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Abstract:

This paper analyses the effectiveness of statutory marginal rates in generating revenue and (local) progressivity in personal income taxation. Utilising an analytical approach, we derive expressions for the elasticity of the average tax rate and its progression in response to changes in marginal tax rates. The analysis recognises the endogeneity between taxable income and marginal rates (behaviour) and is carried out for the individual taxpayer and the population aggregate. Regarding tax collection, we confirm a low elasticity of the average tax rate to marginal tax rates, individually and in the aggregate. Regarding progressivity, when the marginal rate of a given bracket increases, the progressivity of this specific bracket is heightened. However, it decreases the progressivity of the brackets above while leaving the progressivity in the brackets below unchanged. In other words, increasing the marginal tax rate in a given bracket is "backwards neutral" but "forward regressive". Finally, to show the use of the analytical expressions derived, they are applied to a Spanish microdata set of tax returns.

Keywords: Personal income tax, marginal tax rates, average tax rates, tax rate elasticity

JEL codes: D31, H20, H24

Introduction

Personal income tax (PIT) serves three core functions in fiscal policy: raising revenue, reducing inequality through redistribution, and doing so without imposing excessive efficiency costs. The design of PIT systems is therefore marked by a fundamental equity–efficiency trade-off: while higher taxation can strengthen redistribution, it may also distort economic behaviour and reduce overall efficiency. To evaluate how the tax system balances these objectives, it is crucial to distinguish between marginal and average tax rates. Marginal rates apply to additional units of income and shape taxpayers' prospective economic decisions, thereby determining the efficiency costs of taxation. Average rates, by contrast, capture the overall burden relative to income and reveal both the revenue capacity of the tax and its degree of local progressivity (Pigou, 1928; Slitor, 1948; Musgrave & Thin, 1948). In short, marginal rates shape forward-looking economic behaviour, whereas average rates determine the extent to which the tax raises funds and redistributes them[1].

This distinction matters because policy debates often focus on raising statutory marginal rates—particularly on high-income earners—as a direct route to increasing revenue and strengthening progressivity. However, empirical evidence suggests that the perceived effectiveness of this strategy has shifted over time. Sabirianova Peter et al. (2010) document that, between 1981 and 2005, statutory marginal rates increasingly came to be regarded as blunt instruments for altering revenue and progressivity, largely due to the efficiency costs they impose. Yet, in the aftermath of the 2008 financial crisis and, more recently, the COVID-19 pandemic, these rates have regained prominence as policy tools aimed at pursuing both revenue-raising and distributional objectives. The assumption is that higher marginal rates will automatically deliver more resources and greater fairness. Yet both revenue collection and progressivity are ultimately governed by average tax rates. If statutory changes in marginal rates do not translate into meaningful adjustments in average rates, their impact on revenue and equity may be small, or even offset by behavioural responses such as income shifting or avoidance. For this reason, effective tax design should be guided less by marginal rates themselves and more by how they affect average rates, which provide the true measure of fiscal yield and progressivity impact.

A natural way to assess the effectiveness of statutory marginal rates is through elasticities. The elasticity of the average tax rate with respect to a marginal rate measure how strongly revenue responds to changes in statutory rates. Similarly, the elasticity of the progression of the average tax rate with respect to a marginal rate indicates their impact on progressivity. These elasticities provide an intuitive benchmark: if they are close to zero,

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[1] The discussion of the equity–efficiency trade-off in personal income taxation can be extended beyond statutory marginal rates. Governments typically adjust multiple tax parameters—thresholds, allowances, deductions, and credits—to reconcile redistributive goals with revenue constraints. In this spirit, Morini and Pellegrino (2018) employ a genetic-algorithm framework to identify politically feasible reforms of the Italian PIT that maximize redistribution while holding revenue constant. Similarly, Pellegrino et al. (2019) develop a multi-objective evolutionary approach that simultaneously evaluates redistributive gains (via the Reynolds–Smolensky index) and efficiency costs (proxied by the level of effective marginal tax rates), emphasizing the need to explicitly account for these trade-offs when designing pragmatic tax reforms. In this paper, by contrast, we focus our attention solely on statutory tax rates, abstracting from the full set of parametric adjustments that typically accompany tax reforms.

marginal rate changes are unlikely to alter revenue or equity in a meaningful way; if they are large, marginal rates become powerful instruments of fiscal design. By focusing on elasticities, we capture both the mechanical effects of the schedule and the behavioural responses of taxpayers, offering a comprehensive perspective on the true effectiveness of marginal rates.

The analytical results reveal a clear pattern. Statutory marginal rates are only weakly effective at raising revenue, since average tax rates respond very little to changes in them. This inelasticity is especially marked in the upper brackets, where policymakers often expect the largest gains. From a distributional perspective, the effects are asymmetric: raising the marginal rate in a given bracket does increase progressivity locally, but it reduces progressivity in all brackets above while leaving those below unchanged. Put differently, marginal rate hikes are backwards neutral—they do not affect the fairness of lower brackets—but forward regressive, as they diminish progressivity for higher-income taxpayers. These findings highlight the limits of using statutory marginal rates as policy tools, showing that their impact on both revenue and equity depends crucially on how they reshape average tax rates across the entire income distribution.

This paper contributes to the literature by providing a formal analytical framework that links statutory marginal rates to both revenue and distributional outcomes through the behaviour of average tax rates. In doing so, it extends the classical approaches to measuring progressivity (Pigou, 1928; Musgrave & Thin, 1948; Kakwani, 1976, 1977) and connects them with modern research on the elasticity of taxable income (Feldstein, 1995; Saez, 2004; Chetty, 2009; Saez et al., 2012). Unlike previous studies, which either examined redistribution using progressivity indices or modelled revenue dynamics under specific assumptions (e.g., Creedy & Gemmell, 2006), this paper derives tractable expressions for the elasticity of the average tax rate and of its progression with respect to statutory rates, both at the individual and aggregate level. The framework allows us to separate mechanical and behavioural components of the response, and to apply them directly to microdata. An empirical application using Spanish tax returns illustrates the relevance of the results for real-world PIT systems. In addition, while the core focus of this paper is on the role of statutory marginal rates as determinants of local progressivity, Appendix B extends the analytical framework to explore the channels through which these rates affect the effective measures of progressivity and redistribution.

The remainder of the paper is organized as follows. Section 2 develops the analytical framework and derives the elasticities of average tax rates and their progression at the individual level. Section 3 extends the analysis to the aggregate distribution of taxpayers, highlighting the implications for revenue and equity at the population level. Section 4 illustrates the empirical relevance of the framework with an application to Spanish personal income tax microdata. Section 5 concludes by summarizing the main findings and discussing their broader implications for the design of personal income tax systems.

2. Individual elasticities

In this section, we derive the analytical expressions for the elasticities of the average tax rate and its progression with respect to statutory marginal tax rates at the individual level[2].

Consider a taxpayer i with taxable income y_i subject to a progressive tax schedule ζ, defined as $\zeta = \zeta(\boldsymbol{A}, \boldsymbol{\tau})$, where $\boldsymbol{\tau} = (\tau_0, \tau_1, \dots, \tau_K)$ denotes the vector of statutory marginal rates and $\boldsymbol{A} = (a_0, a_1, \dots, a_K)$ the corresponding income thresholds, with $K = 0, 1, 2, \dots k$. The total tax liability of taxpayer i, denoted T_i, is:

$$T_i = \sum_{j=0}^{k-1} \left(a_{j+1} - a_j\right) \cdot \tau_j + (y_i - a_k) \cdot \tau_k \qquad [1]$$

Following Creedy and Gemmell (2006), this can be expressed more compactly as

$$T_i = \tau_{k_i} \cdot (y_i - a'_{k_i}) \qquad [2]$$

where τ_{k_i} is the marginal rate corresponding to the bracket in which y_i falls, and a'_{k_i} represents the effective threshold. The effective threshold a'_{k_i} is the amount of income that must be subtracted from the taxpayer's total income so that, if the remainder were taxed entirely at the top marginal rate τ_{k_i}, the resulting liability would equal the liability under the progressive schedule. It is computed as

$$a'_{k_i} = a_k - \sum_{j=0}^{k-1} \frac{\tau_j}{\tau_{k_i}} \cdot \left(a_{j+1} - a_j\right) \qquad [3]$$

where a_k is the nominal upper limit of bracket k, and the summation adjusts for the weighted contribution of the lower brackets.

Using equation [2], the individual average tax rate is given by

$$atr_i = \tau_{k_i} \cdot \left[1 - \frac{a'_{k_i}}{y_i}\right] \qquad [4]$$

while the progression of the average tax rate is

[2] We deliberately restrict the analysis to statutory marginal tax rates (SMTRs) –i.e. the rates explicitly defined in the tax schedule. These rates are the ones most visible in public debate and the natural target of policy reform. Effective marginal tax rates (EMTRs), in contrast, also reflect deductions, allowances, and credits, and therefore vary widely across taxpayers. While EMTRs are very important for applied microsimulation studies, their heterogeneity makes them less suitable for a general analytical framework such as the one developed here. By concentrating on statutory rates, we can provide transparent results that highlight the core mechanisms through which legislated parameters influence average tax rates, revenue, and progressivity. However, it must be clear that the statutory rate schedule is only part of the picture, as deductions, allowances, and tax credits also contribute to shaping both taxpayers' effective burdens and the overall distributional outcome of the PIT.

$$atrp_i = \frac{\tau_{k_i} \cdot a'_{k_i}}{y_i^2} \qquad [5]$$

Equation [4] indicates that a taxpayer's average tax rate rises with the statutory marginal rate but declines as income grows relative to the effective threshold — meaning that taxpayers further above the threshold face a lower average burden relative to their marginal rate. Equation [5] shows that the progression of the average tax rate is stronger when both the marginal rate and the effective threshold are higher, but it diminishes rapidly as income increases, reflecting the flattening of progressivity within each bracket. Building on these relationships, we next derive the elasticities of the average tax rate and of its progression with respect to statutory marginal tax rates, which measure how changes in marginal tax rates translate into variations in revenue and progressivity, under the assumption that marginal rate changes do not cause taxpayers to move across brackets.

2.1. The elasticity of the individual average tax rate to changes in statutory marginal tax rates

From equation [4], the elasticity of the individual average tax rate with respect to any statutory marginal tax rate $\tau_h \in \boldsymbol{\tau}$ is defined as

$$\eta_{atr_i,\tau_h} = \frac{d\, atr_i}{d\, \tau_h} \cdot \frac{\tau_h}{atr_i},$$

which, in the absence of income effects[3], takes the form:

$$\eta_{atr_i,\tau_h} \begin{cases} = \frac{\tau_h}{\tau_{k_i}} \cdot \frac{(a_{h+1} - a_h)}{\left(y_i - a'_{k_i}\right)} & if \quad \tau_h < \tau_{k_i} \\ = \frac{(y_i - a_k)}{\left(y_i - a'_{k_i}\right)} - \frac{\tau_{k_i}}{1-\tau_{k_i}} \cdot ETI_i \cdot \frac{a'_{k_i}}{\left(y_i - a'_{k_i}\right)} & if \quad \tau_h = \tau_{k_i} \\ = 0 & if \quad \tau_h > \tau_{k_i} \end{cases} \qquad [6]$$

Here, $ETI_i = \eta_{y_i,(1-\tau_{k_i})}$ represents the elasticity of taxable income, capturing the behavioural response of taxpayer i to changes in their residual marginal tax rate, $(1 - \tau_{k_i})$.[4]

[3] Most of the literature rejects the existence of income effects in personal income tax, implying that average rate changes induced by marginal tax rates do not generate a behavioural response in the taxpayer. This literature includes Gruber and Saez (2002), Bakos et al. (2008), Gottfied and Witczak (2009) and Kleven and Schultz (2014). For a discussion of income effects and the elasticity of the tax base, see Creedy (2022, chapter 9).

