting the importance of considering the income of all taxpayers, beyond the two spouses, when calculating the effective rate of households.

5 It should be noted that the amount of certain items, such as income from economic activities, is reduced by a set of deductible expenses, as opposed to other sources of income, such as income from employment, where the amount is reported on a gross basis, that is to say, before any income tax deductions are applied.

6 General income includes income from employment, capital income to be included in general taxable income, income from real estate, income from economic activities, special schemes to be included in general taxable income and net capital gains (or losses) to be included in general taxable income. Savings income includes capital income to be included in savings taxable income, income attribution schemes to be included in savings taxable income and net capital gains (or losses) to be included in savings taxable income.

are calculated by subtracting the amount paid from the sum of the liabilities corresponding to the general and savings taxable amounts and dividing the result by gross income.

For the calculations in this article, the sample is restricted to taxpayers or households with positive gross income, non-negative sources of income (labour, capital and economic activities) and whose average effective rate does not exceed the maximum marginal rate applicable in 2019 of 48%. 90% of observations at individual level and 95% at household level, representing 97% of taxpayers in both groups, meet these conditions.

3 Progressivity and heterogeneity of effective personal income tax rates

This section illustrates two fundamental features of the personal income tax in Spain. First, its progressive nature, as evidenced by the fact that effective income tax rates generally rise with income. Second, the significant variation in those effective rates for the same level of income, resulting from the application of the dual nature of the personal income tax, the high number of tax benefits available and the regional differences in tax rates and the aforementioned benefits. The purpose of the parametric functions estimated in this paper is to capture this progressivity and condense the heterogeneity of effective rates in a simple expression that allows them to be approximated on the basis of gross income.

Chart 1 shows, for different gross income brackets, expressed as multiples of mean income, different points along the distribution of effective rates, for both individuals (Chart 1.a) and households (Chart 1.b).[7, 8] The figure illustrates shows that, at each of the selected measures of location (the 1st, 10th, 50th, 90th and 99th percentiles of the distribution of effective rates), the tax liability relative to gross income (the effective rate) generally increases with gross income. To be specific, effective rates are zero at the lowest income levels, scale rapidly with increasing income and then slow their rate of increase as they reach the highest income brackets. For example, for households (see Chart 1.b), the median effective rate is zero when income is below 40% of mean income, 17.8% for households whose income is double the mean income and reaches 24.8% when the income amounts to quadruple the mean income.[9]

The considerable disparity in tax liabilities, once they are positive, is also evident in the pronounced differences in the quantile values of the distribution of effective rates, after adjusting for the same level of income. For example, Chart 1.b shows that 10% of households whose gross income was close to the average in 2019 bore an effective tax rate below 5% (the value of the blue line at value 1 on the horizontal axis), while another 10% paid more than 20% (the value of the green line at value 1 on the horizontal axis).

The parametric functions presented in the next section estimate a single effective rate for each income level, making it straightforward to approximate personal income tax revenue for a population when only its income distribution is known. Thus, they condense the significant variability in effective rates for a single income level described in the previous paragraph. These functions can also be used to simulate the impact of reforms by changing their parameters.

7 The values of the measures of location shown on these charts correspond to taxpayers whose declared income falls within the interval defined by the point on the horizontal axis and the same point plus 0.1 times mean gross income.

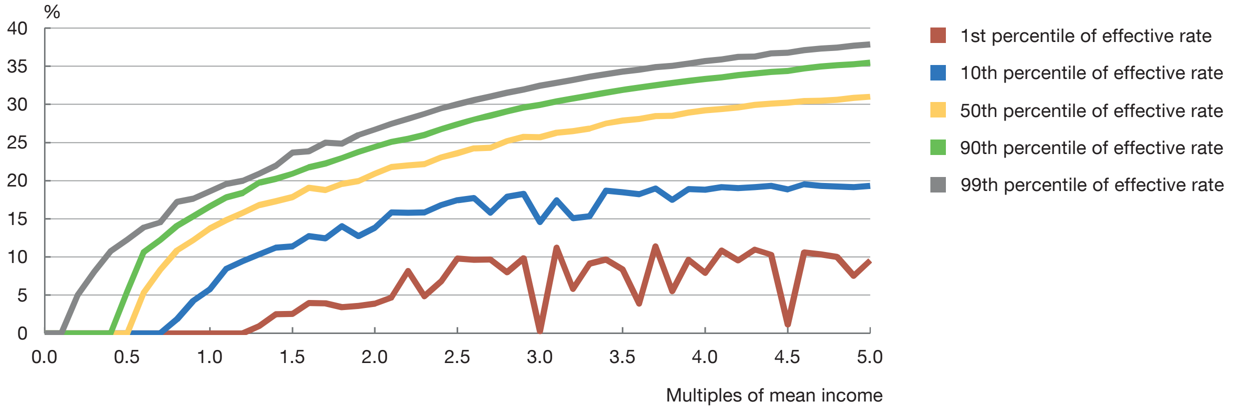
8 The mean gross income in 2019 was €27,729 for individuals and €42,998 for households.

9 In general, in the case of individuals, those earning 0.5, 1 2, or 4 times the mean income are associated with the 33rd, 69th, 94th and 99th percentiles of the income distribution, respectively. For households, these are the 37th, 70th, 92nd and 99th percentiles, respectively.

