FISCAL DRAG IN THEORY AND IN PRACTICE: A EUROPEAN PERSPECTIVE

2025

BANCO DE ESPAÑA
Eurosistema

Documentos de Trabajo
N.º 2545

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FISCAL DRAG IN THEORY AND IN PRACTICE: A EUROPEAN PERSPECTIVE [*]

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We thank Matteo Cotella and Hippolyte Giraud for excellent research assistance. Special thanks to Xabier Moriana-Armendariz for his help with Appendix C. We are also very grateful to Alari Paulus for the thoughtful discussion and helpful comments on our paper. We thank Aristoklis Avgousti, participants at the ESCB Network on Microsimulation Modelling, at the EUROMOD Research Conference in Marseille, at the Eighth ESCB Research Cluster 2 Workshop, and at Banco de España and European Central Bank research seminars. The views expressed in this presentation are those of the authors and do not necessarily represent the views of the Eurosystem or any institution listed in the affiliations of the contributing authors.

Documentos de Trabajo. N.º 2545

November 2025

https://doi.org/10.53479/41507

ISSN: 1579-8666 (online edition)

Abstract

This paper presents a comprehensive characterization of "fiscal drag" —the increase in tax revenue that occurs when nominal tax bases grow but nominal parameters of progressive tax legislation are not updated accordingly— across 21 European countries using a microsimulation approach. First, we estimate tax-to-base elasticities, showing that the progressivity built in each country's personal income tax system induces elasticities around 1.7-2 for many countries, indicating a potential for large fiscal drag effects. We unpack these elasticities to show stark heterogeneity in their underlying mechanisms (tax brackets or tax deductions and credits), across income sources (labor, capital, self-employment and public benefits), and across the individual income distribution. Second, we extend the analysis beyond these elasticities to study fiscal drag in practice between 2019 and 2023, incorporating observed income growth and legislative changes. We quantify the actual impact of fiscal drag and the extent to which government policies have offset it, through either indexation or other reforms. Our results provide new insights into the fiscal and distributional effects of fiscal drag in Europe, as well as useful statistics for modeling public finances.

Keywords: personal income tax, inflation, indexation, bracket creep.

JEL classification: D31, H24, E62.

Resumen

Este artículo presenta un análisis exhaustivo del fenómeno de la «progresividad en frío» *(fiscal drag)* —el aumento de la recaudación tributaria que se produce cuando las bases imponibles nominales crecen, pero los parámetros nominales de una legislación tributaria progresiva no se actualizan en consecuencia— en 21 países europeos mediante microsimulación. En primer lugar, se estiman las elasticidades entre recaudación e ingresos imponibles, y se muestra que la progresividad incorporada en el impuesto sobre la renta de las personas físicas de cada país genera elasticidades en torno a 1,7-2 en muchos casos, lo que indica un elevado potencial para que se produzca progresividad en frío. Se documenta una marcada heterogeneidad en los mecanismos subyacentes a estas elasticidades (tramos impositivos frente a deducciones y créditos fiscales), entre las distintas fuentes de renta (trabajo, capital, trabajo por cuenta propia, prestaciones públicas) y a lo largo de la distribución de ingresos de los individuos. En segundo lugar, se amplía el análisis más allá de dichas elasticidades para estudiar la progresividad en frío en la práctica entre 2019 y 2023, incorporando el crecimiento observado de las rentas y los cambios legislativos. Se cuantifica el impacto real de la progresividad en frío y en qué medida las políticas gubernamentales lo han compensado, ya sea mediante la indexación o a través de otras reformas. Nuestros resultados aportan nueva evidencia sobre los efectos fiscales y distributivos de la progresividad en frío en Europa, así como estadísticos útiles para la modelización de las finanzas públicas.

Palabras clave: impuesto sobre la renta de las personas físicas (IRPF), inflación, indexación.

Códigos JEL: D31, H24, E62.

1 Introduction

Fiscal drag refers to the increase in tax revenue that occurs when there is nominal growth of the tax base, whereas parameters that define a progressive tax system are not increased in line with such growth, leading to a rise in the average effective tax rate. This effect is more prevalent in personal income taxes (PIT), which often display a high degree of progressivity due to progressive tax schedules or tax deductions and credits.[1,2] Fiscal drag, therefore, plays an important role in public finance analysis with implications for the elaboration of fiscal projections (e.g., Creedy and Gemmell, 2004; Belinga et al., 2014), for macro modeling of public finances (e.g., Hack, 2025), and for the analysis of behavioral responses to and distributional consequences of taxation as well as optimal tax design (e.g., Saez, 2003; Immervoll, 2005; Sutherland et al., 2008; Heer and Süssmuth, 2013; Paulus et al., 2020). Fiscal drag can also play a role as an automatic stabilizer (Auerbach and Feenberg, 2000; Immervoll, 2006; Dolls et al., 2012) or as a discretionary revenue measure.[3]

The recent spike in inflation that started in 2021 and the consequent growth in household income has triggered a renewed interest in fiscal drag from analysts and policymakers interested in estimating its budgetary effects and distributional implications.[4] In the European Union (EU), personal income tax remains at the discretion of each EU Member State, which can give rise to potentially large and heterogeneous fiscal drag effects across countries. As a consequence, uniform shocks may hit Member States asymmetrically, which can pose a risk to macroeconomic stability in the absence of a centralized fiscal capacity (Farhi and Werning, 2017; Bilbiie et al., 2021).

This paper provides a comprehensive characterization of fiscal drag across 21 European countries (all euro area and Hungary) in the recent period. We leverage microdata from the European Union Survey of Income and Living Conditions (EU-SILC) and a microsimulation tool that models the tax and benefits legislation of all European countries, allowing for the simulation of individual tax liabilities under different counterfactual scenarios of income

[1] In the long term, PIT's nominal tax base can grow for two reasons: inflation and productivity. In this paper, we generally refer to fiscal drag as the effect stemming from both sources, although we will consider indexation scenarios based on both CPI and nominal tax base growth.

[2] Note that fiscal drag could occur in other tax instruments as long as they have a progressive nature and are based on nominal tax parameters. Alternatively, tax instruments that are based on quantities, such as some excise duties, could see a reduction in revenue defined in real terms if the nominally defined tax is not updated.

[3] For an example of explicit use of fiscal drag as a discretionary measure in the U.K., see Waters and Wernham (2022). In the European Union, revenue induced by fiscal drag will be explicitly considered as a discretionary measure under the new fiscal framework.

[4] See the OECD (2023), the IMF (Balasundharam et al., 2023), the European Commission (Leventi et al., 2024), the Institute for Fiscal Studies for the U.K. (Waters and Wernham, 2022) or the Bank of Spain (Balladares and García-Miralles, 2024).

growth and tax policies.[5,6] Our results provide detailed and comparable estimates of tax progressivity across Europe in terms of tax-to-base (TTB) elasticities and their potential impact on fiscal drag, including a deep exploration of their determinants and heterogeneous effects. We also estimate actual fiscal drag in the recent period, isolating the effect of government action either through indexation measures or through other reforms, so as to provide a data-driven characterization of indexation practices across Europe within a unified modeling framework, as opposed to existing qualitative overviews (e.g., OECD, 2023; Balasundharam et al., 2023).

Two different determinants give rise to fiscal drag effects: the progressivity embedded in the design of the tax at a given point in time, and the degree of updating of nominal tax parameters over time to keep up with the nominal growth of the tax base. The progressivity of the tax system provides a measure of potential fiscal drag that would occur, *in theory*, if the nominal tax base grows but tax parameters are not updated. The combination of this progressivity with the degree of updating of tax parameters for a given growth of the tax base determines the actual fiscal drag that occurs *in practice*.

In the first part of the paper, we estimate the potential fiscal drag embedded in the tax system of each country through TTB elasticities, i.e. the relative change in tax revenue following a nominal homogeneous 1% increase in the tax base with no change in tax legislation. These elasticities, which are equivalent to the average marginal tax rate divided by the average tax rate, have a direct use in models of fiscal projections as they indicate what would happen to tax revenue in a no-indexation scenario.[7] Across the set of countries studied, two-thirds have tax systems that produce relatively similar TTB elasticities, ranging from 1.7 to 2. Interestingly, despite the complexity and differences that characterize the personal income tax designs across countries, elasticities seem to converge around these values. We also find, however, some outlying elasticities as big as 2.4 or as small as 1.1, in line with the characteristics of those tax systems. In general, these estimates are large, but in line with previous results (Price et al., 2015, report an elasticity of around 1.85 on average for all OECD countries) and imply that in the absence of adjustments in the tax parameters,

[5]We use EUROMOD, an open-source microsimulation model for the EU developed and maintained by the Joint Research Center of the European Commission that contains detailed coding of the legislation on direct taxes and benefits of all 27 EU Member States. For examples of research that leverages EUROMOD, see Dolls et al. (2012), Paulus and Tasseva (2020), Doorley et al. (2021), or Amores et al. (2025).

[6]We follow the methodology of Balladares and García-Miralles (2025), who use administrative tax data for Spain. This allows for a validation of our survey-based results for that country (see Online Appendix C).

[7]We implement our analysis on the most recent microdata available at the time of the study, corresponding to incomes received during 2019 and the corresponding PIT legislation. We focus the first part of the analysis on 2019 so as to maintain consistency between the microdata and the legislation, but we also compute elasticities given the 2023 legislation based on updated data according to observed growth of aggregate income concepts.

tax revenue, and effective average tax rates would grow markedly.

We document, however, substantial heterogeneity in the origins of these elasticities across three dimensions. First, we unpack these elasticities by exploring the underlying mechanisms, as we decompose the contribution to the elasticity that stems from bracket progressivity as well as from each tax deduction or credit present in the tax legislation. We find that on average, around half of fiscal drag is driven by bracket progressivity and half is driven by tax deductions and credits, with the latter often concentrated in just one or two large tax deductions. Second, we further explore the drivers of these elasticities by estimating heterogeneity by income source. We document larger elasticities for labor income and smaller elasticities for capital income and for pensions and benefits (the two latter being often subject to a flatter schedule or to exemptions and large allowances). These elasticities and their heterogeneity by income source can be useful tools for modeling and projecting tax revenues, especially in times when there are large differences in the growth rate of each type of income. Third, we compute TTB elasticities across decile groups of the individual tax base distribution to provide a non-parametric illustration of the heterogeneous elasticities across individuals and their mechanisms. We uncover wide within-country variation, with higher elasticities for the low and middle incomes, which can be as high as 40% for some taxpayers, as these individuals are often more affected by the relative loss of tax deductions or credits that in some cases are very rapidly phased-out as nominal income increases.

We also document how these elasticities would affect the progressivity of the system and income inequality if income grows homogeneously and tax parameters remain unchanged. We find that the tax system becomes less progressive in all countries (tax rates grow more for low-income taxpayers, as illustrated in our distributional analysis), a result in line with existing literature. However, we find mixed results on inequality. For a majority of countries, inequality is reduced, mainly due to the fact that the share of low-income zero-tax payers remains broadly unchanged, while tax rates increase for all positive taxpayers, even if they increase less for the top incomes. However, for around a quarter of countries, inequality increases. This paints a more nuanced picture than the common finding in the literature that inequality always decreases.

In the second part of the paper, we study the fiscal drag that occurred *in practice* during the period 2019 to 2023. To do so, we compute tax liabilities for baseline scenarios in 2019 and 2023 that reflect actual tax collection in these two years, and we then construct counterfactual scenarios for 2023 for two polar cases: one of no indexation, where the tax system of 2019 remains unchanged, and one with full indexation, where the tax system of 2019 is fully indexed according to either concurrent HICP, lagged HICP or nominal tax base growth. The difference between these two polar counterfactuals of no-indexation and full-

indexation provides an estimation of the *potential* impact of fiscal drag: the revenue that could be collected during this period if tax parameters remained unchanged with respect to a fully-indexed scenario. Note that this potential fiscal drag is directly related to the TTB elasticities, but it also depends on the potentially heterogeneous income growth observed.