[4] The elasticity of taxable income (ETI) recognises the fact that the magnitude of the taxpayer's taxable income is endogenous to marginal tax rates. Feldstein (1995, 1999) was a pioneer in exploring and highlighting the importance of the elasticity of taxable income. Subsequently, the ETI has been intensively studied, both theoretically and empirically. Without being exhaustive, this literature includes Saez (2004),

A positive and statistically significant ETI_i implies that an increase in τ_{k_i} reduces reported taxable income, thereby dampening revenue growth.

Equations [6] show that the sensitivity of the taxpayer's average tax rate to changes in the schedule's K marginal rates is not uniform; it depends on the position of the adjusted marginal rate τ_h relative to the taxpayer's own rate τ_{k_i}:

- **Lower-bracket change ($\tau_h < \tau_{k_i}$)**: The resulting elasticity is purely mechanical, determined by y_i and the schedule parameters $\boldsymbol{A}$ and $\boldsymbol{\tau}$. Wider lower brackets and higher marginal rates increase this elasticity, particularly when τ_h approaches τ_{k_i}.

- **Own-bracket change ($\tau_h = \tau_{k_i}$)**: The elasticity combines two opposing effects. The mechanical component, $\frac{(y_i - a_k)}{(y_i - a'_{k_i})}$, captures the direct adjustment of the tax burden. The behavioural component, $\frac{\tau_{k_i}}{1-\tau_{k_i}} \cdot ETI_i \cdot \frac{a'_{k_i}}{(y_i - a'_{k_i})}$, offsets part of this effect, as taxpayers reduce taxable income when faced with higher marginal rates.

- **Upper-bracket change** ($\tau_h > \tau_{k_i}$): Changes in marginal rates for income levels above the taxpayer's own bracket have no impact on their average tax rate.

Differentiating η_{atr_i,τ_h} with respect to taxable income yields:

$$\frac{d\eta_{atr_i,\tau_h}}{dy_i} \begin{cases} = -\frac{\tau_h}{\tau_{k_i}} \cdot \frac{(a_{h+1} - a_h)}{\left(y_i - a'_{k_i}\right)^2} & if \quad \tau_h < \tau_{k_i} \\ = \frac{(a_k - a'_{k_i}) + \frac{\tau_{k_i}}{1-\tau_{k_i}} \cdot ETI_i \cdot a'_{k_i}}{\left(y_i - a'_{k_i}\right)^2} & if \quad \tau_h = \tau_{k_i} \\ = 0 & if \quad \tau_h > \tau_{k_i} \end{cases} \qquad [7]$$

Equation [7] reveals that the elasticity of the average tax rate rises with income only when the marginal rate being modified corresponds to the taxpayer's own bracket ($\tau_h = \tau_{k_i}$). In that case, higher income amplifies both the mechanical and behavioural components. When the change occurs in a lower bracket ($\tau_h < \tau_{k_i}$), elasticity declines with income, reflecting the diminishing effect of lower-bracket adjustments. For upper-bracket changes ($\tau_h > \tau_{k_i}$), elasticity remains zero, as those rates do not affect taxpayers below the threshold.

Chetty (2008, 2009), Giertz (2009), and Saez et al. (2012). For a detailed review of the concept of ETI, see Creedy (2022).

To illustrate these patterns, we apply the framework to the 2020 Spanish general income tax schedule for the Central Government, summarized below:

ζ_{2020}	
$\vec{A}$	$\vec{\tau}$
0	0.095
12,450	0.12
20,200	0.15
35,200	0.185
60.000	0.225

Assuming no behavioural response ($ETI_i = 0$), Figure 1 depicts the relationship between η_{atr_i,τ_h} and taxable income for each of the five marginal rates. The highest elasticity occurs for τ_0 among taxpayers within the first bracket. Beyond this range, elasticities decrease sharply, approaching zero in the uppermost bracket. For all other marginal rates, η_{atr_i,τ_h} remains well below unity and affects only taxpayers near the upper limit of each bracket.

In summary, except for η_{atr_i,τ_0}, which equals one for all taxpayers in the first bracket, the elasticities of individual average tax rates are highly inelastic. This suggests that changes in statutory marginal rates have limited effectiveness in altering taxpayers' average burdens and, consequently, overall revenue collection.

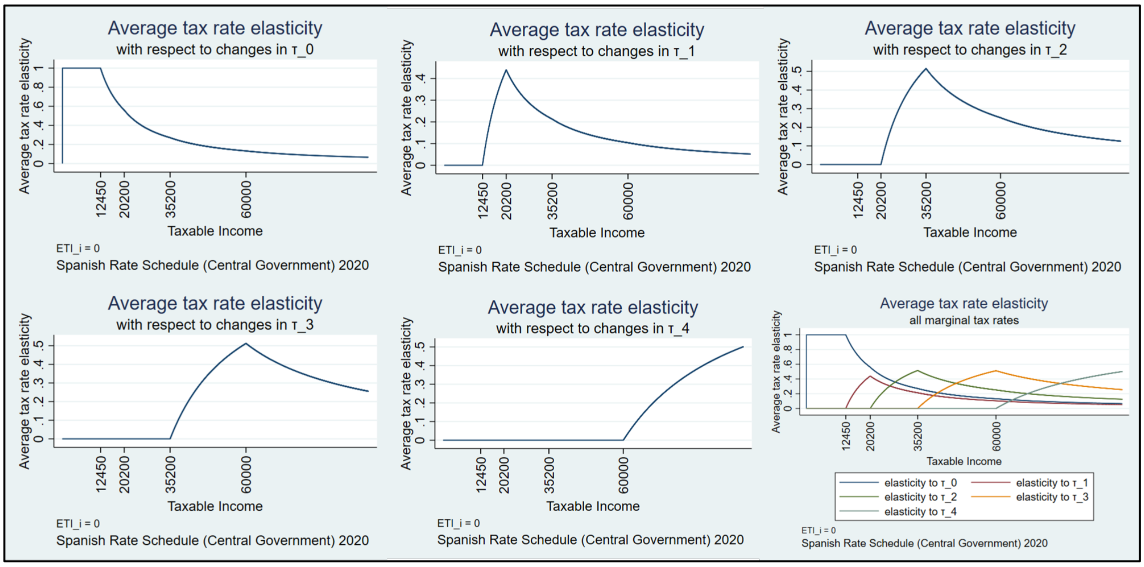

Figure 1: Profile of the average tax rate elasticity to changes in the marginal tax rates as taxable income increases.

To account for behavioural reactions, Figure 2 displays simulated profiles of $\frac{d\,\eta_{atr_i,\tau_h}}{d\,y_i}$ for three alternative values of ETI_i. Behavioural responsiveness affects all brackets except the first, where elasticity remains purely mechanical. In higher brackets, the main effect is a rightward shift of the elasticity curve, meaning that elasticities decline for taxpayers facing an increased marginal rate, and even turn negative near the lower threshold of each bracket.

This pattern reveals that when behavioural responses are significant, raising marginal rates may reduce taxable income among affected taxpayers, undermining both revenue and progressivity objectives. The divergence between mechanical and behavioural elasticities becomes more pronounced at higher income levels, where effective thresholds are larger and adjustment incentives stronger. These results underscore that the responsiveness of the average tax rate to statutory tax rate changes is highly nonlinear, constrained by both the structural features of the tax schedule and taxpayers' behavioural reactions.

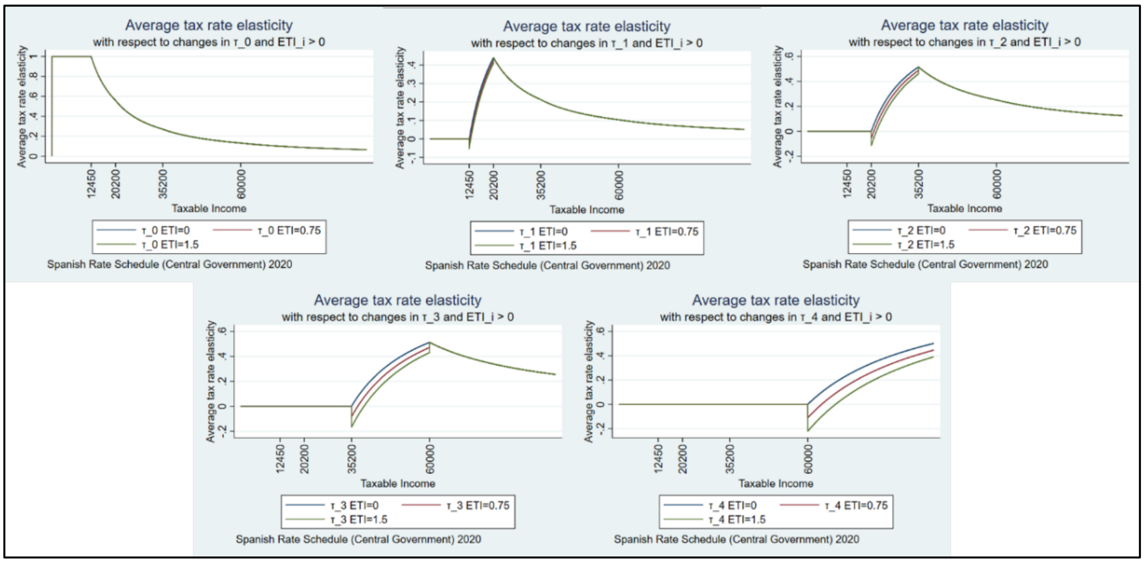

Figure 2: Changes in the profile of the elasticity of the average tax rate with different intensities in the taxpayers' behavioural reactions (ETIs).

2.2. *The elasticity of the individual average tax rate progression to changes in statutory marginal tax rates*

Building on equation [5], the elasticity of the progression of the average tax rate with respect to a statutory marginal tax rate $\tau_h \in \boldsymbol{\tau}$is defined as

$$\eta_{atrp_i,\tau_h} = \frac{datrp_i}{d\tau_h} \cdot \frac{\tau_h}{atrp_i}$$

From this expression, we obtain:

$$\eta_{atrp_i,\tau_h} \begin{cases} = -\frac{\tau_h}{\tau_{k_i}} \cdot \frac{(a_{h+1} - a_h)}{a'_{k_i}} & if \quad \tau_h < \tau_{k_i} \\ = \frac{a_k}{a'_{k_i}} + 2 \cdot \frac{\tau_{k_i}}{1-\tau_{k_i}} \cdot ETI_i & if \quad \tau_h = \tau_{k_i} \\ = 0 & if \quad \tau_h > \tau_{k_i} \end{cases} \qquad [8]$$

Equation [8] shows that increasing a marginal tax rate enhances progressivity for taxpayers within the affected bracket ($\tau_h = \tau_{k_i}$), reduces it for those in higher brackets ($\tau_h < \tau_{k_i}$), and leaves it unchanged for those in lower brackets ($\tau_h > \tau_{k_i}$). In other words, a rise in a marginal rate produces a localized gain in progressivity—a "within-bracket" strengthening of redistribution—at the cost of forward regressivity (a reduction in progressivity above that bracket) and backward neutrality (no change below it). This asymmetric response highlights the inherent structural limitation of statutory marginal rates as instruments for enhancing overall local progressivity.