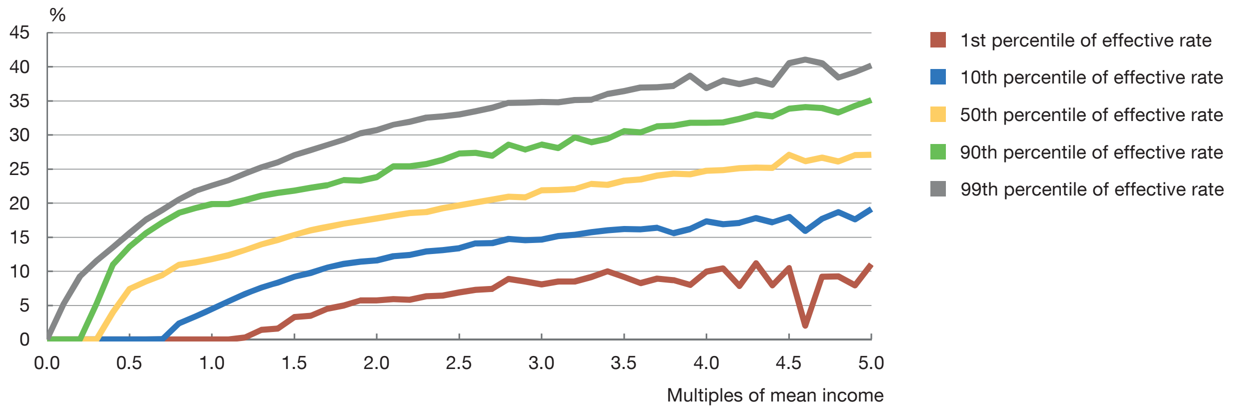
Chart 1

Distribution of effective personal income tax rate by multiples of mean income (2019)

1.a Individuals (a)



1.b Households (a)



SOURCE: Banco de España.

a The values of the measures of location plotted in the chart correspond to taxpayers whose declared income falls within the interval defined by the point marked on the horizontal axis and the same point plus 0.1 times mean gross income.

4 Parametric estimates of the Spanish personal income tax

As we have seen in the previous section, although effective personal income tax rates generally rise with income, there is substantial disparity within the same level of income. This disparity is typically not taken into account in macroeconomic models and must therefore be summarised in simple functional forms in order to characterise personal income taxes in quantitative models that can simulate tax reforms and compute after-tax income in surveys where information is collected solely in gross terms.[10]

Following García-Miralles, Guner and Ramos (2019), this section presents two types of parametric estimates for the personal income tax, both for individuals and for households. First, a single function that links the effective rate with gross income. Second, three functions that capture: 1) the relationship between the effective general tax rate and general income, 2) the effective savings tax rate and savings income, and 3) tax credits and deductions. The latter approach allows the above-mentioned duality of the Spanish personal income tax to be characterised, while facilitating the analysis of more specific personal income tax reforms, for instance changes in capital tax rates.

In mathematical terms, and using the same notation as García-Miralles, Guner and Ramos (2019), the single function that links the effective personal income tax rate and gross income is expressed as follows:

$$t(\tilde{I}) = \begin{cases} 0 & if\ \tilde{I} < \bar{I} \\ f(\tilde{I}) & if\ \tilde{I} \geq \bar{I} \end{cases}$$

where t is the effective rate; $\tilde{I}$ is gross income, expressed as multiples of mean gross income; $\bar{I}$ is the income threshold beyond which the effective rate takes a positive value; and $f(\tilde{I})$ is a parametric function. The income threshold $\bar{I}$ captures the fact that the effective personal income tax rate is zero for a considerable number of taxpayers (see Chart 1), and takes a value that minimises the mean square error of the difference between the observed effective rate and the rate estimated by applying the functional form.

For the function $f(\tilde{I})$, two parametric forms are estimated. First, a specification called HSV, as follows:

$$f(\tilde{I}) = 1 - \lambda \tilde{I}^{-\tau}.$$

In this functional form, the parameters λ and τ have an economic interpretation. The former captures the average effective rate, while the latter represents its progressivity.[11]

10 A considerable body of literature has estimated parametric functions of income tax. See, for example, Heathcote, Storesletten and Violante (2017), Guner, Kaygusuz and Ventura (2014) and Gouveia and Strauss (1994) for the United States, and Calonge and Conesa (2003) and García-Miralles, Guner and Ramos (2019) for Spain.

11 The HSV expression implies that after-tax income ($\tilde{I} - \tilde{I}f(\tilde{I})$) is equal to $\lambda \tilde{I}^{1-\tau}$. Thus, $1-\tau$ is the elasticity of after-tax income income to gross income. Furthermore, for positive values of τ, the marginal rate ($d(t(\tilde{I})\tilde{I})/d(\tilde{I})$) is always higher than the average rate ($t(\tilde{I})$); see Heathcote, Storesletten and Violante (2017).

Second, a function known as GS is estimated, expressed as follows:[12]

$$f(I) = b\,[1 - (sI^{p} + 1)^{-1/p}],$$

where, unlike the HSV specification, income (I) is expressed in euro instead of in multiples of mean income. Again in contrast to the HSV function, in the GS specification the effective rate converges to a constant value as income rises, and therefore the two functional forms can yield markedly distinct estimates in the higher income brackets.

In the second approach (using three functions to characterise the personal income tax), the general income equation takes the same form as in the previous approach. The effective savings rate, meanwhile, is set out as a piecewise linear function:

$$t_s(\tilde{I}_s) = \begin{cases} \alpha + \zeta\, I_s & if\ \tilde{I}_s < \bar{S} \\ \kappa & if\ \tilde{I}_s \geq \bar{S} \end{cases}$$

where t_s is the effective savings rate; $\tilde{I}_s$ is savings income, expressed as multiples of mean savings income; and $\bar{S}$ is the savings income threshold beyond which the effective rate takes a constant value, given by κ. This threshold is recalculated so as to minimise the mean square error. In the function bracket below $\bar{S}$, α is the intercept and ζ is the slope of the line that links savings income with its effective rate; in other words, it determines how much the effective rate increases when income increases, i.e. its progressivity.