We then calculate the difference between the actual tax collection of 2023 and the full-indexation counterfactual to obtain an estimate of the *actual* impact of fiscal drag during the period. The difference between actual tax collection and the no-indexation scenario then provides an estimate of *offset* fiscal drag. Conveniently, by expressing actual fiscal drag and offset fiscal drag as ratios of the potential fiscal drag we obtain a normalized and comparable measure across countries that can be interpreted as a data-driven characterization of fiscal drag and recent indexation practices.

The first insight from this analysis is that all countries have offset fiscal drag to some extent during the period considered. That is, revenue collection in 2023 has been below that of a no-indexation counterfactual where the 2019 PIT legislation has been kept constant until 2023. This is because all countries have done some form of tax reform that has lowered revenue. However, there is a huge variation in the extent to which fiscal drag has been offset. We document that around one-third of the countries considered have offset less than 80% of the potential fiscal drag, and in some cases, as little as 20% was offset. Another third of countries can be considered to have largely offset fiscal drag, which we define as deviating by less than 20% above or below perfect offsetting. That is, their revenue in 2023 is close to that of a full-indexation scenario where the 2019 PIT legislation was updated according to the average growth of the three indices considered. Finally, the remaining third of countries have overcompensated fiscal drag, meaning that their revenue collection has been significantly lower than that expected under full-indexation. This was mainly due to other reforms, rather than indexation.

The second insight is that the type of policy measures adopted to achieve the different degrees of offsetting has been remarkably heterogeneous between and within the three groups of countries considered. Some countries have relied on indexation measures, by updating nominal parameters broadly in line with income or price growth,[8] while other countries have relied on other forms of PIT reform unrelated to indexation. There are also countries that have implemented a mix of these two. We note that a stricter definition of offsetting policies based only on indexation measures would indicate larger fiscal drag effects during this period.[9]

[8] Note that we classify as indexation measures both statutory indexation that is well defined and occurs more systematically, and discretionary indexation that is implemented ad-hoc, often with less clear guidelines. We further document which countries use each, and find that they are both used with a comparable frequency.

[9] We note that the distinction between these two types of policies, indexation and other reforms, is often

Literature review and our contributions. In line with our conceptual distinction, a first strand of the literature on fiscal drag has focused on studying tax-to-base (TTB) elasticities that measure the effect of tax base growth on tax revenue, such as the pioneering work of Immervoll (2005) and more recent contributions of Price et al. (2015) or Boschi and d'Addona (2019).[10] A second strand now places more emphasis on studying the effects of fiscal drag in practice, as in Paulus et al. (2020), Waters and Wernham (2022) or Moriana-Armendariz (2023) shifting the focus from potential fiscal drag embedded in tax systems to the actual fiscal drag that can prevail despite government actions, whether through indexations or other tax reforms.[11]

A major contribution of this paper is that it provides estimates of fiscal drag based on microdata for 21 European countries, while previous studies that use microdata have been limited to a few countries.[12] We therefore provide micro-based estimates that are novel for many countries and that allow us to extract richer and updated insights from a wider cross-country comparison. The second contribution of our paper is to use two complementary methodological approaches within a consistent and homogeneous framework, providing estimates that map fiscal drag from its origin (the progressivity of each tax system that we capture through TTB elasticities) to its final impact (which involves accounting for policy changes and observed income growth, as well as the estimation of counterfactuals). Our different estimates have implications for policymakers interested in fiscal developments as well as for optimal tax design. Finally, we go beyond other cross-country studies by thoroughly unpacking TTB elasticities across income sources, across the income distribution, and through its mechanisms.[13]

difficult. Furthermore, they can interact with each other and are often adopted jointly by policymakers.

[10]Note that Immervoll (2005) focuses on understanding the impact of fiscal drag on inequality rather than on estimating elasticities, but in a setting that corresponds to our notion of fiscal drag "in theory", under homogeneous income growth and constant tax parameters. Other works in this spirit include Sutherland et al. (2008), Zhu (2014) and Shahir and Figari (2024).

[11]The focus of this paper is on fiscal drag and personal income taxation, but our analysis relates to the more general concept of tax buoyancy (e.g., Lagravinese et al., 2020; Cornevin et al., 2023) and the related concept of benefit erosion (e.g., Paulus et al., 2020; Leventi et al., 2024). Altig et al. (2024) further consider the impact of fiscal drag on consumption.

[12]For example, Immervoll (2005) studies Germany, the Netherlands and the U.K., Paulus et al. (2020) study Belgium, Bulgaria, Estonia, Greece, Hungary, Italy and the UK and Shahir and Figari (2024) considers Ethiopia, South Africa, Tanzania, Uganda, Mozambique, and Zambia. Related work has considered a large set of countries like us, but to answer a different question: the impact of wage indexation in Europe (Leventi et al., 2024). There are also papers estimating fiscal drag for a large set of countries using aggregate time series data (e.g., Boschi and d'Addona, 2019; Mourre and Princen, 2019; Hayo et al., 2023) or based on calculations for representative households (Price et al., 2015).

[13]Balladares and García-Miralles (2025) do a similar exploration of TTB elasticities in Spain, and Waters and Wernham (2022) explore impacts in nominal terms across decile groups in the U.K. We also add to the analysis of Paulus et al. (2020) by complementing the focus on inequality with a more fiscal view that estimates revenue impacts as well as implications on effective tax rates.

The paper is structured as follows. Section 2 introduces the institutional framework of the analysis. Section 3 presents the data and the microsimulation tool used in the study. Section 4 and section 5 describe the methodology and the results of our two conceptual approaches. Section 6 concludes with a summary and discussion of our results.

2 Institutional framework

2.1 The personal income tax across Europe

The personal income tax (PIT) encompasses all fiscal mechanisms established by the government to levy taxes on household incomes, regardless of the income source. Tax legislation is country-specific and often complex, varying both between countries and, in some cases, also within them due to both state and regional tax policies. Personal income taxes enable governments to raise revenue and reduce inequalities, as their design is often progressive, with average effective tax rates growing with income. Typically, tax systems include tax rates and brackets, which determine the amount levied based on individual incomes, as well as tax deductions and credits designed to relieve some individuals of fiscal pressure based on their personal characteristics. Given the wide variety of tools and objectives associated with personal income tax, tax systems differ significantly across European countries.

Indexation practices in personal income taxation aim to adjust tax brackets, deductions, and credits to account for inflation, thereby preventing taxpayers from facing higher average tax rates despite no real increase in purchasing power. Some tax systems implement statutory or automatic indexation, linking nominal tax parameters to indicators of price or income growth. Others apply discretionary adjustments, where tax authorities periodically revise tax parameters based on economic conditions or policy decisions. In addition, other types of policy reforms might compensate for the increase in tax revenue due to fiscal drag, even if not formally implemented as indexation policies. It is worth emphasizing that it is often unclear what type of indexation policy is followed by a given country, as these indexation policies can change over time, and different measures are sometimes implemented simultaneously.

We provide in Appendix Table A.1 a qualitative classification of indexation practices during our period of analysis. Between 2019 and 2023, a significant majority of the countries considered (the euro area and Hungary) implemented some form of response to fiscal drag through personal income tax (PIT) adjustments. Out of the 21 countries considered, 16 introduced some type of indexation—either statutory or discretionary. Among these, six countries (Austria, Belgium, Germany, France, the Netherlands, and Slovakia) applied statutory indexation, which is defined as automatic or quasi-automatic adjustments embedded

in the tax code. Ten countries (Estonia, Spain, Finland, Ireland, Lithuania, Luxembourg, Latvia, Malta, Portugal, and Slovenia) opted for discretionary indexation measures, often ad hoc and partial in scope. Germany implemented both statutory and discretionary indexation during this period. In contrast, five countries did not adopt any form of indexation during this period: Cyprus, Greece, Croatia, Hungary, and Italy.

In addition to indexation, all countries implemented other PIT reforms that were not primarily aimed at addressing fiscal drag. These are structural or one-off measures such as new deductions, changes in tax brackets, or rate adjustments. These findings suggest that while indexation mechanisms are not uniformly adopted across EU member states, governments frequently resort to alternative reforms—especially in response to exceptional economic conditions like the recent inflation surge. We provide further country-specific details on each country's institutional framework in Online Appendix B. For recent qualitative overviews of indexation practices across countries, see OECD (2023) and Balasundharam et al. (2023).

2.2 Definitions

Throughout the paper, we consider the following concepts and definitions that aim to encompass the different features of PIT systems across Europe. Online Appendix B provides further details on how these concepts map into each country's specific concepts.

Gross income: Total income a person or household earns from all sources, whether taxed or not. It includes labor income (wages and salaries), capital income (interest, dividends, rental income, and capital gains), self-employment income, and pensions and benefits.

Tax base: The tax base includes all gross incomes subjected to PIT, before any exemptions, allowances, or deductions are applied.

Taxable income: The taxable income is obtained from the tax base by exempting, partially or fully, some types of income (e.g., pensions or some types of benefits) and subtracting deductions or allowances (e.g., social insurance contributions paid by the employee). The PIT tax schedule is applied to the tax base.

Personal income tax revenue or *tax liability*: Personal income tax revenue refers to the amount effectively collected by the government from the tax base of the taxpayers. While in some countries there is one single personal income tax instrument, in others there is more than one, sometimes as a result of supplementary tax instruments, in which case, we treat them together as long as we consider them economically equivalent.[14]

Tax credits and deductions: are allowances that directly reduce the household's gross tax liability. In some countries, these tax credits can result in a tax refund.

[14]Our decision to group tax instruments is often guided by the modeling structure embedded in EUROMOD itself, which also aims for a definition that allows meaningful comparison across countries.

Social security contributions: In most countries, workers contribute a share of their gross income to social security in return for a pension income in the future. Often, these contributions are matched by a tax exemption of the same size.[15]

Nominal tax parameters: are monetary amounts defined in the tax legislation that characterize tax deductions and credit amounts and thresholds, as well as tax bracket thresholds, influencing the marginal or average tax rate.

3 Data and the microsimulation tool

Our empirical analysis is based on Eurostat's Survey on Income and Living Conditions (EU-SILC) and uses EUROMOD, a microsimulation tool maintained by the European Commission. In the context of our study, both EU-SILC and EUROMOD have the unique advantage of providing a fully harmonized framework across all EU countries.

While other country-specific microsimulation tools might be able to provide a more detailed modeling of the tax legislation or better coverage of the tails of the distribution, the combination of EUROMOD and EU-SILC data has proven successful at modeling fairly detailed recent policy changes (Amores et al., 2025). Furthermore, we validate our results for Spain with those derived from administrative tax records (see Online Appendix C).

Data. The cross-sectional version of the European Union Survey on Income and Living Conditions (EU-SILC), produced by Eurostat, covers all EU countries and has an annual frequency. The survey collects individual and household-level information on disposable income components such as earnings, social contributions, taxes, pensions, and other social transfers, as well as other socio-demographic information.

All simulations in this paper are based on the EU-SILC 2020 survey, whose income reference period is 2019. Often, these variables and aggregates are defined in nominal terms (e.g., average wage, average pension, statutory minimum wage). For simulations conducted for 2023, we update each of these income variables according to their aggregate growth between 2019 and 2023. These growth rates are calculated for each income source based on the latest available official statistics. As a result of this updating process, individual income growth differs as long as there are individual differences in income composition.

Note that the simulated tax revenue from these simulations might differ from that reported in official statistics in the period 2019 to 2023 for a number of reasons (see Maier and Ricci, 2022). First, total revenue might differ because survey data fail to capture the very

[15] EUROMOD already incorporates these types of automatic adjustments, which we preserve and account for when calculating TTB elasticities, as detailed in section 4.1.

top earners who have a large impact on revenue collection. Second, EUROMOD might induce small biases due to features of the tax code that cannot be modeled given the available information or that are simplified in the calculations. And third, the updating of the 2019 microdata done within EUROMOD is based only on individuals' nominal growth of the tax base and therefore fails to incorporate observed growth (e.g., through number of taxpayers), which can induce a growing divergence with respect to official statistics. We discuss these potential sources of error and how we evaluate their impact and address them in each of the methodological subsections 4.1 and 5.1 of the paper.