To examine how this elasticity evolves along the income distribution, we differentiate η_{atrp_i,τ_h} with respect to taxable income:

$$\frac{d\eta_{atrp_i,\tau_h}}{dy_i} \begin{cases} = 0 & if \quad \tau_h \neq \tau_{k_i} \\ = 2 \cdot \frac{\tau_{k_i}}{1-\tau_{k_i}} \cdot \eta_{ETI_i,y_i} \cdot \frac{ETI_i}{y_i} & if \quad \tau_h = \tau_{k_i} \end{cases} \qquad [9]$$

Equation [9] indicates that the elasticity of average tax rate progression increases with income only when the taxpayer's own marginal rate changes ($\tau_h = \tau_{k_i}$) and the elasticity of taxable income (ETI_i) is positive and rises with income. This pattern aligns with empirical evidence showing that higher-income taxpayers tend to be more responsive to marginal rate changes (Sammartino & Weiner, 1997; Carroll, 1998; Gruber & Saez, 2002; Esteller-Moré et al., 2018; Kemp, 2019; Creedy, 2022, ch. 7). For all other taxpayers, η_{atrp_i,τ_h} remains invariant with respect to income levels.

To visualize these relationships, Figure 3 presents the evolution of η_{atrp_i,τ_h}across the five marginal tax rates of the 2020 Spanish general income tax schedule (ζ_{2020}), assuming no behavioural response ($ETI_i = 0$). The results show that an increase in the marginal rate of a given bracket strengthens local progressivity within that bracket but simultaneously weakens progressivity in higher brackets, confirming the presence of forward regressivity.

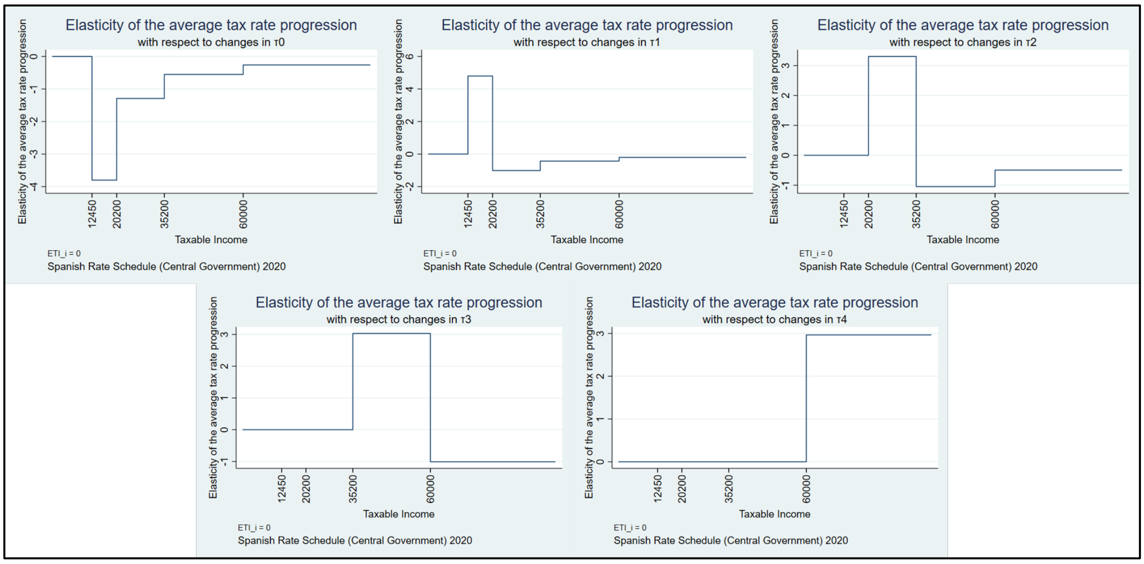

Figure 3: Profile of the elasticity of the average tax rate progression to changes in the marginal tax rates as taxable income increases.

Figure 4 illustrates how behavioural responsiveness modifies these profiles. When taxpayers react to higher marginal rates ($ETI_i > 0$), the effect emerges exclusively within the affected bracket ($\tau_h = \tau_{k_i}$), where greater behavioural sensitivity amplifies the elasticity of progressivity. For taxpayers in other brackets, the elasticity remains unchanged, confirming the strictly local nature of these adjustments.

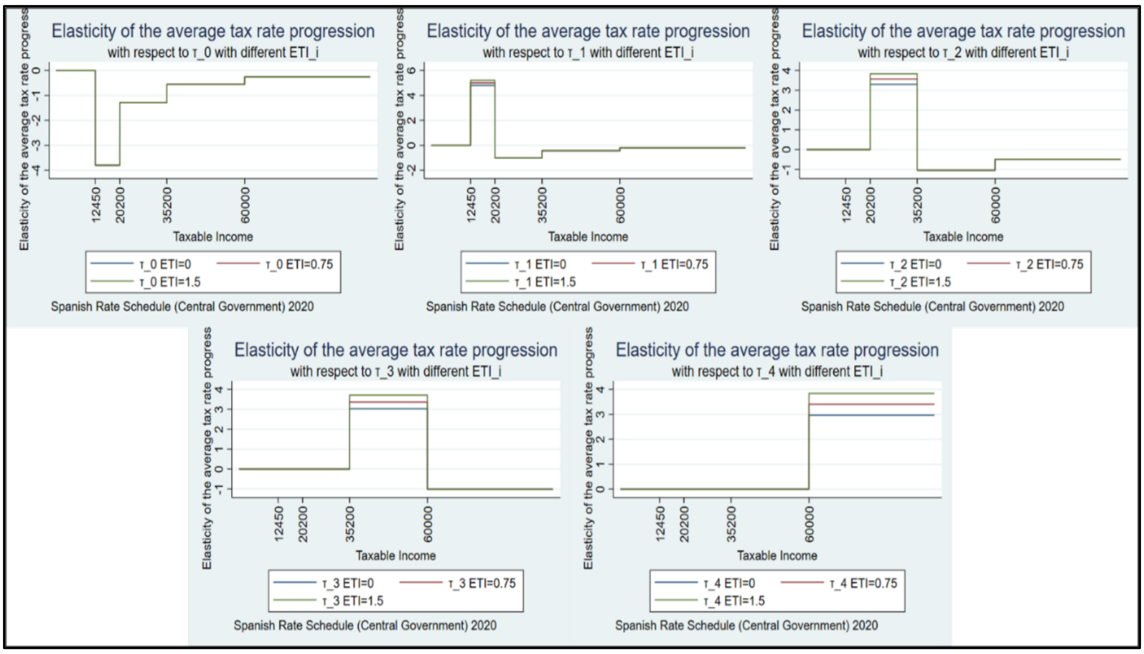

Figure 4: Changes in the profile of the elasticity of the average tax rate progression with different intensities in the taxpayers' behavioural reactions (ETIs).

3. Aggregate elasticities

From a policy perspective, the population-wide– elasticities of the average tax rate convey richer information than their individual counterparts. They capture not only how single taxpayers react to marginal rate changes but also how the income distribution across brackets amplifies or dampens these effects at the macro level. Aggregate elasticities, however, are not a mere arithmetic average of individual elasticities: they are weighted by the income masses and behavioural responses embedded in the statutory tax schedule. Their magnitude therefore depends critically on both the *shape* of the schedule and the *composition* of the taxpayer population.

Building on this premise, we derive the analytical expressions for the aggregate elasticities of the average tax rate and its progression. The derivation begins by specifying the aggregate tax function that relates total revenue to the statutory marginal tax rates, the bracket thresholds, and the income distribution. Following Creedy (2011, p. 280), total revenue can be expressed as

$$T = \sum_{j=0}^{k} \tau_j \cdot \left(\bar{y}_j - a_j\right) \cdot P_j + \sum_{j=0}^{k-1} \tau_j \cdot \left(a_{j+1} - a_j\right) \cdot P_j^{+} \qquad [10]$$

Here j indexes income brackets, $\bar{y}_j$ is the mean taxable income within bracket j, P_j is the number of taxpayers in that bracket, and P_j^{+} is the cumulative number of taxpayers in all higher brackets. Parameters a_j and a_{j+1} denote the lower and upper thresholds, respectively, while τ_j is the statutory marginal tax rate applied to income between those bounds.

The first term on the right-hand side of equation [10] represents the tax revenue generated within the *last bracket reached* by each taxpayer's income —that is, the portion of income that lies between the lower and upper thresholds of the bracket in which the taxpayer is effectively located and is fully taxed at the corresponding marginal rate τ_j. The second term, in contrast, accounts for the revenue raised from the *lower brackets* that each taxpayer's income passes through before reaching its final bracket. These lower segments of income are taxed at the marginal rates applicable to the preceding brackets, thereby contributing to total revenue across multiple segments of the schedule. Together, these two components describe the mechanical mapping between the tax schedule and total revenue before any behavioural adjustment occurs.

3.1 The elasticity of the population average tax rate to changes in statutory marginal tax rates.

Given equation [10], the aggregate average tax rate (ATR) for a population of N taxpayers is defined as

$$ATR = \frac{T}{Y} \qquad with \qquad Y = \sum_{i=1}^{N} y_i \qquad [11]$$

The elasticity of the aggregate average tax rate with respect to any statutory marginal rate τ_j is

$$\eta_{ATR,\tau_j} = \frac{dATR}{d\tau_j} \cdot \frac{\tau_j}{ATR} = \eta_{T,\tau_j} - \eta_{Y,\tau_j} \quad [12]$$

This decomposition expresses the response of the average tax rate to a marginal rate change as the difference between the revenue elasticity and the taxable-income elasticity capturing, respectively, the channels through which tax rate changes affect the overall burden[5].

The elasticity of total tax revenue with respect to τ_j can be written as

$$\eta_{T,\tau_j} = \frac{\tau_j}{T} \cdot \left[P_j \cdot \left(\bar{y}_j - a_j - \frac{\tau_j}{1-\tau_j} \cdot \overline{ETI}_j \cdot \bar{y}_j \right) + P_j^{+} \cdot \left(a_{j+1} - a_j \right) \right] \quad [13]$$

and the elasticity of aggregate taxable income as

$$\eta_{Y,\tau_j} = -\frac{P_j \cdot \bar{y}_j}{Y} \cdot \frac{\tau_j}{1-\tau_j} \cdot \overline{ETI}_j \quad [14]$$

Equation [13] identifies two distinct contributions to the revenue response. The first term inside the squared brackets is the within-bracket mechanical effect, proportional to the number of taxpayers in the bracket and their average income but reduced by the potential behavioural response captured by the average elasticity of taxable income ($\overline{ETI}_j$). The second term reflects the spillover mechanical effect from taxpayers whose incomes exceed the upper threshold a_{j+1}, whose lower portion of income, $(a_{j+1} - a_j)$, are still taxed at τ_j. Taken together, these two components illustrate that a variation in a single marginal rate affects aggregate revenue through both a *direct within-bracket effect* and an *indirect cross-bracket effect*, as higher-income taxpayers also pay the lower marginal rates on portions of their income lying below the affected threshold.