Lastly, the function that approximates tax credits takes an exponential form:

$$c(\tilde{I}) = \beta_0 + \beta_1\, \exp(\tilde{I})^{\gamma},$$

where c denotes the tax credits expressed as a fraction of gross income.[13] In this expression, $\beta_0 + \beta_1$ determines the tax credits for taxpayers with no income. Note that if β_1 is positive and γ is negative, tax credits decrease as income rises.

Tables 1 and 2 show, for the one-function and three-function approaches, respectively, the estimated value of the parameters, obtained through non-linear least squares.

Charts 2 and 3 set out the different functional forms. The horizontal axes show gross income brackets expressed as multiples of mean income, while the vertical axes show the effective rate for those income brackets. Each data point on the unbroken line shows the average effective rate of taxpayers whose mean income falls between the corresponding value on the horizontal axis and the value immediately before it. The dotted lines show the

12 The names of these two functional forms derive from the initials of the authors of the papers where they were used: Heathcote, Storesletten and Violante (2017) and Gouveia and Strauss (1994), respectively. The HSV function was also used in Bénabou (2002).

13 This is the only functional form that differs from those estimated in García-Miralles, Guner and Ramos (2019), which models tax credits as follows: $c(\tilde{I}) = \beta_0 + \exp(\beta_1)\exp(\beta_2\tilde{I})\tilde{I}^{\beta_3}$.

Table 1
Parametric estimates of personal income tax: one-function approach (2019)

	Individuals	Households
HSV function		
λ	0.8858	0.8817
	(0.0000)	(0.0001)
τ	0.1446	0.0996
	(0.0001)	(0.0001)
$\bar{I}$	56%	34%
Mean square error	0.0014	0.0024
GS function		
b	0.3069	0.3195
	(0.0002)	(0.0010)
s	0.0000	0.0054
	(0.0000)	(0.0000)
p	3.4676	1.3320
	(0.0117)	(0.0063)
$\bar{I}$	56%	38%
Mean square error	0.0013	0.0024

SOURCE: Banco de España.

parametric estimate of the effective rate according to the functional form at the corresponding point on the horizontal axis. For instance, Chart 2.a shows that taxpayers whose gross income is equivalent to between 4.8 and 5.0 times the mean income pay an average effective rate of 28.6%. For a taxpayer earning more than five times the mean income, the GS and HSV functions predict an effective rate of 26.6% and 29.3%, respectively.

Chart 2 presents the one-function approach for individuals and households. As can be seen, this approach is able to capture the rate of increase in the average effective rate across the income distribution. The HSV function, in the case of individuals, does not converge to a constant effective rate and therefore tends to overestimate the average rate paid by higher-income taxpayers. The GS function does converge to a constant rate, but underestimates the average rate paid by such taxpayers (see Graph 2.a). In the case of households, both the HSV and the GS functions track average effective rates very accurately (see Graph 2.b).

Chart 3 and 4 characterise the personal income tax using three functions for individuals and households. In both cases, the parametric approaches very accurately track the effective rates observed in the data. Specifically, both the HSV and GS functions capture the progressivity of effective general tax rates, although in some instances they tend to underestimate them in the higher income brackets, especially for households (see Charts 3.a and 4.a). On the other hand, the piecewise linear function condenses the behaviour of savings tax rates (see Charts 3.b and 4.b), while the exponential function appears to provide a good representation of the change in tax credits across the income distribution (see Charts 3.c and 4.c).

Table 2

Parametric estimates of personal income tax: three-function approach (2019)

	Individuals	Households
General income: HSV function		
λ	0.8830	0.8758
	(0.0000)	(0.0001)
τ	0.1586	0.1061
	(0.0001)	(0.0001)
$\bar{I}$	58%	37%
Mean square error	0.0010	0.0022
General income: GS function		
b	0.3570	0.3921
	(0.0003)	(0.0016)
s	0.0008	0.0084
	(0.0000)	(0.0001)
p	2.3252	1.0969
	(0.0053)	(0.0046)
$\bar{I}$	60%	40%
Mean square error	0.0011	0.0022
Savings income: piecewise linear function		
α	0.1247	0.1264
	(0.0001)	(0.0002)
ζ	0.0106	0.0099
	(0.0001)	(0.0002)
κ	0.1911	0.1955
	(0.0427)	(0.0390)
$\bar{S}$	6.08%	6.96%
Mean square error	0.0062	0.0055
Tax credits: exponential function		
β_0	0.0061	0.0099
	(0.0001)	(0.0001)
β_1	0.0141	0.0217
	(0.0001)	(0.0003)
γ	-0.8174	-2.7632
	(0.0179)	(0.0555)
Mean square error	0.0015	0.0013

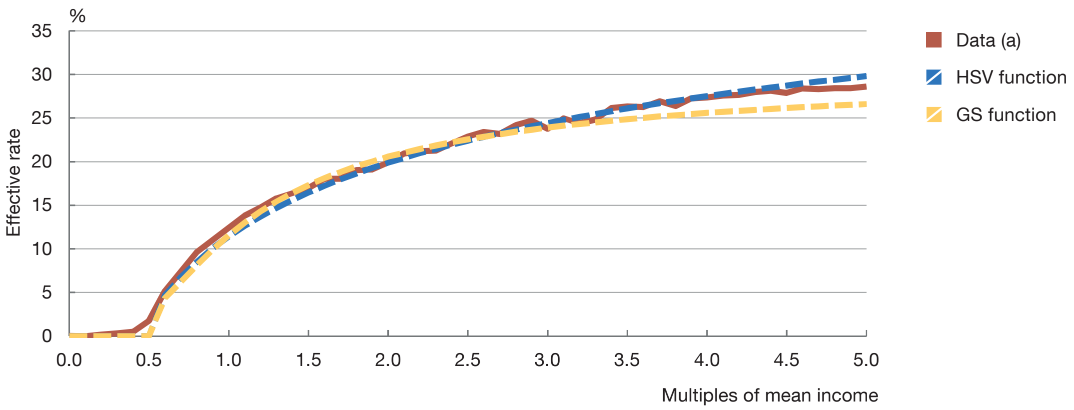
SOURCE: Banco de España.