Microsimulation tool. EUROMOD is an open-source microsimulation model for the EU developed and maintained by the Joint Research Center of the European Commission (see Sutherland and Figari, 2013; Bornukova et al., 2024). The model contains detailed coding of the legislation on direct taxes and benefits of all 27 EU Member States, in most cases from 2006 up to 2023, allowing for the simulation of tax liabilities and benefit entitlements at both the individual and household level. The microsimulation model runs on EU-SILC data. EUROMOD calculates taxes and benefits accounting for their complex interactions, enabling an accurate calculation of individual and household disposable income. We use version I6.0+ of EUROMOD, which incorporates modeling information up to June 2023. In some cases, we have updated or corrected some policies that were modeled only partially or that changed throughout the year. These updates and small divergences from the publicly released model are mentioned for each country in Online Appendix B. Note that EUROMOD does not incorporate behavioral responses to tax-benefit changes, therefore, it is static and delivers so-called "morning-after" effects.

EUROMOD allows us to simulate baseline scenarios under actual legislation and given the income observed in the microdata, as well as the estimation of counterfactual scenarios under changes in the tax-benefit legislation or in the underlying data. We rely heavily on the construction of these counterfactual scenarios to estimate different measures of fiscal drag and its underlying mechanisms, as detailed in our methodology subsections 4.1 and 5.1.

4 Potential fiscal drag as tax-to-base elasticities

4.1 Methodology: estimating TTB elasticities

We aim to characterize the progressivity embedded in each country's PIT systems, which we see as a measure of potential fiscal drag. Our main instrument to measure this progressivity is the estimation of a tax-to-base (TTB) elasticity, which captures the relative change in

PIT revenue following a homogeneous 1% increase in the tax base for all taxpayers across all income sources. Formally, we define the TTB elasticity for each taxpayer as:

$$\frac{\frac{\partial t}{t}}{\frac{\partial y}{y}} = \frac{y}{t} \times \frac{\partial t}{\partial y} = \frac{\partial t/\partial y}{t/y} = \frac{MTR}{ATR}, \tag{1}$$

where y denotes tax base, and t represents PIT revenue. Note that the TTB elasticities are equivalent to the ratio of the average marginal tax rate (MTR) and the average tax rate (ATR). In a progressive system, marginal rates are generally higher than average tax rates across the income distribution, giving rise to TTB elasticities that are larger than 1. This over-proportional effect is what we identify as potential fiscal drag and can be seen as an upper bound of fiscal drag in the absence of any indexation or changes in the PIT parameters and under homogeneous income growth. Note also that these elasticities are *static* because they are calculated under a *ceteris paribus* assumption, where all parameters outside the PIT system remain fixed, and there are no behavioral responses. The size of the elasticity, therefore, depends on the design of the PIT legislation (e.g., brackets, deductions, and credits) as well as on the underlying distribution of income and personal characteristics of the taxpayers relevant to the calculation of their tax liability.

We estimate the elasticity by simulating a 1% increase in all sources of income that enter the tax base of all individuals and then calculating the resulting tax liability, keeping the PIT legislation constant, including the value of nominal tax parameters. We then compute the TTB elasticity as the percentage growth in PIT revenue divided by the percentage growth in the tax base, with the latter being 1%.

This very simple approach needs to address a number of methodological choices related to how the PIT system interacts with other tax instruments, benefits, and social security. The choices are often country-specific and require careful consideration of each tax benefit system. We guide our choices by the idea of estimating TTB elasticities that isolate the effect of not indexing PIT parameters while other parameters and features of the tax-benefit systems are allowed to adjust freely in response to the simulated growth of the PIT tax base, in line with each country's standard practice. Two examples of this are the following. First, as a result of increasing labor income, social security contributions (SSCs) paid by the employee also grow, and in many countries, these are tax-deductible in the PIT. We allow this to happen. Furthermore, in cases where there is a minimum or maximum contribution defined as a nominal parameter, we also increase these by 1%, contrary to the PIT parameters. We do this because these are not PIT parameters and because it is a more frequent practice to update these SSC thresholds in line with income growth. Another example is a few countries where PIT includes nominal values of statutory minimum wage or average wage as

parameters, which generally have the effect of reducing TTB elasticities, as they are indexed to income growth. These cases are detailed and discussed in Online Appendix B.

4.1.1 Unpacking TTB elasticities

Mechanisms. An advantage of our microsimulation approach is that it allows for a thorough exploration of the mechanisms that give rise to these elasticities. We decompose TTB elasticities by isolating the effects of the different tax parameters of each country's legislation, distinguishing between tax brackets and the most important tax credits and deductions. We proceed by first simulating a 1% increase in the income included in the tax base while simultaneously increasing all PIT parameters by the same relative amount, simulating a scenario close to perfect indexation to income growth. Second, by iteratively removing these increases for each of the parameters that determine the brackets and specific deductions and credits, we calculate the contribution of each of these components to the overall elasticity.

Heterogeneity by income source. We also explore the determinants of our TTB elasticities by calculating specific elasticities for the different income sources: labor, self-employment, capital income, and benefits and pensions. We increase each income source separately and calculate the elasticity as the relative change in revenues divided by the relative change in the tax base (with this change in the tax base being solely driven by a 1% increase in the income source of interest).

4.1.2 Distributional Analysis

Elasticities across the individual tax base distribution. We further calculate separate TTB elasticities for each decile group across the individual tax base distribution. This non-parametric approach enables a granular view of how the progressivity of the tax system affects different income levels, revealing the distinct impacts of potential fiscal drag on redistribution and inequality. We further document, for each decile group, the mechanisms driving the elasticities.

Specifically, we calculate the elasticity of each decile group as the ratio of the change in total taxes paid by individuals in that group to the change in their tax base. Note that, as a result of this procedure, we obtain elasticities that are a weighted average of the individual elasticities within each decile group, with weights corresponding to their tax liability. This is consistent with the aggregate elasticity we estimate for all taxpayers (where those with higher tax liabilities have a greater impact on the TTB elasticity) and ensures that the elasticities of each decile group add up to the aggregate elasticity. However, this also means that zero-tax payers, whose elasticity is undefined (a 1% increase in their income leads to no

change in their tax liability), have a null weight and do not impact the estimated elasticity. We present our results together with the distribution of zero-tax payers to provide a more complete and nuanced picture.

Progressivity and inequality. Our microsimulation approach allows for an examination of the potential impact of fiscal drag on redistribution and inequality. We assess inequality by calculating the Gini index, as well as the 90:10 and 80:20 ratios, which compare the income levels of the top 10% and 20% of the distribution, respectively, with the bottom 80% and 90%. To measure progressivity, we apply the *Kakwani index* (see Kakwani, 1977), defined as the difference between the concentration index of the tax change (indicating the distribution of tax changes) and the baseline Gini index of the income distribution.

4.2 Results: TTB elasticities across countries, its determinants and heterogeneity

4.2.1 TTB elasticities and their determinants

This section presents our estimated TTB elasticities for all countries considered. Figure 1 graph (a) shows that the estimated TTB elasticities induced by PIT legislation in 2019 range around 1.8, with fourteen out of the twenty-one countries ranging from 1.7 to 2. These results suggest that despite the wide variety of tax designs across countries, elasticities tend to converge to these values. We also document, however, some outlying cases with elasticities varying from 1.1 for Hungary to 2.4 for Croatia in line with specific features of their tax system that we discuss below.

When breaking down the TTB elasticities by the mechanisms that give rise to them, we uncover wide heterogeneity across countries. A first and important insight is that while bracket progressivity plays a large role in fiscal drag, the combination of tax deductions and tax credits is of similar importance. Furthermore, among these tax deductions and credits, it is often one or two specific ones that have a meaningful impact on the elasticity, such as the often present family allowance or other types of large tax deductions.[16]

Looking more closely at the variation across countries, in graph (b) of Figure 1, we find that some elasticities are driven almost entirely by bracket progressivity (such as in Austria, Luxembourg, Malta, and Cyprus) whereas others are driven almost entirely by tax deductions and credits (such as Hungary, Estonia, Slovakia and Croatia). In many other countries, the elasticities are driven by these two types of mechanisms with varying intensity.

[16]For a detailed characterization of these types of tax deductions and credits across Europe, see Turrini et al. (2024) and Online Appendix B.

We note that the lowest elasticities correspond to countries with flat tax schedules, where bracket progressivity does not contribute to their TTB elasticity. Countries with the highest elasticities are often influenced by very progressive tax schedules, although Croatia, the country with the highest elasticity, has a flat schedule while displaying the largest elasticity because of a very prominent tax deduction, as explained in Online Appendix B. We report all the estimates that underlie Figure 1 in Appendix Table A.2.

While we focus our detailed analysis of TTB elasticities on 2019 to maintain consistency between the observed microdata and the legislation, we also estimate elasticities based on 2019 microdata updated to 2023, under the assumption of homogeneous growth within each of the different income sources that form the tax base. The comparison and the 2023 values are presented in Appendix Figure A.1 and Appendix Table A.3. We find that the elasticities are generally stable across these years. This suggests that despite the recent inflation spike and reforms of the tax legislation, there have not been major changes affecting the progressivity of the PIT legislation in this period as measured by TTB elasticities, except for a meaningful reduction in the elasticity of Croatia, and increase in Greece, and a few other smaller changes that can be mainly explained by changes in the tax legislation, as described in the relevant cases in Online Appendix B. Note that slight differences in elasticities may also arise due to composition effects from differential growth rates across income sources as we show in the next subsection.

4.2.2 Tax-to-base elasticities by income source

We document significant differences when we calculate the elasticities specific to each income source in some countries, as documented in graph (a) of Figure 2 and in Appendix Table A.2. The elasticity for labor income is close to the overall elasticity by construction, as labor income is the main component of households' overall income, as shown in graph (b). In general, we note that pensions and benefits have lower TTB elasticities in many countries, with nine countries reporting an elasticity close to or lower than one due to exemptions or tax allowances affecting this type of income. Capital income also tends to induce a lower elasticity than labor income across the countries, although to a lesser extent than pension and benefits. This is consistent with the design of PIT in these countries, where capital income is generally subject to less progressive tax brackets or is only subject to a flat tax rate. However, there are a few exceptions where capital income elasticity is higher, either because it is taxed at higher marginal rates (even if these rates are flat) or because it interacts with specific tax deductions and tax credits. Country-specific details are provided in Online

Appendix B.[17]

It is worth noting that these differences in elasticities by income source have important implications for revenue projections if different income sources grow at different paces, as using a single aggregate elasticity may under- or over-estimate revenue forecasts. Our disaggregated elasticities allow for refined projections that could incorporate these differences and reduce forecast error. Note that different elasticities by income source also have implications for the distributional impact of fiscal drag across the individual distribution, as we illustrate next.

4.2.3 Tax-to-base elasticities across the individual income distribution

We report, for each country, the estimated TTB elasticities by decile groups of the tax base distribution as well as their underlying mechanisms in Figure 3 and Appendix Table A.4. This non-parametric display of heterogeneity across decile groups, as opposed to computing single indices of volatility or dispersion, has the advantage of identifying jumps or kinks in the distribution of elasticities, of importance to evaluate the tax design of each country with more granularity. Importantly, Figure 3 also shows the share of zero-tax payers within each decile for each country, whose elasticities are undefined and do not affect the elasticities of each decile group, as explained in subsection 4.1.[18]

Notably, we estimate that elasticities at specific parts of the income distribution can be very large, which suggests large marginal tax rates for those taxpayers. This indicates that fiscal drag would have a large impact in the absence of parameter updating. This raises concerns about potential inefficiencies, as very high marginal tax rates could undermine the fairness of the tax system and diminish work incentives at the intensive margin. By decomposing the sources of these elasticities across deciles, we pin down the specific features of the tax that drive these inefficiencies, often related to tax deductions and credits. Further details are provided for each country in Online Appendix B, including explanations for some of the extreme values observed that can be as large as a TTB elasticity of almost 40 in Austria.