Equation [14], in turn, measures how total taxable income contracts as marginal tax rates rise. The negative sign reflects behavioural adjustments: higher statutory rates lower the net-of-tax return $(1 - \tau_j)$ and may induce taxpayers to reduce their reported taxable income through changes in labour effort, capital allocation, entrepreneurial activity, or tax-planning behaviour. The strength of this behavioural effect depends on three elements:

5 Starting from the identity $ATR = T/Y$, taking natural logarithms on both sides gives $\ln(ATR) = \ln(T) - \ln(Y)$. Differentiating with respect to the statutory marginal rate τ_j yields $d\ln(ATR)/d\ln(\tau_j) = d\ln(T)/d\ln(\tau_j) - d\ln(Y)/d\ln(\tau_j)$. This directly leads to $\eta_{ATR,\tau_j} = \eta_{T,\tau_j} - \eta_{Y,\tau_j}$, which is the expression in equation [12].

(i) the income share of taxpayers in the affected bracket, $P_j\bar{y}_j/Y$;
(ii) the relative size of the marginal rate, $\tau_j/(1-\tau_j)$; and
(iii) the degree of behavioural responsiveness, $E\bar{T}I_j$.

These results provide a transparent framework for interpreting aggregate tax elasticities. The overall elasticity of the average tax rate, η_{ATR,τ_j}, summarises how statutory changes translate into variations in both revenue and the effective tax burden across the entire income distribution. Because the expressions in [13]-[14] require only readily available information—marginal rates, bracket thresholds, taxpayer counts, and average incomes by bracket—they can be implemented with administrative or survey data in most countries. Hence, this approach offers a tractable and policy-relevant tool to evaluate how statutory marginal rate reforms affect tax revenue and tax progressivity.

3.2 *The elasticity of the aggregate progression of the average tax rate to changes in statutory marginal tax rates.*

Building on the preceding analysis of aggregate elasticities, we now examine the responsiveness of aggregate local progressivity—that is, how the slope of the average tax rate evolves as income increases. By definition, the progression of the aggregate average tax rate is given by $ATRP = dATR/dY$, and its elasticity with respect to changes in the statutory marginal rate τ_j, denoted η_{ATRP,τ_j}, is defined as

$$\eta_{ATRP,\tau_j} = \frac{d\,ATRP}{d\,\tau_j} \cdot \frac{\tau_j}{ATRP}.$$

Using equation [11] and rearranging terms, we obtain:

$$\eta_{ATRP,\tau_j} = \eta_{MTR,\tau_j} \cdot \frac{LP}{LP-1} - \eta_{T,\tau_j} \cdot \frac{1}{LP-1} + \eta_{Y,\tau_j} \cdot \frac{2-LP}{LP-1} \qquad [15]$$

where LP denotes the liability progression of the tax system, defined as the ratio between the aggregate marginal and average tax rates, $LP = MTR/ATR$. The derivation of equation [15] is shown in *Appendix A*.

The parameters $\eta_{T,\tau_j}$and η_{Y,τ_j}, defined previously in equations [13] and [14], represent, respectively, the elasticities of total tax revenue and aggregate taxable income with respect to the statutory marginal rate τ_j.The remaining component, η_{MTR,τ_j}, measures the elasticity of the aggregate marginal tax rate itself. Given that the aggregate marginal rate is defined as[6]

[6] Formally, the aggregate marginal tax rate is defined as $MTR = dT/dY$. Starting from $T = \sum_i T_i(y_i)$, and differentiating with respect to income yields $dT = \sum_i MTR_i\, dy_i$, where $MTR_i = dT_i/dy_i$ is the individual

$$MTR = \frac{\sum_{j=0}^{k} \tau_j \cdot \bar{y}_j \cdot P_j}{Y}$$

its elasticity with respect to τ_j can be expressed more compactly as

$$\eta_{MTR,\tau_j} = w_j + \frac{\tau_j}{1-\tau_j} \overline{ETI}_j \, (\nu_j - w_j) \qquad [16]$$

where $w_j = \frac{\tau_j \, \bar{y}_j \, P_j}{\sum_{m=0}^{k} \tau_m \, \bar{y}_m \, P_m}$ and $\nu_j = \frac{P_j \, \bar{y}_j}{\mathrm{Y}}$

The weight w_j represents the share of bracket j in total marginal revenue—that is, its direct contribution to the aggregate marginal tax rate—while ν_j denotes the share of total taxable income generated by taxpayers in that bracket. A detailed derivation of equation [16] is provided in *Appendix A*.

Equation [16] shows that the elasticity of the aggregate marginal tax rate can be decomposed into two complementary components. The mechanical effect, captured by w_j, reflects the direct contribution of bracket j to the aggregate marginal rate when behaviour is held constant. The behavioural effect, in turn, depends on the tax intensity $\tau_j/(1-\tau_j)$ and the average elasticity of taxable income $E\bar{T}I_j$, weighted by the difference between the bracket's share of total income and its share of marginal revenue, $(\nu_j - w_j)$.

When $\nu_j > w_j$ behavioural responses amplify the overall elasticity—since the bracket accounts for a larger share of income than of marginal revenue—while the opposite holds when $\nu_j < w_j$.[7]

Equation [15] thus shows that the elasticity of aggregate progressivity arises from three interrelated sources. The first term captures the influence of the aggregate marginal rate elasticity, amplified by the factor $LP/(LP-1)$. The second term reflects the contribution of total revenue, which enters negatively with weight $1/(LP-1)$. The third term represents the effect of changes in aggregate taxable income, whose magnitude depends on the liability progression and is weighted by $(2-LP)/(LP-1)$.

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marginal tax rate. If all individual incomes vary proportionally ($dy_i = \lambda y_i$), then $dT/dY = \sum_i MTR_i y_i / \sum_i y_i$, implying that the aggregate marginal tax rate is an income-weighted average of individual marginal rates. This corresponds to the discrete formulation used in equation [16], which treats each statutory marginal rate τ_j as representative of taxpayers in bracket j, weighted by their share of total taxable income.

[7] The relative magnitudes of ν_j and w_j determine how behavioural responses affect the elasticity of the aggregate marginal tax rate. When $\nu_j > w_j$, the bracket accounts for a larger share of total income than of marginal revenue—typically reflecting middle-income ranges with relatively low statutory rates but many taxpayers. In this case, an increase in τ_j triggers behavioural adjustments (e.g., reduced labour effort, income shifting, or lower entrepreneurial activity) across a broad tax base, thereby amplifying the overall elasticity of the aggregate marginal rate. Conversely, when $\nu_j < w_j$, as in top-income brackets with high statutory rates and a narrow tax base, behavioural effects play a smaller aggregate role: even if high-income taxpayers adjust their reported income, their limited weight in total income dampens the impact on the overall elasticity of the marginal tax rate.

This decomposition shows that the responsiveness of tax progressivity to statutory marginal rate changes is driven by the joint influence of structural, arithmetic, and behavioural forces: structural, through the liability progression that governs the relationship between marginal and average rates; arithmetic, through the direct revenue effect of rate changes; and behavioural, through the income adjustments that reshape the tax base. The steeper the liability progression—that is, the greater the gap between marginal and average rates—the more amplified the interaction of these forces becomes, making progressive tax systems particularly sensitive to even small changes in statutory marginal rates.

The analytical framework developed above formally characterises the local responsiveness of tax burdens and local progressivity to statutory marginal rate changes. For completeness, *Appendix B* extends this framework to encompass *effective* measures of progressivity and redistribution—providing a theoretical bridge between the local mechanisms analysed in this section and the global distributive indicators of Kakwani and Reynolds–Smolensky, while maintaining the paper's central focus on local progressivity.

4. An Empirical Application: Elasticities in the Spanish PIT

To illustrate the empirical relevance of the analytical framework developed earlier, this section computes the corresponding elasticities using microdata from Spanish income tax returns. The analysis relies on the most recent available wave (2020) of the *Sample of Tax Returns* compiled jointly by the Spanish Institute for Fiscal Studies (IEF) and the Spanish Tax Agency (AEAT), available when this empirical exercise was initiated. This dataset, representative of the national Personal Income Tax (PIT), includes 3,586,147 tax records extrapolated to a total population of 21,638,795 tax returns. All Spanish regions are covered except the Basque Country and Navarre, which operate under their own fiscal regimes.

The empirical exercise should be interpreted as a simulation-based application of the theoretical expressions derived in Section 2. Using real microdata, it quantifies how individual average and marginal tax rates, total revenue, and local progressivity respond to changes in statutory marginal tax rates. The analysis focuses exclusively on the General tax schedule of the central government, which applies to non-savings income and represents the core progressive component of the Spanish PIT.

Table 1 summarises the main structural features of this schedule, including the nominal income thresholds (a_j), statutory marginal tax rates (τ_j), effective thresholds (a'_j), and the distribution of taxpayers across the five brackets — both the number of taxpayers within each bracket (P_j) and the number of taxpayers in all higher brackets (P_j^+). It also reports the mean taxable income ($\bar{y}_j$).

Table 1. Spanish PIT general schedule: thresholds, rates, and taxpayer distribution (2020).

Brackets	a_j	τ_j	a'_j	P_j	P_j^+	$\bar{y}_j$
0 -12,450	0	0.095	0	9,426,896	12,209,333	3,863.60
12,450 – 20,200	12,450	0.12	2,593.70	3,926,286	8,283,047	16,589
20,200 – 35,200	20,200	0.15	6,115	5,230,224	3,052,823	26,808
35,200 – 60,000	35,200	0.185	11,618	2,320,202	732,621	43,055
> 60,000	60,000	0.225	20,219	732,621	0	105,528

4.1. *Individual elasticities of average tax rates*

Following the analytical framework in Section 2, the individual elasticity of the average tax rate, $\eta_{atr,\tau}$, captures the purely mechanical transmission of statutory marginal rate changes to taxpayers' average liabilities. In this baseline simulation, behavioural adjustments are ruled out (i.e. $ETI = 0$). Table 2 reports the mean elasticities of these individual average tax rates with respect to each statutory marginal rate, while the last row presents the population-weighted average elasticity, summarising the overall responsiveness of the system.

The results confirm the low sensitivity of individual average tax rates to changes in statutory marginal rates, with a clear declining pattern across income brackets. The first marginal rate (τ_0) exhibits the largest impact (0.5877), though still below unity, followed by τ_1 (0.1463) and τ_2 (0.1185). In contrast, the elasticities for τ_3 and τ_4 are very small (0.0348 and 0.0118, respectively).