To assess the accuracy of the different parametric approaches, Tables 3 and 4 set out estimates for individuals and households, respectively. The first column shows the distribution of tax revenue by income bracket, while the remaining columns show the percentage deviation of the revenue predicted by the different parametric functions from the data. This exercise yields two key results. First, the parametric estimates provide a close approximation of total personal income tax revenue (see the last row in each table). For instance, under the three-functional approach the predicted revenue deviates from the data by between -2.8% and 0.4% for individuals and by between -1.9% and -2.0% for

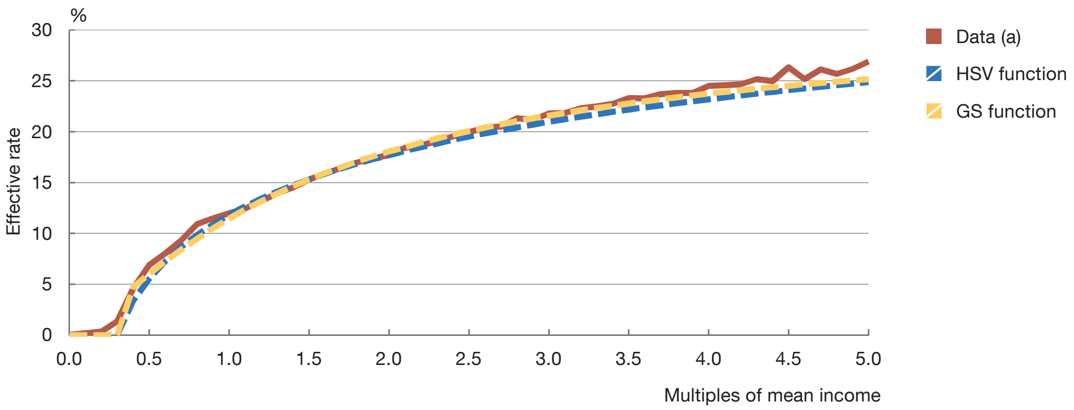
Chart 2

Parametric estimates of personal income tax: one-function approach (2019)

2.a Individuals



2.b Households



SOURCE: Banco de España.

a The data series show the average effective rate of taxpayers whose declared income falls within the interval defined by the point marked on the horizontal axis and the same point plus 0.1 times mean gross income.

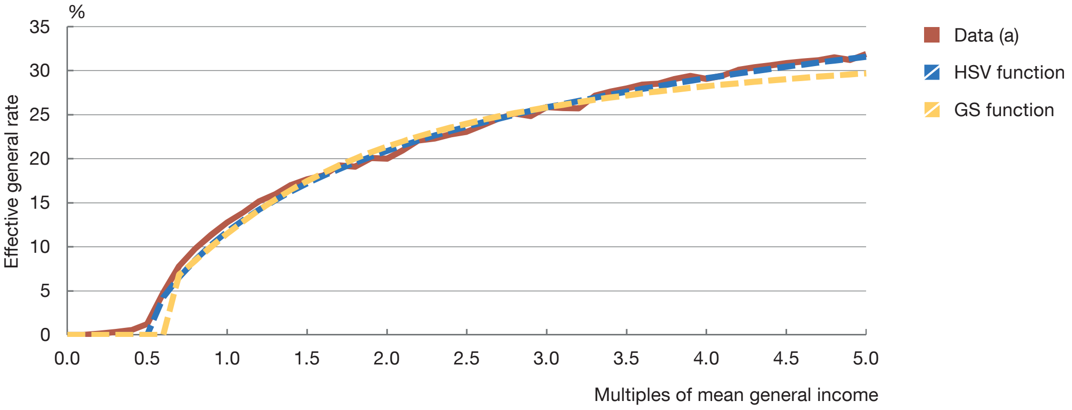
households. Under the one-function approach the deviations are likewise minor for the GS function but are more pronounced for the HSV function. Second, the most marked differences between the actual tax revenue and that predicted under the parametric approaches are predominantly at the higher end of the income distribution. For instance, in the case of households, the three-functional approach underestimates tax revenue from taxpayers in the top 1% of the income distribution by around 9.5%. The difference between the observed and predicted tax revenue in this segment of the income distribution is particularly notable for the one-function approach expressed using the HSV formula, since that function, as noted above, does not converge to a constant effective rate.

Charts 5 and 6 illustrate the changes observed in these parametric functions relative to the estimates in García-Miralles, Guner and Ramos (2019), which, as noted above, are only

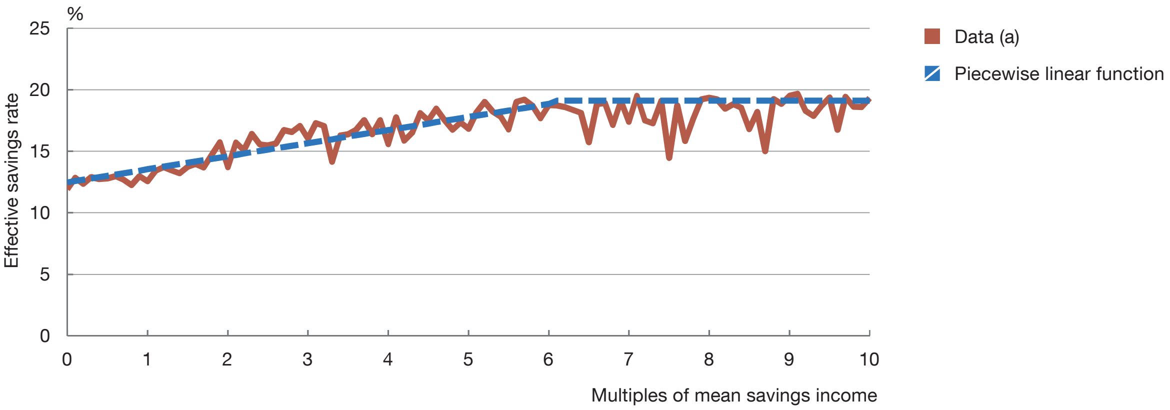
Chart 3

Parametric estimates of personal income tax: three-function approach. Individuals (2019)