Despite the large variability in cross-country results, some common trends emerge, which we summarize in Figure 4. Graph (a) shows the difference in the TTB elasticities of the bottom 80% and top 20% and of the bottom 90% and top 10% of the tax base distribution,

[17] Note that the nature of our survey data might be more prone to misreporting of some income sources, such as capital, which warrants more caution in the interpretation of these results.

[18] In more than half of the countries analyzed, over 90% of taxpayers in the first decile group do not pay PIT, indicating that the elasticity calculated for this group is representative of only a small fraction of taxpayers within the decile group. We report in graph (d) of Figure 4 a cross-country overview of zero-tax payers.

showing that the top elasticities are systematically lower. Graph (b) shows the TTB elasticities in the lower and upper halves of the distribution. In all countries studied, elasticities are higher in the lower half of the distribution. These two findings suggest that fiscal drag reduces the progressivity of the PIT, as we explicitly document later. Graph (c) shows the maximum and minimum values of the elasticities across deciles of each country. Although there is a wide range of peak-to-trough differences, for most countries, the highest elasticities are found either in the second decile or in adjacent deciles, with Croatia, Hungary, Greece, and France being notable exceptions, as their peak elasticity is placed towards the middle of the distribution.

Impact on inequality and progressivity. We begin by examining the effect of fiscal drag on the progressivity of the tax system in our setting of homogeneous income growth and unchanged tax parameters.[19] The impact of fiscal drag on progressivity is theoretically ambiguous, as formally shown in Immervoll (2005).[20] To measure its empirical impact, we compute the Kakwani index, which quantifies the degree of progressivity of the tax system, before and after the 1% increase in incomes. Graph (a) of Figure 5 shows this difference. We observe negative values across all countries, meaning that when incomes grow and tax parameters are unchanged, the progressivity of the system is reduced. This relates to the distribution of TTB elasticities shown in Figure 3 and Figure 4, as the effective tax rates are increasing less for top income earners than for middle and low ones. This finding generalizes, for a larger set of countries, the empirical findings of Immervoll (2005) for Germany, the Netherlands, and the United Kingdom.

We then study the effect on inequality through two inequality indicators (the Gini index and the Ratio 80:20) calculated for the net-of-tax income before and after the 1% increase in income, keeping the tax legislation constant. The difference in Gini or in the Ratio 80:20 after income growth indicates whether inequality has increased or decreased. The diamond-shaped markers in graph (b) of Figure 5 show these differences, and we observe that they take negative values for around two-thirds of countries, meaning that inequality would be reduced. These results generally hold both for the Gini index (which puts more weight on inequality in the middle part of the distribution) and for the Ratio 80:20 (which puts more weight on the extremes of the distribution). We observe, however, that in the remaining countries, the impact on inequality is more sensitive to the specific measure considered and in some cases shows an increase in inequality.

[19] For reference, Appendix Figure A.2 shows a description of the progressivity of each country's PIT system, measured as the share of tax revenue paid by individuals in the top 20% of the tax-base distribution relative to the share of total tax-base they earned.

[20] Immervoll (2005) shows that the erosion of tax credits unequivocally reduces progressivity, while the effects of eroded deductions and bracket thresholds are theoretically ambiguous.

It should be noted that income growth per se already impacts inequality (either based on gross incomes or on net-of-tax incomes, even with a fully indexed tax legislation). This is due to the presence of individuals with a tax base equal to zero, who are not affected by the 1% increase in incomes.[21] To filter out the effect of income growth from that of fiscal drag on inequality, we compute an alternative measure: the percentage change in a given inequality indicator (Gini or Ratio 80:20) between gross income and net income, both in the scenario before and after incomes have grown by 1%. We then take the difference between these two percentages to measure whether the inequality-reduction capacity of the tax system has increased or decreased because of fiscal drag. The round-shaped markers in graph (a) of Figure 5 show that these differences are generally positive, meaning that inequality-reduction increases after incomes have grown, given constant tax parameters. This is in line with the results obtained using the simpler approach described before.

Overall, our results indicate that fiscal drag tends to reduce inequality in most, though not all, countries, and that this finding is robust to alternative measures. We find that tax-to-base elasticities are generally larger for low- and middle-income individuals, implying a reduction in progressivity. Yet inequality still falls, because the tax liability of very low-income individuals remains zero even as their incomes rise, and this effect more than offsets the decline in progressivity. It is worth emphasizing that the inequality-reduction effect of fiscal drag is a common result in the literature (e.g., Immervoll, 2005; Paulus et al., 2020). However, our results show that this is not a universal result, as a non-negligible proportion of the countries we analyze display an increase in inequality.[22]

5 Fiscal drag in practice through counterfactual microsimulations

In this section, we turn to our assessment of fiscal drag "in practice" over the period 2019–2023, by incorporating observed growth of different income sources as well as actual policy changes—some of which might consist in the nominal updating of tax parameters intended to offset fiscal drag, and some might be other changes in the design of the tax. As in the previous section, we use a microsimulation approach to estimate aggregate PIT revenue over this period, as well as to construct counterfactual scenarios of full and no indexation that allow us to quantify the potential revenue collected from fiscal drag in 2023 and how

[21] The composition of taxable income is not homogeneous across countries, with some countries excluding significant parts of social transfers, which are typically more relevant for low-income households.

[22] Our results add to the work of Zhu (2014), who documents nonlinearities in bracket-creep effects in Germany for different levels of income growth. We show that even for a constant and small growth rate, there are differences across countries in the impact on inequality.

much of it was effectively offset by policy measures. Our methodology follows closely that of Balladares and García-Miralles (2025).

5.1 Methodology: defining counterfactual scenarios

The first step of the analysis consists of estimating baseline scenarios for each of the years of interest, based on the actual PIT legislation of those years. The estimation of the baseline year 2019 is the same as in the previous section and also relies on 2019 microdata. For the following years up to 2023, which is the focal year for this analysis, we incorporate the corresponding legislation and we update the 2019 microdata using disaggregated growth rates for the different components that form the tax base, such as average wage growth, pension growth, or growth in capital income, and which vary by country.

Note that, as a result of our updating procedure, there is heterogeneous income growth across individuals due to the different sources and composition of their income, but we lack information on individual heterogeneity within each of these income sources. This is, however, a relatively small limitation for the aggregate results that are presented in this section, since these are mainly driven by the top earners, who in turn drive the aggregate growth rates we use.

Note also that the simulated tax revenue from these baselines might differ from that reported in official statistics in the period 2019 to 2023 for several reasons (as discussed in section 3), which we attempt to correct by rescaling our estimates. Specifically, we rescale our baseline and counterfactual simulations according to the ratio between the simulated tax revenues and the official ones for each year of analysis.[23]

In a second step, we estimate different counterfactual scenarios in 2023 under alternative legislation that allows us to estimate the revenue collected as a result of fiscal drag, as well as the effect of policy measures in offsetting it. We further distinguish between indexation policies and other policies that also affected PIT revenue during this period, as detailed below.

We estimate five different counterfactuals in 2023, as well as the 2023 baseline, as summarized in Table 1. In scenario (1), the 2023 baseline is simulated by updating the 2019 microdata to 2023 and applying the 2023 legislation. Scenario (2) updates the data to 2023 but keeps the tax system of 2019 unchanged with PIT parameters maintained at their 2019 values. Scenarios (3), (4), and (5) also update the data to 2023 but apply the 2019 legislation with PIT parameters fully indexed according to one of three alternative indices: tax base growth in scenario (3), lagged HICP in scenario (4), or concurrent HICP in scenario

[23] We illustrate in subsection 5.2 the size of this divergence for each country.

(5). Finally, scenario (6) considers the baseline 2023, as in (1), but without the indexation measures that were actually implemented over the period, reverting those PIT parameters back to their 2019 values. This scenario helps to disentangle the effects of indexation reforms from those of other reforms that affected PIT revenue.

Table 1: Counterfactual scenarios for year 2023

	2023 Baseline	No indexation	Full-indexation			2023 without indexation
	(1)	(2)	(3)	(4)	(5)	(6)
PIT legislation	2023	2019	2019			2023
Nominal PIT parameters	2023	2019	2019, indexed			2019
Indexation practice	–	None	Tax-base growth	Lagged HICP	Concurrent HICP	–

Notes: This table summarizes the alternative simulations we run for the year 2023. Column (1) shows our baseline simulation that aims to replicate observed tax collection for that year. Columns (2) to (6) show different counterfactual scenarios we consider for the year 2023 under different indexation practices and different PIT legislation. All simulations are based on the same microdata (EU-SILC 2020) updated to incomes of 2023.

We define **potential fiscal drag** as the difference in PIT revenue collected in the two polar scenarios of no indexation (2) and full indexation (3), (4) or (5) or the average of these three full-indexation scenarios. The potential fiscal drag is a measure of the additional revenue that would have been collected in 2023 if the tax legislation remained unchanged since 2019, compared to a fully indexed scenario. We define **actual fiscal drag** as the difference between the actual PIT revenue collected in 2023, corresponding to scenario (1), and the PIT revenue collected in (2), (3), (4), or the average of these three. We then define the **offset fiscal drag** as the difference between the PIT revenue collected under the no indexation scenario (2) and the actual PIT revenue collected of scenario (1). This is equivalent to the potential fiscal drag minus the actual fiscal drag.

Importantly, we can compute ratios of actual and offset fiscal drag relative to the potential fiscal drag. This allows comparisons across countries that abstract from the magnitude of potential fiscal drag (which is closely linked to the progressivity of each country's tax system) and focus on the impact of government action through tax reforms and indexation. Specifically, we define:

$$\text{Offset Fiscal Drag Ratio} = \frac{\text{offset fiscal drag}}{\text{potential fiscal drag}} = \frac{(2)-(1)}{(2)-(3\,\text{or}\,4\,\text{or}\,5)} \tag{2}$$

This ratio provides us with a data-driven characterization of fiscal drag offsetting practices for a given period and can be used for meaningful cross-country comparisons, as we will show in the subsection 5.2.

Finally, we decompose each offset fiscal drag ratio by whether it is driven by indexation or other tax reforms. For this calculation, we use use the PIT revenue collected under scenario (6), where the tax legislation of 2023 is revised to revert indexation policies (but not other reforms) back to their 2019 levels. We do not further distinguish between statutory and discretionary indexation measures in this decomposition, given that virtually all countries have followed either one or the other over the period studied, as we document in Appendix Table A.1.

5.2 Results: actual and offset fiscal drag across countries

This section presents the results of our assessment of fiscal drag in practice over 2019–2023 across all 21 countries considered. We begin by displaying detailed results of the evolution of PIT revenue between 2019 and 2023, as well as the revenue in 2023 under each counterfactual scenario considered. We first focus on the four largest countries studied (Germany, Spain, France, and Italy), reported in Figure 6 and show the results for all other countries in Appendix Figure A.3. Underlying numbers to these figures are reported in Appendix Table A.5. We then show a cross-country overview of our results for all 21 countries by reporting all 2023 results for each country in Figures 7 and 8. A more detailed discussion of each country's institutional context and results is presented in Online Appendix B.

Each graph of Figure 6 displays, for a given country, the revenue collected yearly between 2019 and 2023 according to official aggregates and according to our baseline and counterfactual simulations. The gray markers correspond to our baseline simulations, the dashed line shows the official aggregates, and the black markers correspond to our baseline simulations rescaled to match the official aggregates in 2019 and 2023. We use the same 2023 rescaling factor for all counterfactuals estimated in 2023. The five counterfactuals estimated for 2023 under different indexation policies correspond to those explained in the previous methodology section: the red marker simulates revenue collection in scenario (2) without indexation, that is, tax revenue in 2023 if the 2019 legislation was kept without any indexation or reform. The green, yellow, and blue markers correspond to scenarios (3) to (5), which estimate the revenue collection in 2023 if the 2019 legislation was kept with fully indexed parameters, according to the growth rate of the nominal tax base, the lagged HICP index, or the concurrent HICP index. Finally, the flat gray marker corresponds to simulation (6), which estimates the revenue collection of 2023 for the 2023 legislation if indexation measures

that have taken place since 2019 were reverted. This allows us to decompose the effect of indexation measures from other reforms on 2023 revenue.