This pattern mirrors the analytical intuition from Section 2: the effectiveness of marginal rate changes in altering average tax rates declines sharply along the income scale. Inelasticities at higher brackets stem from the diminishing share of taxpayers affected and the smaller fraction of income subject to the incremental rate. Consequently, statutory adjustments at the bottom of the schedule produce the largest relative changes in taxpayers' average liabilities, while those at the top generate negligible effects on overall burdens. This empirical pattern directly mirrors equation [7] in Section 2, where the responsiveness of average tax rates declines as taxable income rises and fewer taxpayers are marginally affected by each statutory rate.

Table 2. Elasticity of individual average tax rates with respect to statutory marginal rates under a static scenario (ETI = 0).*

Brackets	$\bar{\eta}_{atr_i,\tau_0}$	$\bar{\eta}_{atr_i,\tau_1}$	$\bar{\eta}_{atr_i,\tau_2}$	$\bar{\eta}_{atr_i,\tau_3}$	$\bar{\eta}_{atr_i,\tau_4}$
0 -12,450	0.7684**	0	0	0	0
12,450 – 20,200	0.7220	0.2780	0	0	0
20,200 – 35,200	0.3983	0.3132	0.2885	0	0
35,200 – 60,000	0.2118	0.1665	0.4028	0.2189	0
> 60,000	0.0861	0.0677	0.1639	0.3341	0.3482
Total población	0.5877	0.1463	0.1185	0.0348	0.0118

* Average weighted by population size and $ETI_i = 0$

** This average includes taxable incomes equal to zero. If we consider only taxpayers with positive taxable incomes, this average is unity.

A closer look at Table 2 reveals that changes in a given marginal rate affect not only taxpayers within that bracket but also those in higher brackets. In some cases—most notably τ_1, τ_2, and τ_3—the indirect effect on upper brackets exceeds the within-bracket effect. This pattern is fully consistent with the analytical results from Section 2, which showed that individual elasticities depend not only on the statutory rate but also on the internal income distribution within brackets. The heterogeneous distribution of taxable incomes within brackets gives rise to varying sensitivities to marginal rate changes across the income range. Figures 5 and 6 illustrate this heterogeneity: the former shows how taxable income is distributed within each bracket, while the latter depicts—through box plots—the dispersion of individual elasticities, together highlighting how within-bracket composition shapes the effective responsiveness of average tax rates[8].

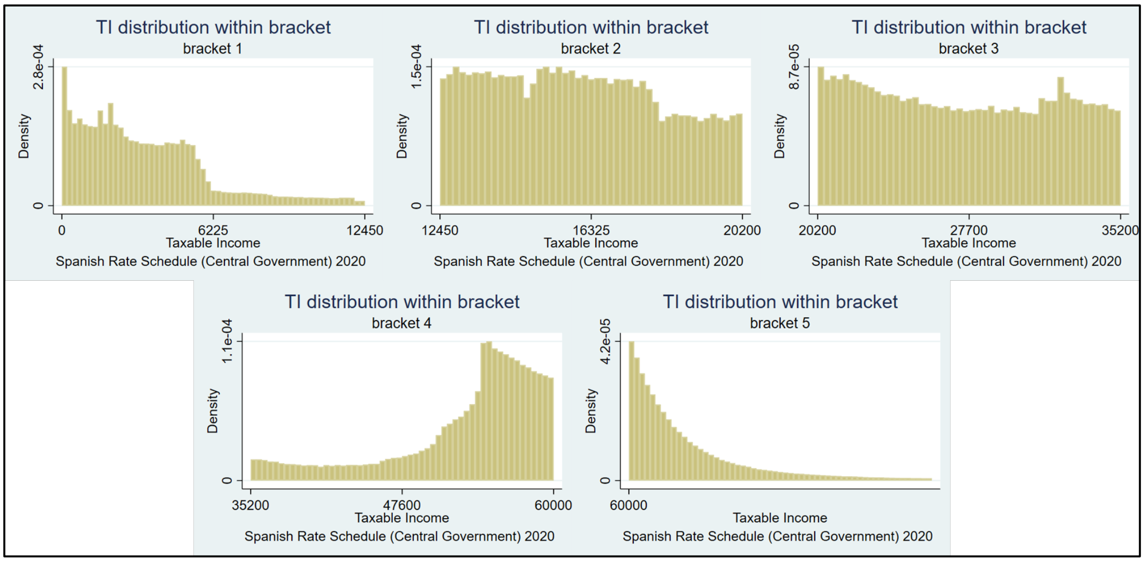

Figure 5: Distribution of the taxable income within each bracket.

[8] A "boxplot" is a graphical device that provides a visual representation of the main characteristics of a distribution. A box plot is formed by a box, two 'whiskers' and two fences. The border at the top of the box is the upper quartile, the below border is the lower quartile, and the line inside the box is the median. Hence, the length of the box shows the interquartile range. The whiskers are the two vertical lines above and below the box, which end in two horizontal lines known as the fences. The upper fence shows the highest value of the distribution that is higher than or equal to the third quartile plus 1.5 times the interquartile range. The lower fence shows the lowest value of the distribution that is less than or equal to the first quartile minus 1.5 times the interquartile range. The box plot, therefore, informs about the centre, the dispersion and the skewness of the distribution.

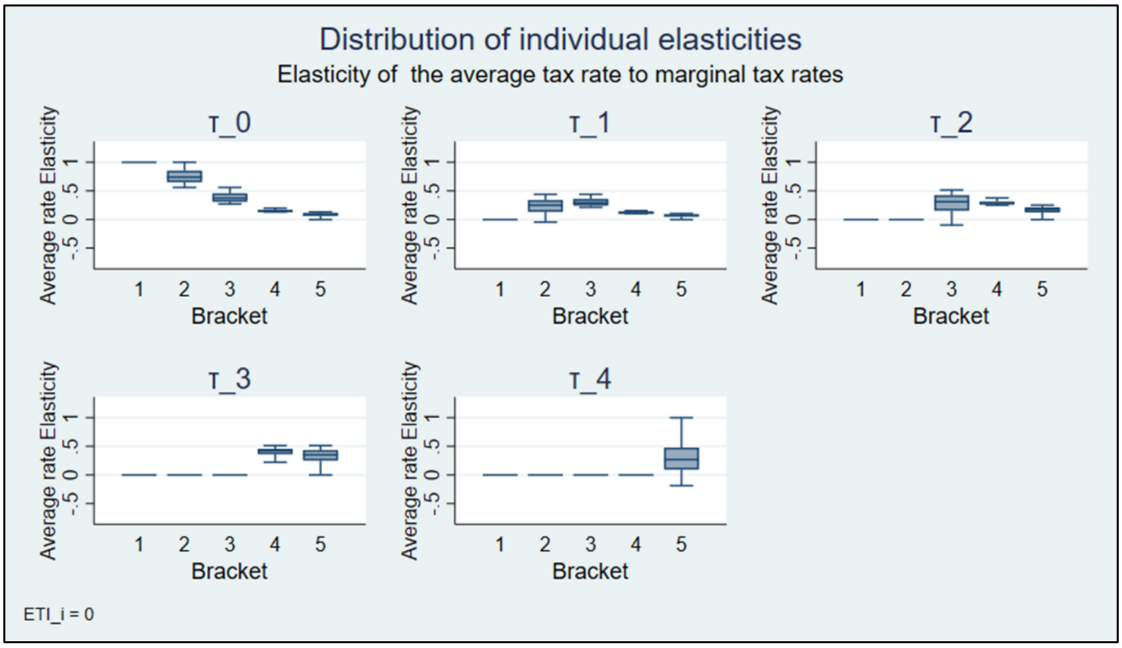

Figure 6: Distribution within each bracket of the individual elasticities of the average tax rates.

4.2. *Individual elasticities of average tax rate progression.*

Table 3 extends the analysis to the elasticity of the progression of individual average tax rates. At the population level, this elasticity is negative for τ_0 but positive and inelastic for all other marginal rates, with magnitudes decreasing steadily across brackets. An increase in a bracket's marginal rate thus enhances local progressivity within that bracket—except for τ_0, where no effect arises—while simultaneously reducing progressivity in higher brackets. This *forward-regressive* pattern aligns with the theoretical results of Section 2, confirming that statutory rate adjustments have asymmetric effects along the tax schedule and only limited capacity to raise overall progressivity.

Table 3. Elasticity of individual tax rate progression with respect to statutory marginal rates under a static scenario (ETI = 0.*

Brackets	$\bar{\eta}_{atrp_i,\tau_0}$	$\bar{\eta}_{atrp_i,\tau_1}$	$\bar{\eta}_{atrp_i,\tau_2}$	$\bar{\eta}_{atrp_i,\tau_3}$	$\bar{\eta}_{atrp_i,\tau_4}$
0 -12,450	0	0	0	0	0
12,450 – 20,200	-3.8	4.8	0	0	0
20,200 – 35,200	-1.2895	-1.0139	3.3034	0	0
35,200 – 60,000	-0.55031	-0.43271	-1.0469	3.0299	0
> 60,000	-0.25999	-0.20443	-0.49459	-1.0085	2.9675
Whole population	-1.0691	0.5726	0.6695	0.2908	0.1005

* Average weighted by population size and assuming $ETI_i = 0$

4.3. *Aggregate elasticities.*

The aggregate results operationalise the analytical decomposition introduced in Section 3—particularly equation [15]—by quantifying how statutory marginal rate changes affect the main tax aggregates. Table 4 presents the corresponding elasticity estimates for aggregate taxable income, total revenue, the aggregate average and marginal tax rates, and overall local tax progressivity. These results provide the empirical counterpart to the theoretical relationships established earlier, where aggregate elasticities were shown to depend jointly on the direct (mechanical) and indirect (behavioural) components of the tax schedule's responsiveness.

In the baseline specification, which abstracts from behavioural reactions (i.e. ETI = 0), total revenue reacts positively but inelastically to all five marginal rates (Table 4). Among them, τ_0 proves the most effective in generating revenue, followed by τ_2 and τ_1, while τ_3 and τ_4 exert weaker effects. Yet, contrary to what is often presumed in policy debates, the estimated elasticities remain within the 0.12–0.33 range, indicating that revenue collection is relatively insensitive to statutory rate adjustments. This result underscores the intrinsic limitation of relying solely on marginal rate increases to expand tax revenue.

As for progressivity, column 6 of Table 4 reports the elasticity of the progression of the aggregate average tax rate (η_{ATRP,τ_j}). Consistent with the analytical model in Section 3.2, the sign of this elasticity depends on the relative magnitudes of η_{MTR,τ_j} and η_{ATR,τ_j}[9]. When $\eta_{MTR,\tau_j} < \eta_{ATR,\tau_j}$ —as in the first two brackets—progressivity declines; conversely, when $\eta_{MTR,\tau_j} > \eta_{ATR,\tau_j}$ —as in the upper three brackets—progressivity rises. The results confirm that while marginal rate adjustments do influence local progressivity, their impact is modest and uneven along the income scale.