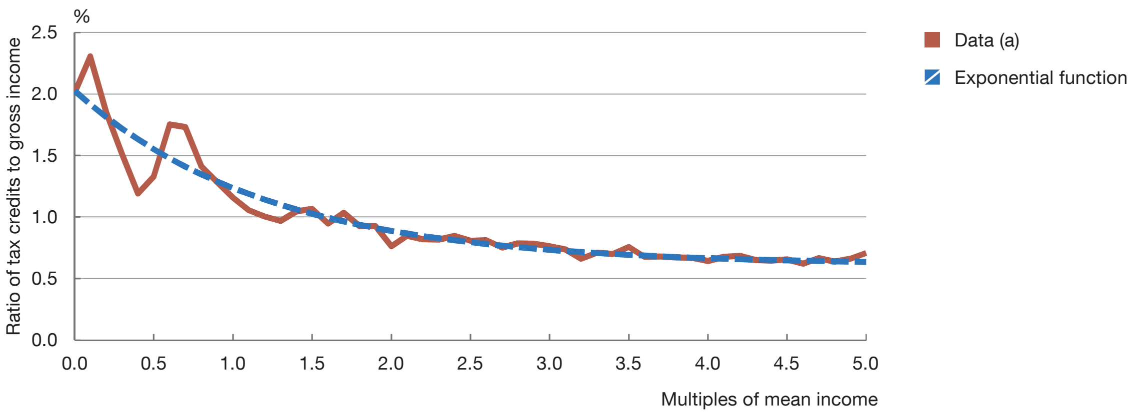
3.a General income



3.b Savings income



3.c Tax credits

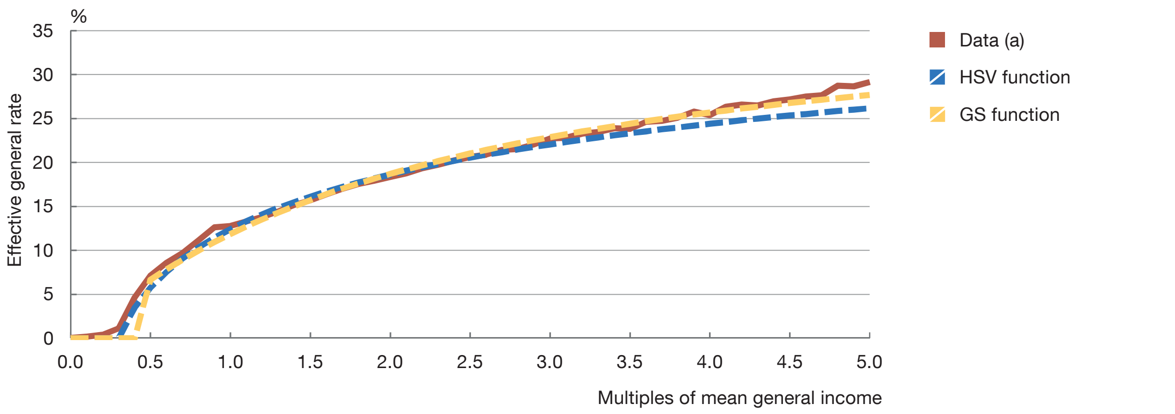


SOURCE: Banco de España.

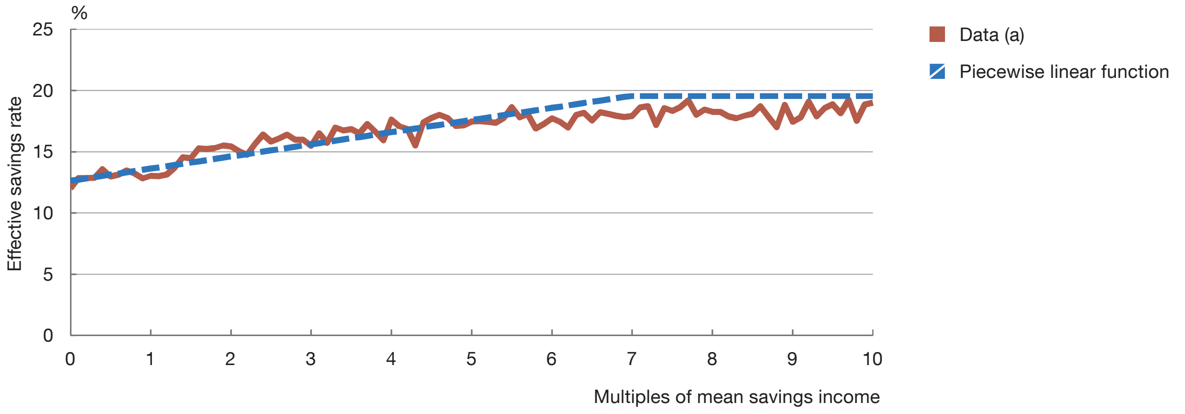
a The data series show the average effective rate of taxpayers whose declared income falls within the interval defined by the point marked on the horizontal axis and the same point plus 0.1 times mean income.