Focusing on each country's results, we observe that for the case of Germany, PIT revenue in 2023 has not only been lower than the no-indexation counterfactual but even lower than any of the three full-indexation counterfactuals. This indicates that substantial reforms have occurred between 2019 and 2023 that overcompensated for potential fiscal drag. Our analysis suggests that more than half of the decrease in revenue with respect to the no-indexation counterfactual is due to indexation policies, while the remaining is due to other reforms. For the case of Spain, observed tax collection has been only slightly lower than the no-indexation counterfactual, suggesting a large fiscal drag effect. Indeed, we observe that tax collection is significantly higher than any of the three full-indexation counterfactuals. We further document that the partial offset of fiscal drag in Spain has been driven by indexation policies. In France, we show that fiscal drag has been entirely compensated, with results ranging slightly depending on the full-indexation counterfactual considered. This complete offsetting, however, has been mainly driven by policies other than indexation measures. Finally, in Italy, as in Spain, fiscal drag has only been partially offset, but in this case, the offsetting has been driven by other policies, rather than by indexation. We note that in the case of Italy, the index used for the counterfactual of full-indexation has a very large impact, as the growth rate of HICP was much higher than that of nominal tax base growth.[24]

Looking at all 21 countries, Figure 7 reports all 2023 estimates as in Figure 6, but reports PIT revenue as a ratio over GDP, and normalizes all counterfactual estimations with respect to the observed ratio of PIT to GDP in 2023. Therefore, the observed PIT/GDP ratio is set to zero, and the different counterfactuals show deviations with respect to it. The numbers that underlie Figure 7 are reported in Appendix Table A.6.

The first takeaway from graph (a) is that all countries have offset potential fiscal drag at least to some extent. This can be seen because the no-indexation counterfactual (red marker) is above zero in all countries, indicating that observed tax collection has been lower than if the 2019 legislation had been kept constant without any indexation.

However, when looking at the full-indexation counterfactuals (green, yellow, and blue markers), we observe clear differences in the extent to which fiscal drag has been offset. In some cases, the offsetting has only been partial, corresponding to those countries where the

[24]Note that our paper focuses on the fiscal drag effect induced by incomplete updating of PIT parameters. Extending the analysis to other taxes and benefits goes beyond our focus. However, we note that governments can counteract fiscal drag effects through other policy reforms. For example in Italy, the government implemented significant cuts to Social Security Contributions rates to reduce the tax burden for dependent employees during a period of high inflation, which counteracted the increase in PIT revenue due to incomplete offset of fiscal drag. Online Appendix B shows these results for Italy.

full-indexation counterfactuals are below zero. This means that keeping the 2019 legislation fully indexed to one of the three indices considered would have led to lower tax collection. For example, countries such as Spain, Italy, or the Netherlands stand out for the size of the tax collection that was due to fiscal drag, which varies depending on the indexation reference considered but ranges around 0.5% of GDP. Other groups of countries have largely offset fiscal drag, as their observed tax collection is around the same level as the full-indexation counterfactuals. These include countries such as Finland, Ireland, France, Portugal, and Greece. Finally, there is a third group of countries where observed tax collection is smaller than the counterfactuals of full-indexation, indicating that reforms have led to an overcompensation of fiscal drag, either because indexation has been paired with other reforms that reduced tax collection or because indexation has been overdone. Countries where this overcompensation is more sizable include Latvia and Slovakia (by more than 0.5% of GDP) and Slovenia, Croatia, and Germany to a lesser extent. Again, these results show some variation depending on the specific index used for the counterfactuals of full-indexation. Generally speaking, indexation counterfactuals based on concurrent HICP lead to the lowest tax collection in most countries, as the growth rate of this index between 2019 and 2023 was higher than that of lagged HICP or nominal tax base growth. See Appendix Table A.7 for a summary of the growth rates used for each counterfactual.

While graph (a) of Figure 7 is informative of the absolute impact of fiscal drag on revenue collection as share of GDP, the results are determined by the interaction of different elements: the TTB elasticity of each country (that is, the level of progressivity of their tax legislation, which, in turn, determines the potential fiscal drag), the growth rate of the different sources of income that form the tax base, and the government actions adopted over the period. To isolate the effect of government action over the period in a way that allows a more meaningful comparison across countries, we show in graph (b) the results in relative terms with respect to each country's potential fiscal drag, which is normalized to 100. Remember that we define potential fiscal drag in subsection 5.1 as the difference between revenue under no indexation and revenue under full indexation. Because we consider three different counterfactuals of full indexation, for this graph, we compute the average of these three counterfactuals. Appendix Figure A.4 shows the results based on each of the three counterfactuals separately.

The black markers in graph (b) of Figure 7 then represent the amount of fiscal drag that has been offset relative to the potential fiscal drag, as defined in equation 2. Values at 100, therefore, indicate that fiscal drag has been fully offset, while values at zero mean a total lack of offsetting. The most striking result is the wide heterogeneity in the degree of offsetting, in line with the results anticipated in graph (a). We observe that in 8 out of the 21 countries considered, fiscal drag has been offset by less than 80% of its potential

effect. The countries where fiscal drag has been offset the least are Cyprus, Spain, Malta, and Italy (with less than 50% offset), followed by Estonia, the Netherlands, Belgium, and Hungary (with less than 80% offset).[25] A second group of countries has offset fiscal drag, with deviations below 20% with respect to full offsetting. These include Finland and Ireland, just below full offset, and France, Portugal, and Greece, just above. Finally, a large number of countries have overcompensated fiscal drag, meaning that revenue has been lower than in the full-indexation counterfactual. These include Luxembourg, Lithuania, Austria, Germany, Hungary, Croatia, Slovenia, Slovakia, and Latvia.

Graph (b) further decomposes the type of policies that have been implemented and which drive the different degrees of offsetting of fiscal drag. We distinguish between indexation policies (increasing nominal parameters broadly in line with price or income growth) and other reforms that affect PIT. We find large heterogeneity along these offsetting mechanisms, even within countries with similar levels of overall offset. We observe that among countries that only partially offset fiscal drag, this is sometimes done through indexation measures (e.g., in Spain or the Netherlands) and sometimes through other measures (e.g., in Cyprus, Malta, or Italy), while others display a mix (e.g., Estonia). The same can be seen for countries that largely offset fiscal drag (driven by indexation measures in Finland and Ireland and by other measures in France, Portugal, and Greece). Finally, we observe that among countries that overcompensate for fiscal drag, it is often the case that other policies are either driving the result or adding up to indexation policies to reach the overcompensation. There are exceptions, however, as Lithuania overcompensated for fiscal drag mainly through indexation. Appendix Figure A.5 shows the relative weight of each of these two types of offsetting mechanisms to the overall degree of offsetting in each country.

At this point, it is worth emphasizing again that the classification of 'other reforms' as offsetting policies (in addition to indexation measures) is not straightforward, which is why we report them separately. Still, we tend to consider both types as offset mechanisms for the following three reasons. First, the classification of a given measure between these two types of policies is sometimes very unclear. Second, the two types of policies interact with each other and are sometimes implemented as part of a joint reform. Third, policymakers are aware of fiscal drag effects and can decide to offset them through policies that are not articulated as indexation but pursue the same goal.[26] Nevertheless, we stress that in our analysis for the

[25] Here we emphasize again that the specific index used for the counterfactuals can affect the results. In the case of Belgium, for example, the counterfactual based on lagged HICP (which is very close to the index effectively used in Belgium) implies almost full offsetting.

[26] Appendix Table A.1 shows a qualitative assessment of the type of policies implemented in each country during the period, further distinguishing between statutory and discretionary indexation. In addition, Online Appendix B offers more details for each country considered and the types of policies that have taken place over this period.

period 2019–2023 more than half of the offsetting of fiscal drag has been driven by policies that we do not classify as indexation. In the absence of these other policies, fiscal drag effects would have been much larger, pointing to a very limited effect of standard indexation practices.

Our final set of results explores the average effective tax rates in 2023 under our baseline and counterfactual estimations. Graph (a) of Figure 8 illustrates that the same results we document for PIT revenue carry over to the computation of tax rates. Indeed, we see that all countries have kept their average effective tax rates below those resulting from the no-indexation counterfactual, which could have led to effective rates up to 2.5 percentage points higher. We also document that countries where fiscal drag was not fully offset also experienced increases in their average effective tax rates with respect to full-indexation counterfactuals. In graph (b) of Figure 8, we further investigate the evolution of average effective tax rates, as we plot 2023 results relative to their 2019 observed value. The results resemble those shown in graph (b) of Figure 7, as we observe stark heterogeneity in the average effective tax rate of 2023 with respect to 2019. Countries where fiscal drag has been more prevalent display a larger increase in the effective tax rate observed in 2023, which was around 1 percentage point higher in Belgium, Estonia, Cyprus, and Spain. On the contrary, countries that overcompensated for fiscal drag have lower effective tax rates in 2023 by around 0.5–1 (e.g., Germany, Latvia, Slovakia, and Austria).

It is also reassuring to see that for every country, the average effective tax rate for the full-indexation counterfactual based on nominal tax base growth, returns an average effective tax rate that almost coincides with that observed in 2019. This is consistent with the idea that keeping the legislation constant over time and updating parameters according to the same rate as the growth of the nominal tax base achieves close to full offsetting of fiscal drag and keeps the effective tax rate constant. We observe as well that indexation based on other indices does not ensure that tax rates stay the same over the period considered, as they can lead to rates that are up to 1 or 1.5 percentage points higher or lower than those of 2019. In most cases, however, differences are below 0.5 percentage points.

6 Conclusion

This paper provides a comprehensive characterization of fiscal drag in Europe using microsimulation. By measuring the progressivity embedded in each tax system through tax-to-base elasticities, we find that many countries' tax systems induce elasticities of around 1.7–2, suggesting a significant potential for fiscal drag effects to occur if tax parameters are not updated in line with income growth. We uncover substantial heterogeneity in these elas-

ticities across mechanisms, income sources, and the individual income distribution. These elasticities have direct implications for revenue collection and inequality.

Extending the analysis beyond these elasticities to estimate fiscal drag in practice over the recent period, we provide a data-driven characterization of fiscal drag and indexation practices in Europe. Our findings reveal large differences ranging from partial compensation to overcompensation of fiscal drag, with significant heterogeneity in the type of policies that have offset it. These variations have a meaningful impact on revenue and effective tax rates, underscoring the importance of fiscal drag for public finances.

These results contribute to a more comprehensive knowledge of PIT systems in Europe, providing relevant information on issues such as their progressivity, the distributional impacts of inflation through its interaction with the tax system, and the potential stabilization properties of PIT systems. Our results also have important implications for ongoing policy debates on the indexation of PIT systems and can provide relevant information on tax elasticities for projection exercises.