Table 4. Aggregate elasticities with respect to statutory marginal rates under a static scenario (ETI = 0).*

τ_j	η_{Y,τ_j}	η_{T,τ_j}	η_{MTR,τ_j}	η_{ATR,τ_j}	η_{ATRP,τ_j}
τ_0	0	0.33245	0.050747	0.33245	-1.0071
τ_1	0	0.17928	0.11463	0.17928	-0.12814
τ_2	0	0.22385	0.30845	0.22385	0.62617
τ_3	0	0.12505	0.27105	0.12505	0.81929
τ_4	0	0.13938	0.25512	0.13938	0.68975

* Average weighted by population size and assuming $\overline{ETI_j} = 0$

Comparing the static scenario (Table 4) with the behavioural one (Table 5) allows us to empirically assess how taxpayer responses contribute to the aggregate elasticity of the marginal tax rate. To evaluate these effects—often overlooked in applied tax policy analyses—Table 5 replicates the same set of elasticities after incorporating behavioural adjustments. The elasticities of taxable income (ETI) employed correspond to those estimated by Arrazola et al. (2019) for Spanish regions, disaggregated by age and gender (Appendix C, Table A.1), and lie in the medium–upper range of values reported for Spain[10].

[9] Because η_{Y,τ_j} is negligible under the static specification (ETI = 0), its effect is muted here but becomes relevant once behavioural responses are introduced.

[10] For an overview of the range of ETI estimates for Spain, see Arrazola and de Hevia (2017). The elasticities used here are consistent with that literature and, crucially, allow for regional heterogeneity, which is essential

Once behavioural responses are introduced, the elasticity structure changes notably. Aggregate taxable income (η_{Y,τ_j}) declines slightly, confirming that higher statutory marginal rates reduce reported income across all brackets, though the magnitude of this response varies along the income scale. Revenue elasticities (η_{T,τ_j}) fall across all brackets, indicating that ignoring behavioural responses leads to an overestimation of the revenue-raising potential of marginal rate changes. In contrast, the elasticity of the aggregate marginal rate (η_{MTR,τ_j}) rises modestly, consistent with the analytical prediction in equation [16]: the behavioural term, $\frac{\tau_j}{1-\tau_j}\,\overline{ETI}_j\,(\nu_j - w_j)$, reinforces MTR elasticity when the income share (ν_j) exceeds the revenue share (ω_j). Indeed, Table 5 (note ‡) reports that $\nu_j > \omega_j$ for the first three brackets, implying that behavioural responses amplify η_{MTR,τ_j} in those ranges, while for higher brackets (τ_3 and τ_4) the opposite holds, consistent with the attenuated response observed empirically.

Meanwhile, the elasticity of the aggregate average tax rate (η_{ATR,τ_j}) displays mixed effects—slightly higher in the lower brackets and lower in the upper ones—suggesting that high-income taxpayers adjust their declared income more strongly [11]. The elasticity of tax progressivity (η_{ATRP,τ_j}) increases across all brackets, confirming that when behavioural effects are incorporated, the tax system exhibits greater effective local progressivity than under static assumptions[12].

for the cross–Autonomous Community comparison. Alternative ETI values would affect magnitudes only marginally and are unlikely to alter the relative regional ordering.

[11] This apparent erratic behaviour of η_{ATR,τ_j} is not so, but is due to the fact that in the absence of behaviour $\eta_{ATR,\tau_j} = \eta_{T,\tau_j}$, while with behaviour, it becomes $\eta_{ATR,\tau_j} = \eta_{T,\tau_j} - \eta_{Y,\tau_j}$. Namely, when behaviour is ignored, the only source of variation in ATR comes from the effect of the marginal rate on tax revenue, T. However, when behaviour is considered, ATR varies not only because of the impact of the marginal tax rates on T, but also because of the effects on the magnitude of the reported taxable income, Y. This double influence that arises when the behavioural reactions are regarded explains the different impact, even in sign, that occurs on ATR when considering and disregarding behavioural responses.

[12] This is so because, with behaviour, the effect of the statutory marginal rates on the aggregate tax rates, ATR and MTR, embodies the consequences of the statutory marginal rates on both tax revenue and the size of the reported taxable income, a consideration ignored in the non-behavioural modelling.

Table 5. Aggregate elasticities with respect to statutory marginal rates incorporating behavioural responses.*

τ_j	η_{Y,τ_j}	η_{T,τ_j}	η_{MTR,τ_j} ‡	η_{ATR,τ_j}	η_{ATRP,τ_j}
τ_0	-0.0042	0.3294	0.0525	0.3335	-0.9987
τ_1	-0.0090	0.1709	0.1170	0.1799	-0.1102
τ_2	-0.0264	0.1930	0.3105	0.2194	0.6791
τ_3	-0.0253	0.0886	0.2676	0.1139	0.8700
τ_4	-0.0241	0.0971	0.2459	0.1213	0.7380

Notes:
* Population-weighted average and assuming actual regional ETI's.
‡ The distribution of the values of ω_j and υ_j across the tax brackets is as:

τ_j	ω_j	ν_j
τ_0	5.1%	8.7%
τ_1	11.5%	15.5%
τ_2	30.8%	33.5%
τ_3	27.1%	23.8%
τ_4	25.5%	18.5%

Table 6 summarises the relative variation of aggregate elasticities once behavioural responses are accounted for. Once behavioural responses are introduced, the elasticity structure changes markedly. As shown in Table 5, the elasticity of aggregate taxable income (η_{Y,τ_j}) becomes negative, confirming that higher statutory marginal rates reduce reported income across all brackets, though the magnitude of this response increases toward the top of the distribution. Revenue elasticities (η_{T,τ_j}) decline uniformly, indicating that ignoring behavioural responses leads to an overestimation of the revenue-raising potential of marginal rate adjustments. In contrast, the elasticities of the aggregate marginal and average tax rates –η_{MTR,τ_j} and η_{MTR,τ_j}– exhibit an asymmetric pattern: they rise modestly in the lower brackets but fall sharply in the upper ones. This inversion reflects the growing sensitivity of taxable income to statutory rates at higher income levels, where the behavioural elasticity of income (η_{Y,τ_j}) is larger in absolute value. The positive values of η_{ATRP,τ_j} across all brackets indicate that incorporating behavioural responses increases local progressivity throughout the schedule. Hence, for Spain, neglecting behavioural responses leads to an overestimation of the revenue-raising capacity of statutory marginal rates and an underestimation of their contribution to local progressivity. In other words, ignoring the sensitivity of taxable income to statutory marginal rates makes the tax appear more revenue-productive and less progressive than it actually is. Since these elasticities depend on both income distribution and behavioural parameters, their effects are not uniform across regions, as illustrated in Appendix C (Table A.2).

Table 6. Relative variation in aggregate elasticities after incorporating behavioural responses (%).

τ_j	η_{T,τ_j}	η_{MTR,τ_j}	η_{ATR,τ_j}	η_{ATRP,τ_j}
τ_0	-0.92	3.44	0.32	0.83
τ_1	-4.67	2.06	0.35	14.03
τ_2	-13.78	0.67	-1.99	8.44
τ_3	-29.15	-1.28	-8.92	6.18
τ_4	-30.33	-3.62	-12.97	7.00

Notes: Relative variation computed as $100 \times (\eta\_with - \eta\_without)/|\eta\_without|$. Population-weighted averages. Behavioural elasticities based on regional ETI estimates from Arrazola et al. (2019).

5. Conclusions

This paper has developed tractable analytical expressions for the elasticity of the average tax rate and its progression with respect to changes in statutory marginal tax rates. These expressions were derived both at the individual level and for the population aggregate, enabling a comprehensive assessment of how tax schedules respond to rate adjustments. Crucially, the framework explicitly accounts for the endogeneity between taxable income and marginal tax rates, thereby capturing the behavioural responses induced by substitution effects.

A key operational advantage of the proposed formulation lies in its computational simplicity. Its estimation requires only basic structural information on the tax schedule—income thresholds and marginal rates—together with data on the distribution of taxpayers and taxable income across brackets. Because such information is readily available in most tax systems, the framework provides a practical and transparent tool for policymakers and researchers seeking to evaluate the revenue and redistributive implications of changes in marginal tax rates.

The empirical application reveals a remarkably low responsiveness of the individual average tax rate to changes in statutory marginal rates, especially within the upper brackets. This inelasticity persists at the aggregate level, showing that statutory marginal rates are far less effective in generating revenue than is often assumed. These results challenge the conventional view that higher marginal rates automatically translate into proportionally higher revenue and highlight the importance of accounting for the underlying taxable income distribution when designing rate reforms.

Regarding progressivity, the findings show that an increase in a marginal rate raises local progressivity within the affected bracket but simultaneously reduces it for higher-income taxpayers while leaving lower brackets unchanged. This pattern—*forward regressivity* and *backward neutrality*—is generally overlooked by aggregate indicators of progressivity, which tend to exhibit an elastic response to marginal rate changes, particularly in higher brackets. When behavioural responses are incorporated, the elasticity of the average tax rate increases slightly in the lower brackets but declines sharply at the top, reflecting stronger income-shifting among high-income taxpayers. Overall, accounting for taxpayer responsiveness enhances the system's effective progressivity, underscoring the need to integrate behavioural dimensions into both empirical assessment and policy design.

From a policy perspective, the results indicate that statutory marginal rates are blunt tools for revenue and asymmetric instruments for equity. Aggregate revenue reacts inelastically—especially at the top brackets—so rate increases at higher ranges deliver limited fiscal yield and are partly offset by behavioural adjustments. In contrast, lower-bracket rate hikes raise revenue more effectively but tend to weaken local progressivity. Therefore, when the policy objective is to increase revenue with minimal distributional distortion, reforms should act on the parameters that shape the average tax rates—such as the width of brackets, base broadening, or the removal of tax credits—rather than through changes in statutory marginal rates. When the aim is to enhance progressivity, small, well-targeted adjustments to intermediate brackets, combined with careful management of liability progression (the relationship between marginal and average rates), are more effective and sustainable than steep rate increases at the very top. The appropriate bracket design ultimately depends on the empirical shape of the pretax income distribution, since the density of taxpayers within income ranges governs both the revenue impact and the distributional effects of any reform. The guiding principle that emerges is clear: target average rates and use statutory marginal rates sparingly and locally.

In conclusion, this paper advances the theoretical and empirical understanding of how statutory marginal tax rates shape both revenue generation and tax progressivity. By providing analytically transparent and computationally straightforward measures, it offers a practical framework for evaluating the efficiency and redistributive capacity of income tax systems. The approach developed here bridges theoretical insight and empirical applicability, offering a foundation for designing tax reforms that are not only more equitable, but also fiscally and behaviourally consistent.