Chart 4
Parametric estimates of personal income tax: three-function approach. Households (2019)

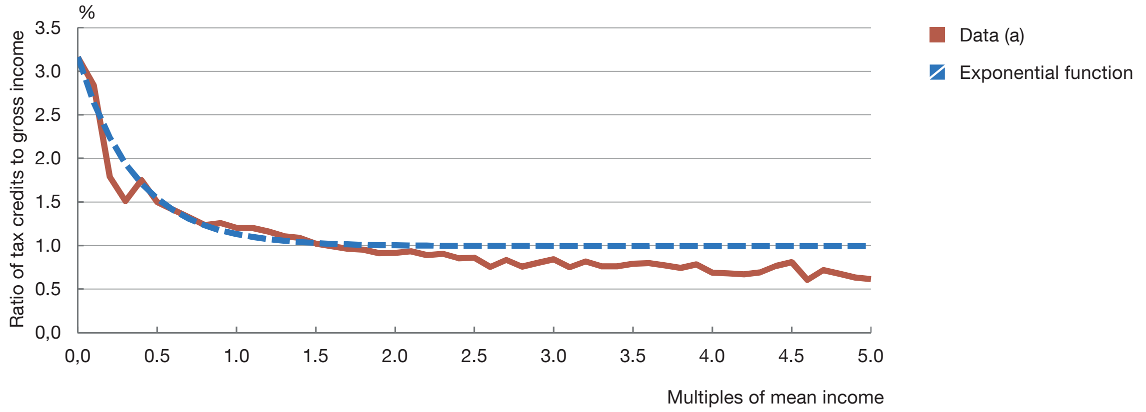
4.a General income



4.b Savings income



4.c Tax credits



SOURCE: Banco de España.

a The data series show the average effective rate of taxpayers whose declared income falls within the interval defined by the point marked on the horizontal axis and the same point plus 0.1 times mean income.

Table 3

Tax revenue: observed and predicted by the functional forms. Individuals (2019)

€bn (second column) and % difference with respect to data (other columns)

	Tax paid	One-function approach (a)		Three-function approach (a)	
		HSV function	GS function	HSV function	GS function
Bottom of income distribution					
1%	0.0	—	—	—	—
1%-5%	-0.1	—	—	—	—
5%-10%	-0.1	—	—	—	—
Income quintiles					
1st (bottom 20%)	-0.4	—	—	—	—
2nd (20%-40%)	0.4	112.6	102.0	-5.9	-20.7
3rd (40%-60%)	6.5	5.4	0.3	-2.1	-2.6
4th (60%-80%)	16.2	-2.9	-0.3	-3.3	-3.6
5th (top 20%)	59.8	12.6	-0.1	1.7	-2.4
Top of income distribution					
90%-95%	10.9	0.7	4.3	2.4	4.6
95%-99%	16.4	0.6	-2.0	0.8	0.2
Top 1%	18.3	42.1	-3.1	3.9	-11.9
Total tax revenue	82.5	10.2	1.0	0.4	-2.8

SOURCE: Banco de España.

a Dashes indicate that the tax paid was negative or zero and, therefore, the percentage difference is not calculated.

Table 4

Tax revenue: observed and predicted by the functional forms. Households (2019)

€bn (second column) and % difference with respect to data (other columns)

	Tax paid	One-function approach (a)		Three-function approach (a)	
		HSV function	GS function	HSV function	GS function
Bottom of income distribution					
1%	0.0	—	—	—	—
1%-5%	-0.1	—	—	—	—
5%-10%	-0.1	—	—	—	—
Income quintiles					
1st (bottom 20%)	-0.3	—	—	—	—
2nd (20%-40%)	2.5	11.0	21.3	-4.3	11.9
3rd (40%-60%)	7.2	1.1	-1.8	-2.0	-5.0
4th (60%-80%)	14.7	2.3	-0.3	2.4	-1.8
5th (top 20%)*(top 20%)*	57.0	4.9	0.9	-2.8	-1.9
Top of income distribution					
90%-95%	10.9	0.1	2.3	0.9	2.3
95%-99%	15.7	-3.0	-0.4	-3.7	0.2
Top 1%	16.7	17.7	-0.1	-9.3	-9.7
Total tax revenue	81.1	4.8	1.4	-1.9	-2.0

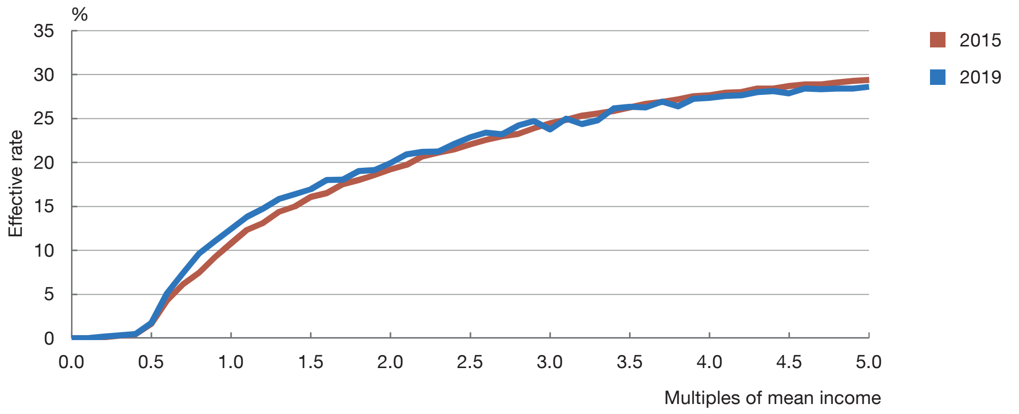
SOURCE: Banco de España.

a Dashes indicate that the tax paid was negative or zero and, therefore, the percentage difference is not calculated.