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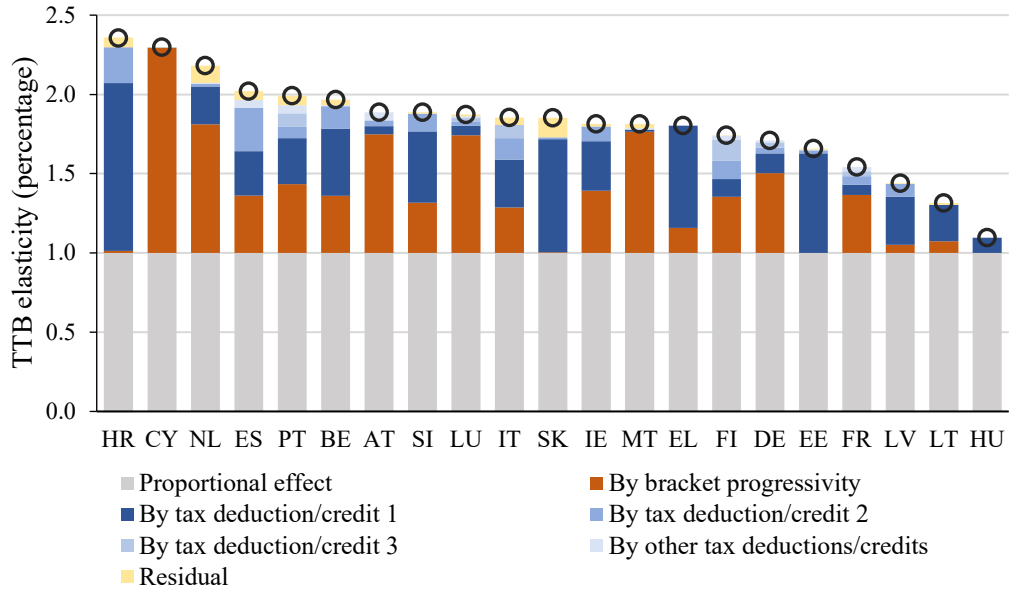
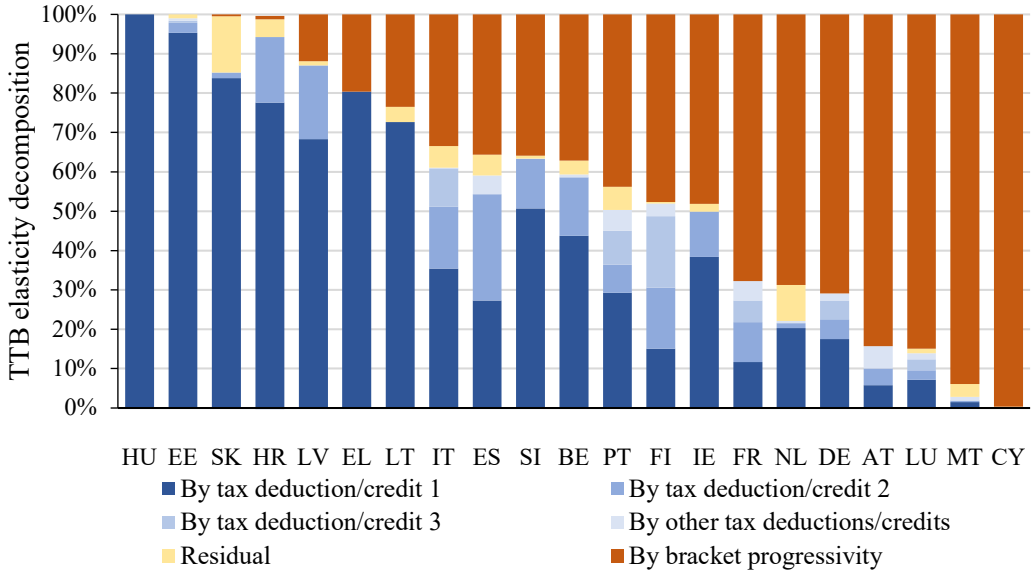
Figure 1: Cross-country comparison of 2019 tax-to-base elasticities and their mechanisms

(a) 2019 tax-to-base elasticities and mechanisms



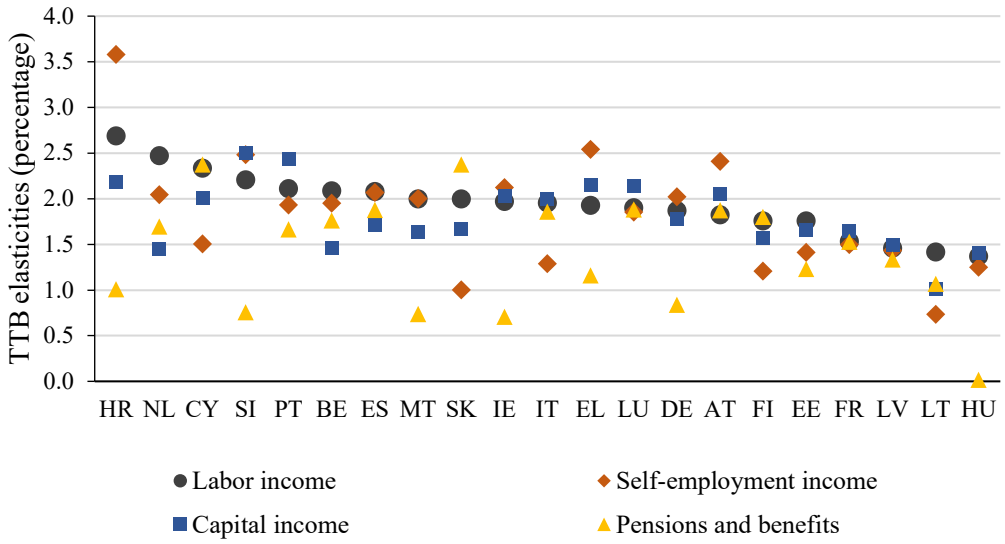
(b) Weight of each mechanism



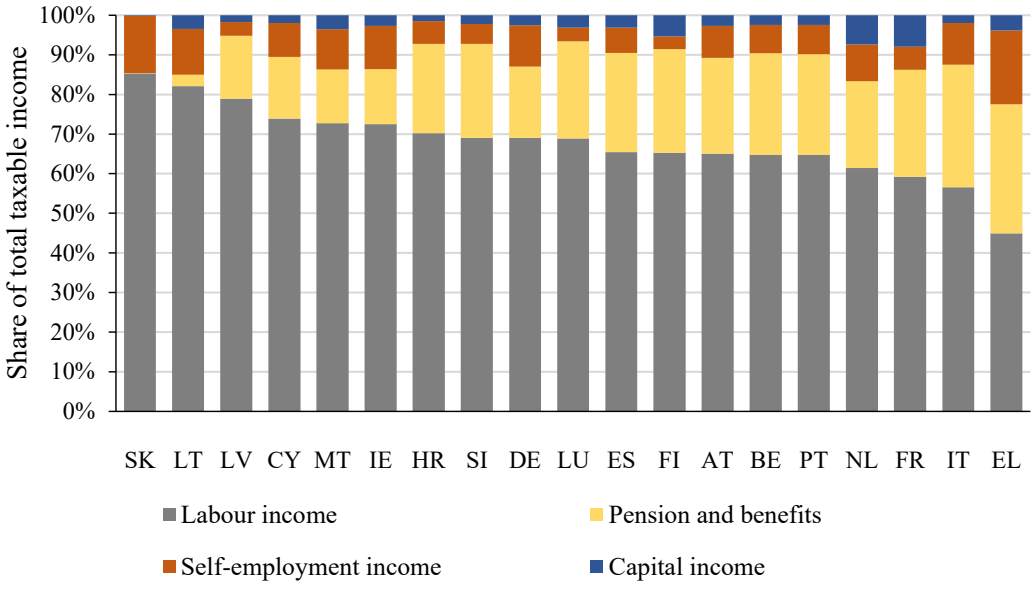
Notes: These graphs present a cross-country comparison of tax-to-base (TTB) elasticities and their underlying mechanisms. Graph (a) shows the estimated elasticity by country and its mechanisms. The elasticities are calculated by estimating the increase in tax revenue following a 1% increase in the tax base of each individual. Graph (b) shows the decomposition of the portion of the elasticity that is above one, normalizing its size to 100. This allows comparing the relative contribution of each mechanism across countries, independent of the size of the elasticity.

Figure 2: Tax-to-base elasticities by source of income

(a) Tax-to-base elasticities



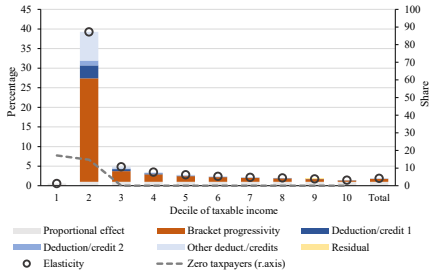
(b) Share of each income source



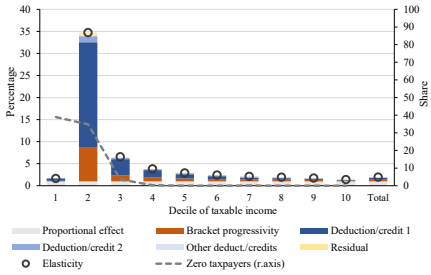
Notes: Graph (a) represents a cross-country comparison of 2019 tax-to-base elasticities by source of income: labor, pensions and benefits, self-employment, and capital income. Each elasticity is computed as the percentage growth in personal income tax revenue following a simulated 1% growth in each of the specific income sources, divided by the percentage growth in the overall tax base. Graph (b) shows the share of each income source in the total tax base.

Figure 3: Decomposition of tax-to-base elasticities across the income distribution for each country

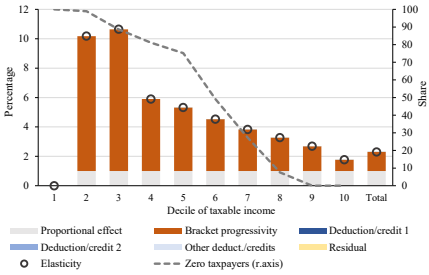
(a) Austria (AT)



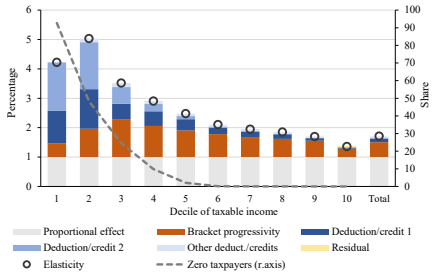
(b) Belgium (BE)



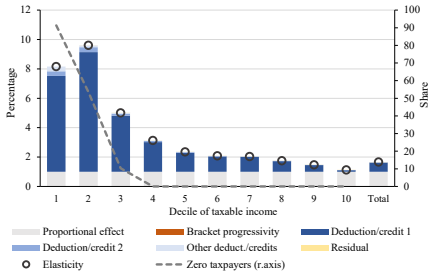
(c) Cyprus (CY)



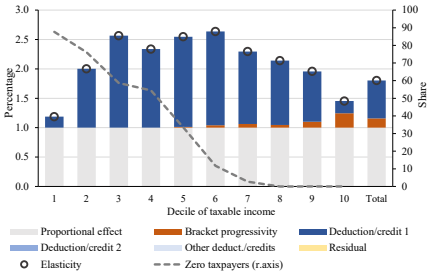
(d) Germany (DE)



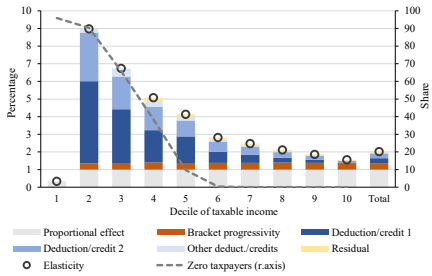
(e) Estonia (EE)



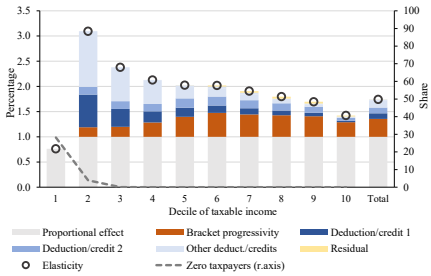
(f) Greece (EL)



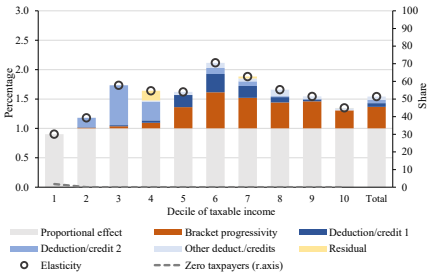
(g) Spain (ES)