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Appendix A. Derivations for equations [15] and [16]

A.1. Elasticity of aggregate progression (equation [15])

Let total tax revenue be T, aggregate taxable income $Y = \sum_{i=1}^{N} y_i$ the aggregate average tax rate $ATR = T/Y$, and the aggregate marginal tax rate

$$MTR \equiv \frac{dT}{dY}.$$

Define liability progression as $LP \equiv MTR/ATR$. The aggregate local progression of the average tax rate is

$$ATRP \equiv \frac{d\,ATR}{d\,Y}.$$

Step 1: Express $\boldsymbol{ATRP}$in terms of $\boldsymbol{ATR}$, $\boldsymbol{MTR}$, and $\boldsymbol{Y}$

Using the quotient rule,

$$ATRP \;=\; \frac{d\left(\frac{T}{Y}\right)}{dY} = \frac{(dT/dY)\,Y - T}{Y^2} = \frac{MTR - ATR}{Y} = \frac{ATR\,(LP-1)}{Y} \qquad \text{(A.1)}$$

Step 2: Elasticity of $\boldsymbol{ATRP}$ w.r.t. $\boldsymbol{\tau_j}$

The elasticity w.r.t. a statutory marginal rate τ_j is

$$\eta_{ATRP,\tau_j} \;\equiv\; \frac{d\,ATRP}{d\,\tau_j} \cdot \frac{\tau_j}{ATRP}.$$

Taking logs in $(A.1)$ and differentiating w.r.t. $\ln \tau_j$,

$$\frac{d\ln\,ATRP}{d\ln\,\tau_j} = \frac{d\ln\,ATR}{d\ln\,\tau_j} + \frac{d\ln\,(LP-1)}{d\ln\,\tau_j} - \frac{d\ln\,Y}{d\ln\,\tau_j} \qquad \text{(A.2)}$$

Since $LP - 1$ differs from LP by a constant,

$$\frac{d\ln\,(LP-1)}{d\ln\,\tau_j} = \frac{LP}{LP-1}\,\frac{d\ln\,LP}{d\ln\,\tau_j}, \frac{d\ln\,LP}{d\ln\,\tau_j} = \eta_{MTR,\tau_j} - \eta_{ATR,\tau_j}$$

because $LP = MTR/ATR$. Sustituyendo en (A.2) y usando $\eta_{ATRP,\tau_j} = \frac{d\ln\,ATRP}{d\ln\,\tau_j}$, etc.:

$$\eta_{ATRP,\tau_j} = \eta_{ATR,\tau_j} + \frac{LP}{LP-1}(\eta_{MTR,\tau_j} - \eta_{ATR,\tau_j}) - \eta_{Y,\tau_j}. \qquad \text{(A.3)}$$

Step 3: Use $\boldsymbol{\eta_{ATR,\tau_j} = \eta_{T,\tau_j} - \eta_{Y,\tau_j}}$

From $ATR = T/Y$,

$$\eta_{ATR,\tau_j} = \eta_{T,\tau_j} - \eta_{Y,\tau_j}. \quad \text{(A.4)}$$

Sustituyendo (A.4) en (A.3) y simplificando:

$$\eta_{ATRP,\tau_j} = \frac{LP}{LP-1}\,\eta_{MTR,\tau_j} - \frac{1}{LP-1}\,\eta_{T,\tau_j} + \frac{2-LP}{LP-1}\,\eta_{Y,\tau_j} \quad [15]$$

<u>A.2. Elasticity of the aggregate marginal tax rate (equation [16])</u>

Let

$$MTR = \frac{N}{Y}, \qquad N \equiv \sum_{m=0}^{k} \tau_m\, \bar{y}_m\, P_m$$

where for bracket m: τ_m is the statutory marginal rate, $\bar{y}_m$ the mean taxable income of taxpayers in m, and P_m their (weighted) count. We consider an infinitesimal change in τ_j and adopt the standard first-order assumptions: no bracket migration at the margin (i.e., P_m fixed) and behavioural responses only through taxable income in the affected bracket j. Denote the average ETI in bracket j by $\overline{ETI}_j$, so that

$$\frac{d\bar{y}_j}{d\tau_j} = -\frac{\bar{y}_j}{1-\tau_j}\,\overline{ETI}_j \quad \text{(A.5)}$$

Step 1: Elasticity identity

Since $MTR = N/Y$,

$$\eta_{MTR,\tau_j} = \eta_{N,\tau_j} - \eta_{Y,\tau_j} \quad \text{(A.6)}$$

Step 2: Elasticity of $\boldsymbol{N}$

Only the j-th term in N depends on τ_j (directly and via $\bar{y}_j$):

$$\frac{dN}{d\tau_j} = \bar{y}_j P_j + \tau_j P_j \frac{d\bar{y}_j}{d\tau_j} = \bar{y}_j P_j \left(1 - \frac{\tau_j}{1-\tau_j}\,\overline{ETI}_j\right)$$

Thus

$$\eta_{N,\tau_j} = \frac{\tau_j}{N}\frac{dN}{d\tau_j} = \frac{\tau_j \bar{y}_j P_j}{N}\left(1 - \frac{\tau_j}{1-\tau_j}\,\overline{ETI}_j\right) \tag{A.7}$$

Define the weight of bracket j in the aggregate marginal rate:

$$w_j \;\equiv\; \frac{\tau_j\,\bar{y}_j\,P_j}{\sum_{m=0}^{k}\tau_m\,\bar{y}_m\,P_m} \;=\; \frac{\tau_j \bar{y}_j P_j}{N} \tag{A.8}$$

Then (A.7) becomes $\eta_{N,\tau_j} = w_j\left(1 - \frac{\tau_j}{1-\tau_j}\overline{ETI}_j\right)$

Step 3: Elasticity of *Y*

Only taxpayers in bracket j adjust their taxable income to first order:

$$\frac{dY}{d\tau_j} = \sum_{i\in j}\frac{dy_i}{d\tau_j} = -\,\frac{\overline{ETI}_j}{1-\tau_j}\sum_{i\in j} y_i = -\,\frac{\overline{ETI}_j}{1-\tau_j}\,P_j\bar{y}_j$$

Hence

$$\eta_{Y,\tau_j} = \frac{\tau_j}{Y}\frac{dY}{d\tau_j} = -\,\frac{\tau_j}{1-\tau_j}\,\overline{ETI}_j\cdot\nu_j \tag{A.9}$$

where $\nu_j = \frac{P_j\bar{y}_j}{Y}$

Step 4: Combine (A.6) - (A.9)

Substituting (A.7) and (A.9) into (A.6):

$$\eta_{MTR,\tau_j} = w_j\left(1 - \frac{\tau_j}{1-\tau_j}\,\overline{ETI}_j\right) \;-\; \left(-\,\frac{\tau_j}{1-\tau_j}\,\overline{ETI}_j\cdot\nu_j\right)$$

which simplifies to:

$$\eta_{MTR,\tau_j} = w_j \;+\; \frac{\tau_j}{1-\tau_j}\,\overline{ETI}_j\,(\nu_j - w_j). \tag{16}$$

Appendix B. From Local to Effective Progressivity and Redistributive Power

The analysis in Section 3 has focused on the local responsiveness of tax progressivity to statutory marginal rate changes, captured by the elasticity of the progression of the aggregate average tax rate (η_{ATRP,τ_j}). This measure describes how the slope of the average tax rate function reacts to adjustments in statutory marginal rates, providing a precise view of how the degree of local progressivity responds to policy changes. However, to assess the broader redistributive capacity of a change in τ_j, it is necessary to link this local measure to global indicators that capture its impact on effective progressivity and overall redistribution. This appendix develops that link by extending the analytical framework to the Kakwani and Reynolds–Smolensky indices. The first measures effective progressivity, while the second quantifies the redistributive power of the tax. Both depend on the same underlying components as the local measures—average and marginal tax rates—but summarise their effects across the entire income distribution.

B.1. Effective progressivity: the Kakwani index

The Kakwani index (K) provides a comprehensive measure of effective progressivity, defined as the deviation between the concentration coefficient of taxes (C_T) and the Gini coefficient of pre-tax income (G_Y):

$$K = C_T - G_Y \tag{B1}$$

K is positive when tax payments are more concentrated among high-income taxpayers than income itself, zero for proportional taxation, and negative for regressivity[13]. While the local measure η_{ATRP,τ_j}captures how the slope of the tax schedule changes at specific income levels, K aggregates those local changes into a single measure of effective progressivity.
Because both C_T and G_Y depend on the vector of statutory marginal rates $\{\tau_j\}$, the total derivative of K with respect to τ_j is:

$$\frac{dK}{d\tau_j} = \frac{dC_T}{d\tau_j} - \frac{dG_Y}{d\tau_j} \tag{B2}$$

Expressing this in elasticity form gives:

$$\eta_{K,\tau_j} = \frac{C_T}{K}\,\eta_{C_T,\tau_j} - \frac{G_Y}{K}\,\eta_{G_Y,\tau_j} \tag{B3}$$

[13] For the decomposition of the redistributive effect into the components attributable to the rate structure, the definition of the taxable base, or the role of tax credits, see Pfähler (1990), Lambert (2001, page 214), and Onrubia et al. (2014).

Equation (B3) shows that the responsiveness of effective progressivity to statutory rate changes arises through two channels:

- Changes in the distribution of tax liabilities (η_{C_T,τ_j}), which reflect not only the direct mechanical transmission of rate changes across brackets but also the behavioural and compositional effects on total tax payments (T).
- Changes in the distribution of pre-tax income (η_{G_Y,τ_j}), which capture behavioural adjustments that alter the distribution of pre-tax taxable income (Y).

In a static setting (ETI = 0), both G_Y and the behavioural component of C_T remain fixed, so that Kchanges only through the mechanical redistribution of tax burdens. When behavioural responses are considered, however, both C_T and G_Y become endogenous to τ_j, and K captures the joint effect of statutory rate changes on tax redistribution, tax-base adjustments, and pretax income redistribution.

B.2. Redistributive power: the Reynolds–Smolensky index

The Reynolds–Smolensky index (RS) measures the overall redistributive impact of the tax, i.e. the reduction in inequality between pre-tax and post-tax incomes:

$$RS = G_Y - G_{Y-T} \tag{B4}$$

where G_{Y-T} denotes the Gini coefficient of disposable income.

Under the standard assumption of no reranking (i.e. taxpayers preserve their income ranking after taxation), RS can be expressed in terms of the average tax rate (ATR) and the Kakwani index (K):

$$RS = \frac{ATR}{1-ATR} \cdot K \tag{B5}$$

This identity shows that the redistributive effect of a tax depends jointly on its effective progressivity and on its average level of taxation. The factor $\frac{ATR}{1-ATR}$ amplifies redistribution: for a given K, a higher average rate increases the reduction in inequality.

Here, η_{ATR,τ_j} denotes the aggregate elasticity of the average tax rate with respect to changes in the statutory marginal rate τ_j—the same concept derived in Section 3.1 for the aggregate tax schedule.

B.3. Total responsiveness of the redistributive effect

Totally differentiating equation (B5) with respect to τ_j gives:

$$\frac{dRS}{d\tau_j} = \frac{K}{(1-ATR)^2} \frac{dATR}{d\tau_j} + \frac{ATR}{1-ATR} \frac{dK}{d\tau_j} \tag{B6}$$

The first term captures how marginal rate changes affect the average tax burden (the arithmetic channel), while the second term represents how they affect the structure of progressivity (the distributional channel).
Expressing this in elasticity form yields:

$$\eta_{RS,\tau_j} = \frac{\eta_{ATR,\tau_j}}{1-ATR} + \eta_{K,\tau_j} \tag{B7}$$

Here, η_{ATR,τ_j} denotes the aggregate elasticity of the average tax rate with respect to changes in the statutory marginal rate τ_j—the same concept derived in Section 3.1. Equation [A7] provides a concise link between the elasticity of the redistributive effect and those of the average tax rate and effective progressivity.