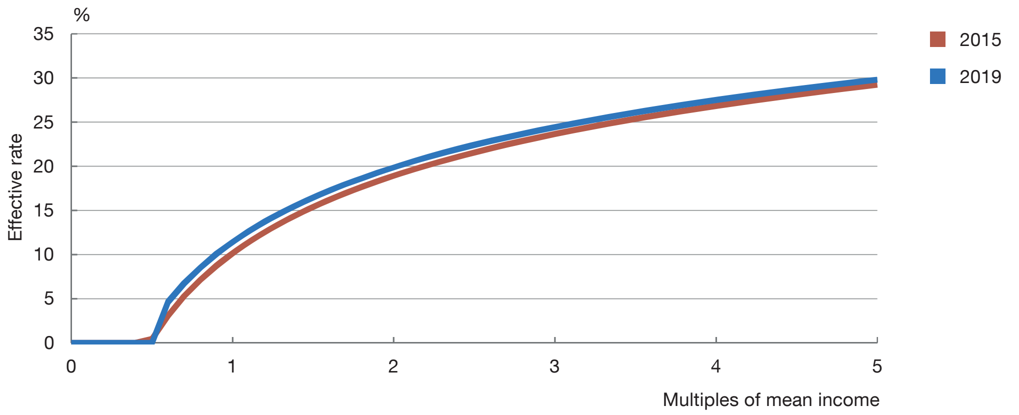
Chart 5

Changes in the parametric functions with respect to García-Miralles, Guner and Ramos (2019). Individuals, 2015 vs. 2019

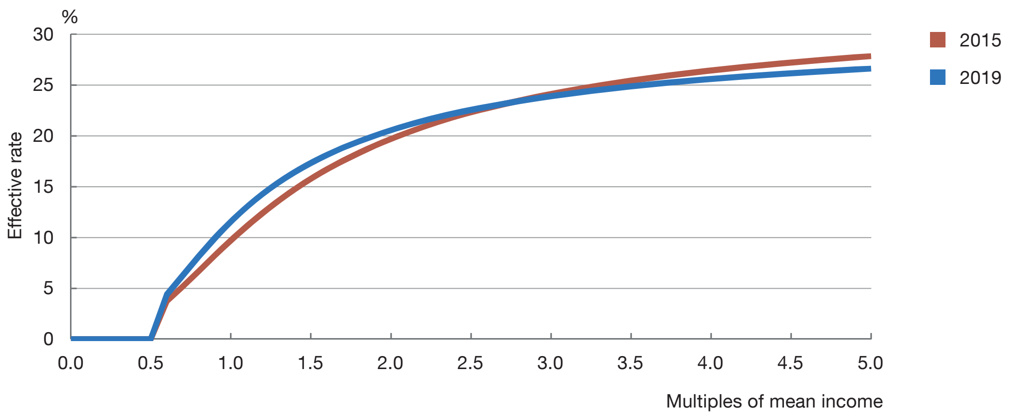
5.a Average effective rates (a)



5.b HSV function



5.c GS function



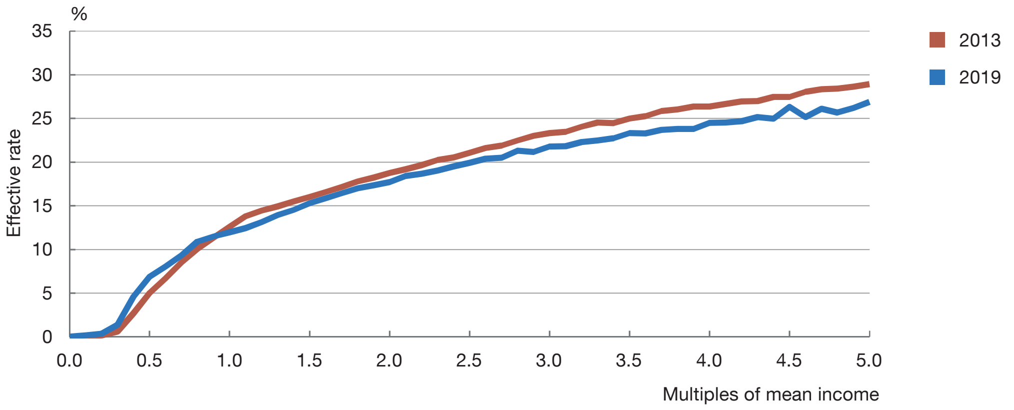
SOURCE: Banco de España.

a The series show the average effective rate of taxpayers whose declared income falls within the interval defined by the point marked on the horizontal axis and the same point plus 0.1 times mean income.

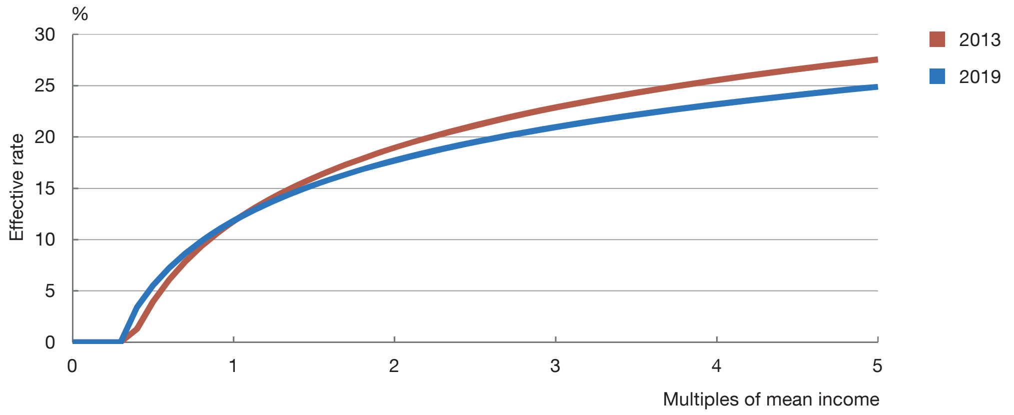
Chart 6

Changes in the parametric functions with respect to García-Miralles, Guner and Ramos (2019). Households, 2013 vs. 2019