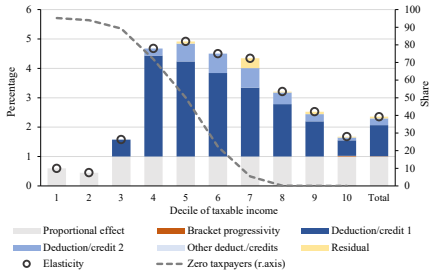
(h) Finland (FI)



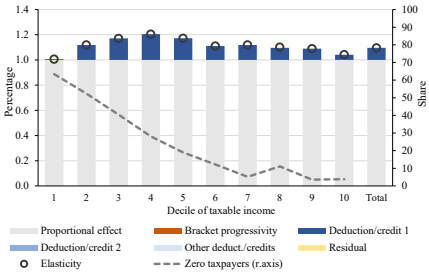
(i) France (FR)



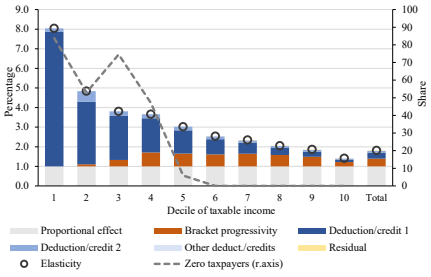
(j) Croatia (HR)



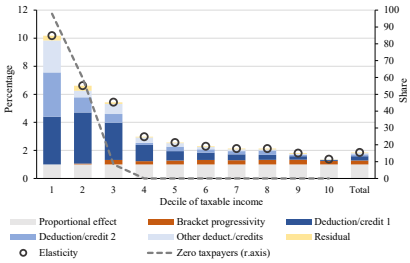
(k) Hungary (HU)



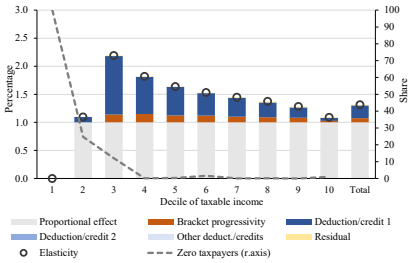
(l) Ireland (IE)



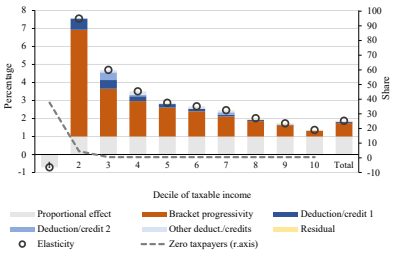
(m) Italy (IT)



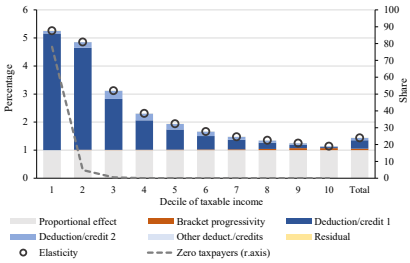
(n) Lithuania (LT)



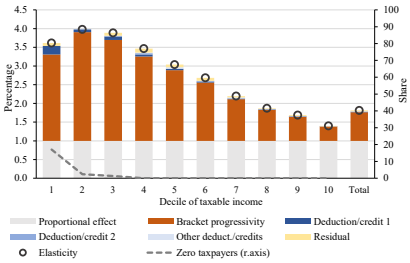
(o) Luxembourg (LU)



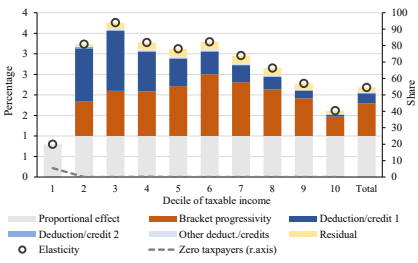
(p) Latvia (LV)



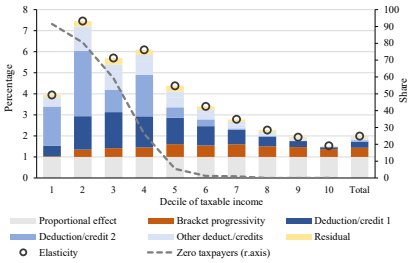
(q) Malta (MT)



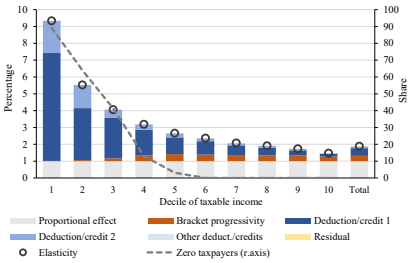
(r) Netherlands (NL)



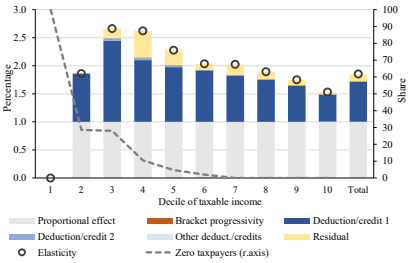
(s) Portugal (PT)



(t) Slovenia (SI)



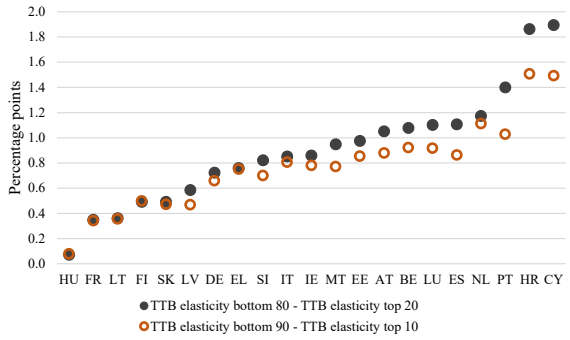
(u) Slovakia (SK)



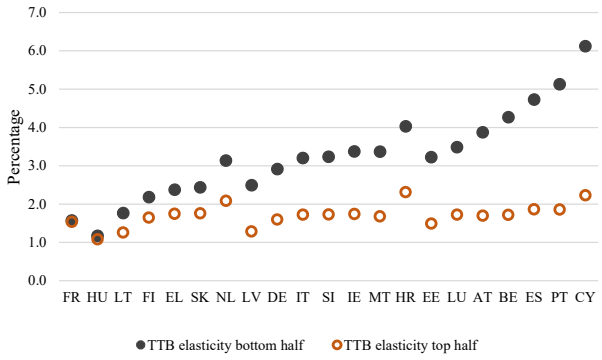
Notes: Each of these graphs shows the distribution of tax-to-base elasticities across the individual distribution of taxable income by decile groups. Each elasticity is broken down by its underlying mechanisms. Each graph also shows the share of individuals with zero tax liability. These individuals have an undefined tax-to-base elasticity (a 1% increase in their income leads to no change in their tax liability) that does not impact the elasticity of their decile group nor the aggregate elasticity. Country-specific details are provided in Online Appendix B.

Figure 4: Distribution of TTB elasticities and share of zero taxpayers

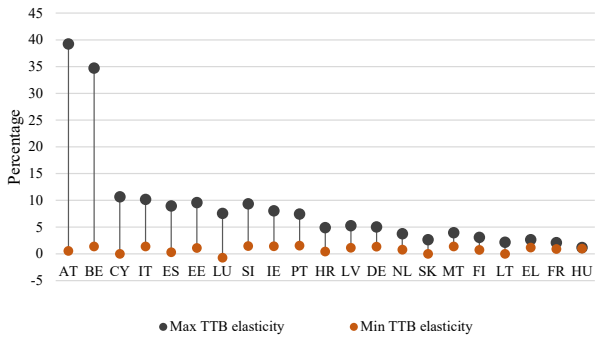
(a) Bottom to top elasticities (80:20 and 90:10)



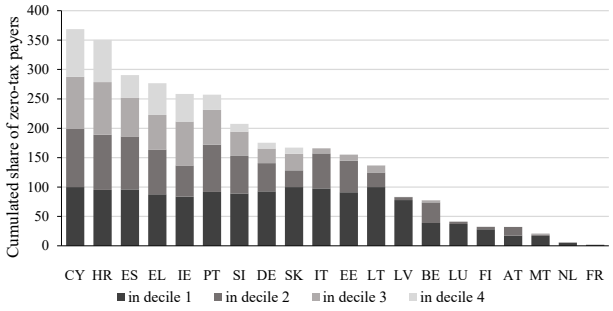
(b) Bottom and top half elasticities



(c) Maximum and Minimum TTB elasticity



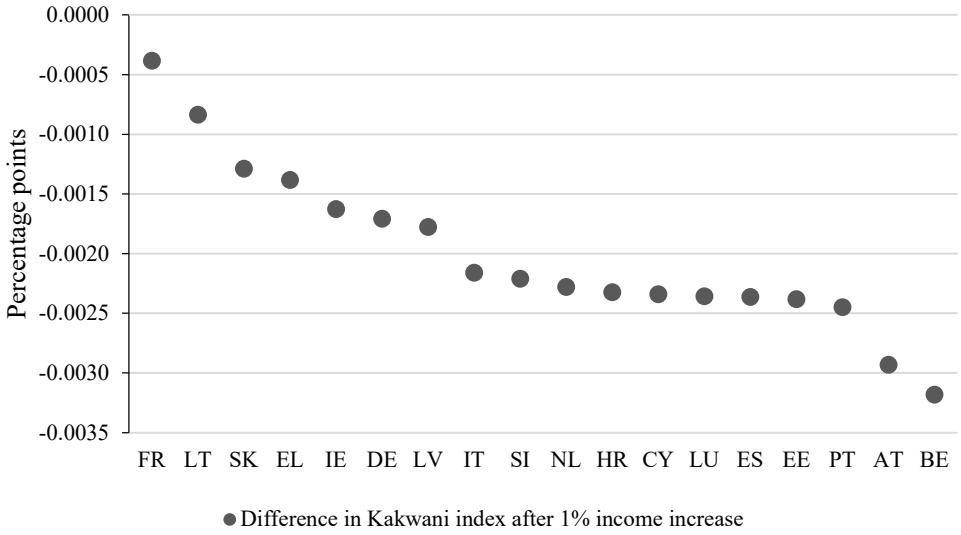
(d) Cumulated share of zero taxpayers



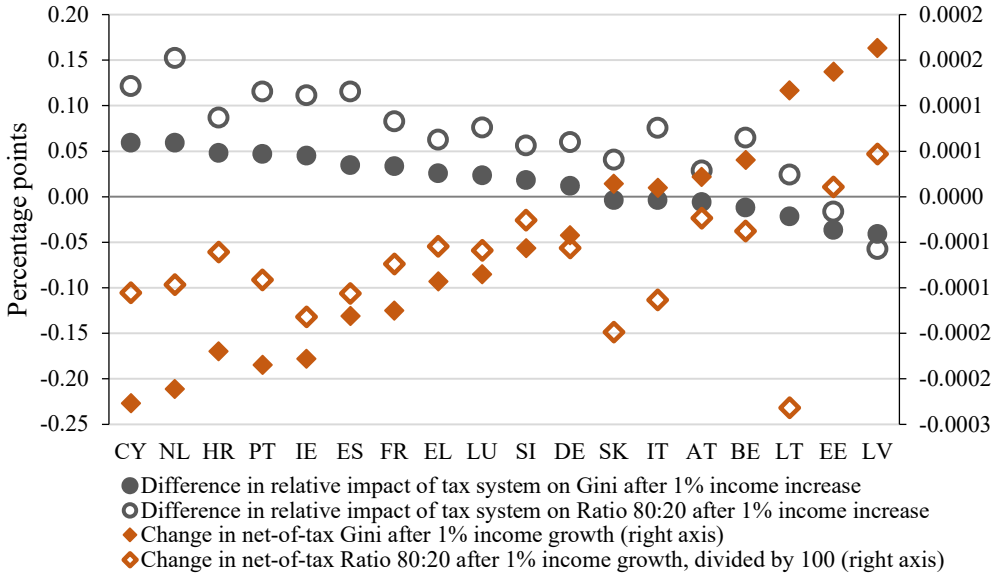
Notes: Graph (a) shows the differences between the weighted tax-to-base elasticity of the top 20 percent (respectively 10 percent) of individuals according to their taxable base, and the weighted tax-to-base elasticity of the bottom 80 percent (respectively 90 percent). Each weighted elasticity is computed by summing the elasticity of each decile, weighted by the share of personal income tax paid by each decile of income earners in the group considered. Graph (b) shows the same weighted averages of the tax-to-base elasticity for the top and bottom half of the distribution. Graph (c) shows the dispersion in elasticities by plotting the highest and the lowest elasticity across decile groups. Graph (d) represents the cumulated share of zero taxpayers in the bottom 40% of the distribution of taxable base, i.e., the sum of shares of zero taxpayers in the first four deciles.