B.4. Full decomposition

Substituting [B3] into [B7] gives the full decomposition of the elasticity of the redistributive effect with respect to a statutory marginal rate:

$$\eta_{RS,\tau_j} = \frac{1}{1-ATR} \cdot \eta_{ATR,\tau_j} + \frac{C_T}{K} \eta_{C_T,\tau_j} - \frac{G_Y}{K} \eta_{G_Y,\tau_j} \tag{B8}$$

This equation identifies three channels through which changes in statutory marginal rates influence the redistributive power of the tax:

- Arithmetic channel (η_{ATR,τ_j}) – captures how statutory rate changes modify the overall average tax rate. This component can be evaluated under both static and behavioural settings, as changes in τ_j may affect taxpayers' average liabilities either mechanically or through income responses.

- Tax-distribution channel (η_{C_T,τ_j}) – reflects how statutory changes alter the concentration of tax payments across the income distribution, encompassing both the direct mechanical redistribution of liabilities and behavioural adjustments that modify the composition of T.

- Income-distribution channel (η_{G_Y,τ_j}) – captures how behavioural responses to marginal rate changes affect the pre-tax income distribution and, hence, the underlying inequality of Y.[14]

[14] This component measures how changes in the statutory marginal rate τ_j modify the Gini coefficient of pre-tax income (G_Y). When higher marginal rates induce stronger income adjustments among top earners—reducing taxable income more at the top—G_Y declines ($\eta_{G_Y,\tau_j} < 0$), which in turn increases the Kakwani index and enhances effective progressivity. The magnitude of this effect depends on the ratio G_Y/K: the

When behavioural responses are excluded, redistribution operates only through the arithmetic and tax-distribution channels. Once behaviour is incorporated, however, all three channels become interdependent: variations in τ_j affect not only the level and distribution of tax liabilities but also the structure of pre-tax incomes, potentially amplifying or offsetting the overall redistributive impact of statutory rate adjustments.

B.5. Analytical and policy implications

Equations (B3)–(B8) provide a formal bridge between the local measures of progressivity derived in Sections 2 and 3 and the effective progressivity and redistributive outcomes summarised by K and RS. They show that the redistributive impact of marginal rate changes depends not only on statutory design but also on behavioural adaptation and the joint evolution of the tax and income distributions.

From a policy perspective, this decomposition allows the separate identification of mechanical redistribution—arising from statutory changes—and behavioural redistribution—driven by taxpayer responses. It thus provides a transparent analytical framework for evaluating the equity–efficiency trade-offs inherent in marginal rate reforms, highlighting that reforms targeted at upper brackets may yield limited redistributive gains if behavioural responses significantly alter the taxable income.

lower the baseline progressivity (small K), the larger the relative contribution of this "income-distribution channel" to overall progressivity changes.

Appendix C. Aggregate regional elasticities and $ETI's$ by Autonomous Communities (region).

Table A.1. Elasticities of the taxable income (ETI) used.

Autonomous Community, gender and age	Male	Female
Catalonia		
45 or younger	0.44	0.74
Older than 45	0.76	1.06
Madrid		
45 or younger	0.2	0.47
Older than 45	0.49	0.75
Murcia		
45 or younger	0.44	0.74
Older than 45	0.76	1.06
Valencia		
45 or younger	0.62	0.94
Older than 45	0.96	1.27
Other Communities		
45 or younger	0	0.32
Older than 45	0.34	0.66

Source: Arrazola et al. (2019)

Table A.2. Aggregate regional elasticities taking into account regional $ETIs$ *.

	τ_0				
Community	η_{Y,τ_0}	η_{T,τ_0}	η_{MTR,τ_0}	η_{ATR,τ_0}	η_{ATRP,τ_0}
Andalusia	-0.0041	0.3801	0.0743	0.3843	-1.0739
Aragon	-0.0034	0.3667	0.0527	0.3701	-1.0917
Asturias	-0.0029	0.3551	0.0452	0.3580	-1.0578
Balearic Islands	-0.0037	0.3524	0.0637	0.3561	-1.0284
Canary Islands	-0.0045	0.3810	0.0808	0.3855	-1.0758
Cantabria	-0.0032	0.3643	0.0516	0.3675	-1.0852
Cast.-León	-0.0039	0.3810	0.0611	0.3849	-1.1083
Cast.-Mancha	-0.0043	0.4031	0.0751	0.4074	-1.1393
Catalonia	-0.0025	0.3046	0.0382	0.3071	-0.9486
C. Valenciana	-0.0108	0.3605	0.0680	0.3713	-1.0493
Extremadura	-0.0052	0.4199	0.0933	0.4251	-1.1688

Galicia	-0.0042	0.3803	0.0674	0.3845	-1.1230
Madrid	-0.0026	0.2470	0.0287	0.2496	-0.8434
Murcia	-0.0091	0.3784	0.0746	0.3876	-1.0796
La Rioja	-0.0038	0.3799	0.0587	0.3836	-1.1161
Ceuta and Melilla	-0.0018	0.2999	0.0324	0.3017	-0.8833
			τ_1		
Community	η_{Y,τ_1}	η_{T,τ_1}	η_{MTR,τ_1}	η_{ATR,τ_1}	η_{ATRP,τ_1}
Andalusia	-0.0070	0.1837	0.1331	0.1907	-0.0739
Aragon	-0.0077	0.1961	0.1357	0.2038	-0.1032
Asturias	-0.0068	0.2000	0.1160	0.2068	-0.1981
Balearic Islands	-0.0074	0.1715	0.1288	0.1788	-0.0514
Canary Islands	-0.0079	0.1749	0.1414	0.1827	-0.0083
Cantabria	-0.0079	0.1924	0.1352	0.2003	-0.0915
Cast.-León	-0.0082	0.1948	0.1424	0.2030	-0.0693
Cast.-Mancha	-0.0079	0.1931	0.1568	0.2010	0.0024
Catalonia	-0.0062	0.1726	0.1047	0.1788	-0.1618
C. Valenciana	-0.0223	0.1668	0.1392	0.1890	-0.0240
Extremadura	-0.0082	0.1896	0.1551	0.1978	0.0002
Galicia	-0.0085	0.1861	0.1507	0.1946	-0.0062
Madrid	-0.0073	0.1424	0.0767	0.1497	-0.2050
Murcia	-0.0177	0.1738	0.1467	0.1915	-0.0021
La Rioja	-0.0078	0.1951	0.1471	0.2029	-0.0472
Ceuta and Melilla	-0.0050	0.1745	0.0946	0.1794	-0.1895
			τ_2		
Community	η_{Y,τ_2}	η_{T,τ_2}	η_{MTR,τ_2}	η_{ATR,τ_2}	η_{ATRP,τ_2}
Andalusia	-0.0213	0.2055	0.3396	0.2268	0.7802
Aragon	-0.0227	0.2074	0.3717	0.2301	0.9063
Asturias	-0.0265	0.2252	0.3988	0.2517	0.9454
Balearic Islands	-0.0209	0.1911	0.3022	0.2120	0.6609
Canary Islands	-0.0200	0.1936	0.3060	0.2136	0.6781
Cantabria	-0.0244	0.2109	0.3664	0.2353	0.8640
Cast.-León	-0.0233	0.2097	0.3643	0.2330	0.8635
Cast.-Mancha	-0.0196	0.2021	0.3440	0.2217	0.8122
Catalonia	-0.0204	0.2040	0.3024	0.2244	0.6097
C. Valenciana	-0.0574	0.1552	0.3250	0.2126	0.8006
Extremadura	-0.0229	0.1978	0.3670	0.2206	0.9488
Galicia	-0.0216	0.1960	0.3378	0.2177	0.8119
Madrid	-0.0253	0.1818	0.2488	0.2071	0.4392
Murcia	-0.0449	0.1667	0.3256	0.2115	0.7944
La Rioja	-0.0224	0.1991	0.3567	0.2215	0.8697
Ceuta and Melilla	-0.0155	0.2380	0.2565	0.2534	0.2825
			τ_3		
Community	η_{Y,τ_3}	η_{T,τ_3}	η_{MTR,τ_3}	η_{ATR,τ_3}	η_{ATRP,τ_3}
Andalusia	-0.0197	0.0818	0.2695	0.1015	0.9135
Aragon	-0.0184	0.0822	0.2597	0.1005	0.8534
Asturias	-0.0214	0.0757	0.2788	0.0972	0.9424

Balearic Islands	-0.0195	0.0985	0.2587	0.1180	0.8055
Canary Islands	-0.0205	0.0850	0.2671	0.1055	0.9034
Cantabria	-0.0182	0.0851	0.2657	0.1033	0.8697
Cast.-León	-0.0203	0.0733	0.2717	0.0936	0.9378
Cast.-Mancha	-0.0186	0.0763	0.2726	0.0949	0.9434
Catalonia	-0.0193	0.1089	0.2757	0.1282	0.8378
C. Valenciana	-0.0518	0.0387	0.2613	0.0905	0.9482
Extremadura	-0.0183	0.0671	0.2405	0.0854	0.8514
Galicia	-0.0193	0.0757	0.2580	0.0950	0.8914
Madrid	-0.0287	0.1089	0.2641	0.1376	0.7937
Murcia	-0.0408	0.0524	0.2614	0.0931	0.9276
La Rioja	-0.0194	0.0812	0.2630	0.1006	0.8715
Ceuta and Melilla	-0.0271	0.1271	0.4007	0.1541	1.2681
			τ_4		
Community	η_{Y,τ_4}	η_{T,τ_4}	η_{MTR,τ_4}	η_{ATR,τ_4}	η_{ATRP,τ_4}
Andalusia	-0.0125	0.0603	0.1784	0.0728	0.5834
Aragon	-0.0129	0.0587	0.1758	0.0716	0.5654
Asturias	-0.0120	0.0491	0.1568	0.0610	0.5073
Balearic Islands	-0.0180	0.0914	0.2411	0.1095	0.7524
Canary Islands	-0.0149	0.0724	0.1987	0.0873	0.6382
Cantabria	-0.0134	0.0559	0.1766	0.0693	0.5773
Cast.-León	-0.0117	0.0491	0.1557	0.0608	0.5113
Cast.-Mancha	-0.0100	0.0425	0.1467	0.0525	0.5021
Catalonia	-0.0206	0.1165	0.2745	0.1371	0.8007
C. Valenciana	-0.0413	0.0285	0.1928	0.0698	0.6917
Extremadura	-0.0097	0.0378	0.1387	0.0475	0.4969
Galicia	-0.0134	0.0705	0.1810	0.0839	0.5601
Madrid	-0.0424	0.1788	0.3754	0.2212	1.0281
Murcia	-0.0298	0.0338	0.1804	0.0636	0.6443
La Rioja	-0.0123	0.0548	0.1695	0.0671	0.5534
Ceuta and Melilla	-0.0169	0.0691	0.2112	0.0860	0.6547

* The elasticities of the taxable income are those obtained by Arrazola et al. (2019).