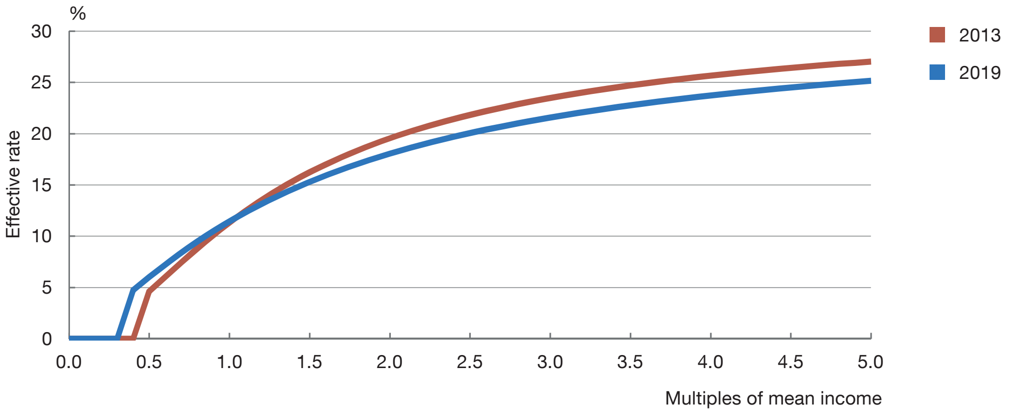
6.a Average effective rates (a)



6.b HSV function



6.c GS function



SOURCE: Banco de España.

a The series show the average effective rate of taxpayers whose declared income falls within the interval defined by the point marked on the horizontal axis and the same point plus 0.1 times mean income.

calculated for 2015 in the case of individuals and 2013 in the case of households.[14] Chart 6.a illustrates the most relevant change: the drop in average effective rates between 2013 and 2019, largely as a result of the 2015 income tax reform. As for the parametric estimates, in the case of individuals there are no major differences in the HSV and GS functions between 2015 and 2019 (see Charts 5.b and 5.c). In the case of households, the 2019 estimates capture the drop in effective rates compared with 2013, both for the HSV and GS functions (see Charts 6.b and 6.c). The HSV function captures a considerable decline in progressivity between 2013 and 2019, reflected in the parameter τ, whose value declines from 0.1224 to 0.0996 in those years. Conversely, the average rates denoted by λ, show greater stability, with the value of this parameter remaining virtually unchanged (0.8823 in 2013 compared to 0.8817 in 2019).[15]

14 Therefore, in the case of individuals, the estimates of García-Miralles, Guner and Ramos (2019) already incorporated the 2015 income tax reform.

15 The estimates of these parameters for 2013 are shown in the second column of Table 10 in García-Miralles, Guner and Ramos (2019).

References

Anghel, B., H. Basso, O. Bover, J. M. Casado, L. Hospido, M. Izquierdo, I. A. Kataryniuk, A. Lacuesta, J. M. Montero and E. Vozmediano. (2018). "Income, consumption and wealth inequality in Spain". *SERIEs,* 9, pp. 351-387. https://link.springer.com/article/10.1007/s13209-018-0185-1

Bénabou, R. (2002). "Tax and education policy in a heterogeneous-agent economy: What levels of redistribution maximize growth efficiency?". *Econometrica,* 70(2), pp. 481-517. https://doi.org/10.1111/1468-0262.00293

Calonge, S. and J. C. Conesa. (2003). "Progressivity and effective income taxation in Spain: 1990 and 1995". Working paper, Centre de Recerca en Economia del Benestar. https://scholar.google.com/citations?view_op=view_citation&hl=es&user=o03xdt4AAAAJ&citation_for_view=o03xdt4AAAAJ:ZeXyd9-uunAC

Fuster, L. (2022). "Macroeconomic and distributive effects of increasing taxes in Spain". *SERIEs,* 13, pp. 613-648. https://link.springer.com/article/10.1007/s13209-022-00269-5

García-Miralles, E., N. Guner and R. Ramos. (2019). "The Spanish personal income tax: facts and parametric estimates". *SERIEs,* 10, pp. 439-477. https://link.springer.com/article/10.1007/s13209-019-0197-5

Gouveia, M. and R. P. Strauss. (1994). "Effective Federal individual income tax functions: an exploratory empirical analysis". *National Tax Journal,* 47(2), pp. 317-339. https://www.journals.uchicago.edu/doi/abs/10.1086/NTJ41789070

Guner, N., R. Kaygusuz and G. Ventura. (2014). "Income taxation of U.S. households: Facts and parametric estimates". *Review of Economic Dynamics,* 17(4), pp. 559-581. https://doi.org/10.1016/j.red.2014.01.003

Guner, N., J. López-Segovia and R. Ramos. (2020). "Reforming the individual income tax in Spain". *SERIEs,* 11, pp. 369-406. https://link.springer.com/article/10.1007/s13209-020-00224-2

Heathcote, J., K. Storesletten and G. L. Violante. (2017). "Optimal tax progressivity: An analytical framework". *The Quarterly Journal of Economics,* 132(4), pp. 1693-1754. https://academic.oup.com/qje/article/132/4/1693/3884644

Serrano-Puente, D. (2020). "Optimal progressivity of personal income tax: a general equilibrium evaluation for Spain". *SERIEs,* 11, pp. 407-455. https://link.springer.com/article/10.1007/s13209-020-00226-0

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