Figure 5: Inequality and progressivity

(a) Impact on progressivity

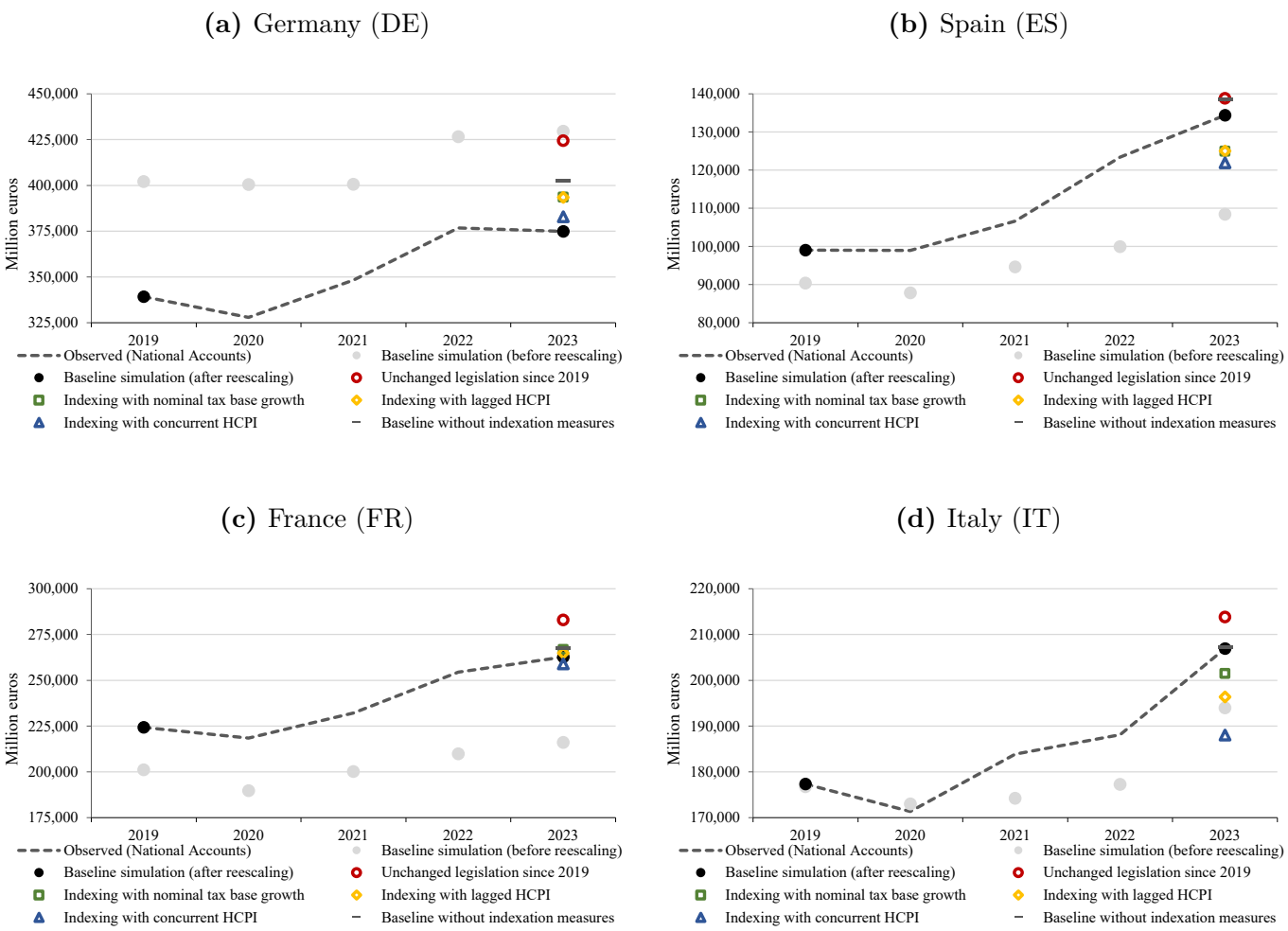


(b) Impact on inequality



Notes: This figure shows the impact of fiscal drag on progressivity and on inequality in a setting where incomes grow homogeneously by 1%. Graph (a) shows the change in the Kakwani progressivity index calculated before and after the 1% increase in income. Negative values mean that the system becomes less progressive. Graph (b) shows the effect on inequality through the lenses of four different metrics. The diamond-shaped markers show the change in a given inequality indicator (either Gini or Ratio 80:20) for net-of-tax incomes after income growth. Therefore, negative values indicate that inequality is reduced. The circle-shaped markers show the difference in the inequality-reduction effect of the tax system after the increase in income, which is measured as the percentage variation in the Gini Index or in the Ratio 80:20 computed for incomes before or after taxes.

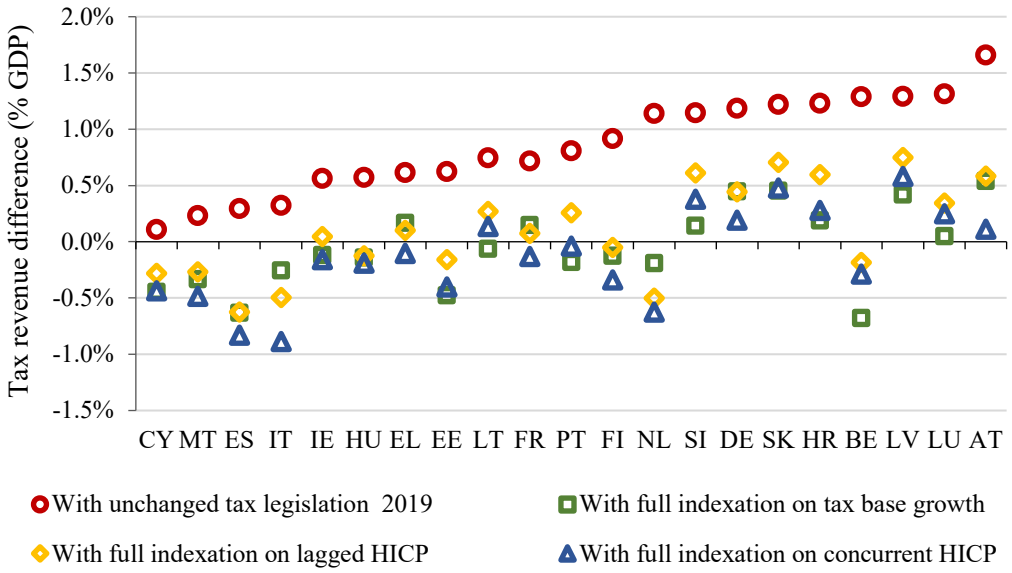
Figure 6: Tax revenue evolution from 2019 to 2023 and counterfactual simulations for 2023



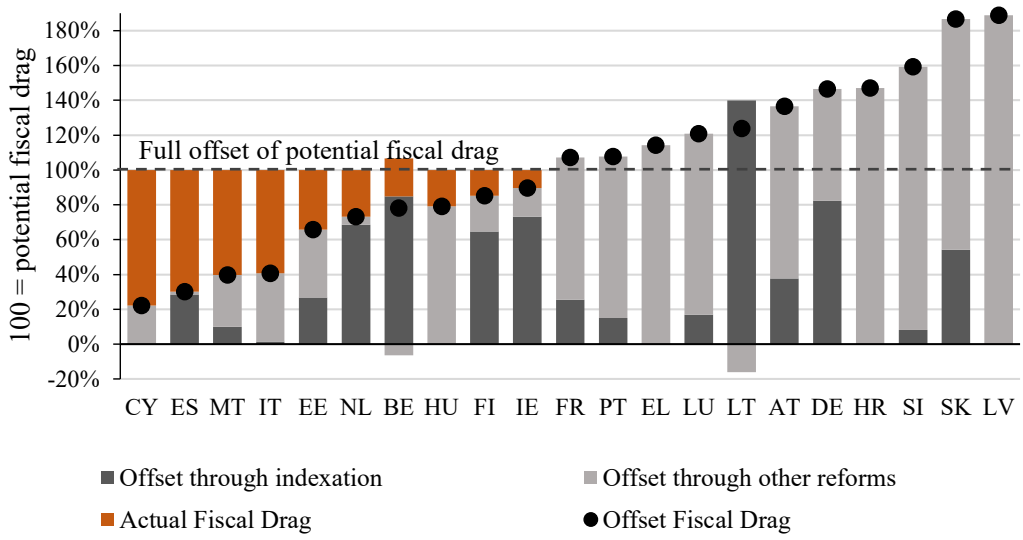
Notes: Results for all other countries are shown in Appendix Figure A.3. Each of these graphs shows, for a given country, the observed evolution of PIT revenue over time (dotted line), our baseline simulations for each key year (black markers), and different counterfactual simulations under alternative indexation policies (colored hollow markers). The flat gray marker corresponds to the 2023 baseline legislation with indexation measures reversed back to 2019. Note that all baseline and counterfactual simulations are rescaled to correct for the observed gap between the baseline simulation and the observed amount. Underlying data is reported in Appendix Table A.5.

Figure 7: Fiscal Drag in 2023 based on alternative indexation counterfactuals for the period 2019–2023

(a) Revenue counterfactuals with respect to observed revenue



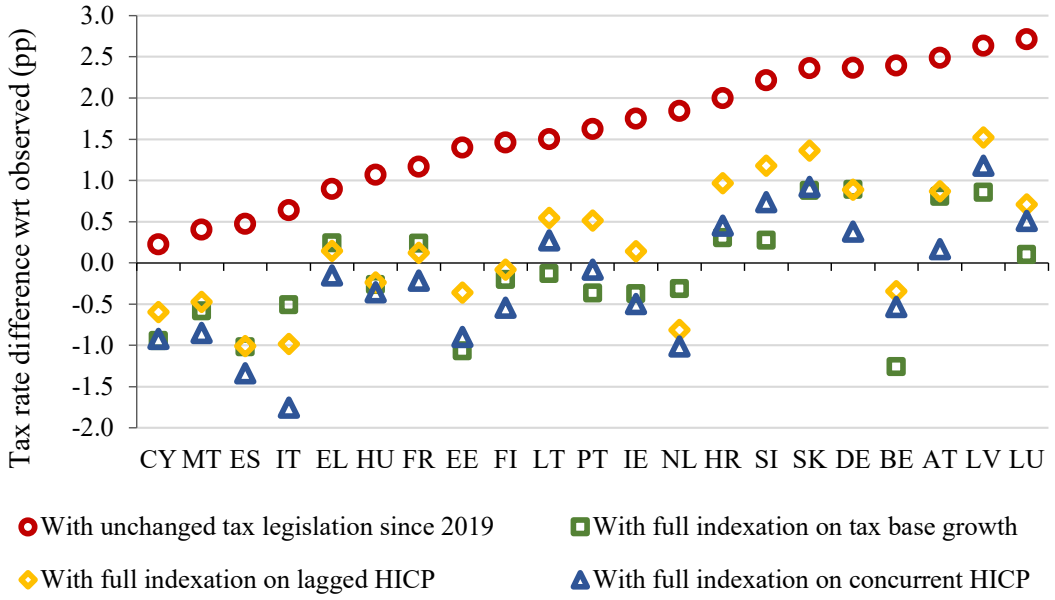
(b) Relative impact and decomposition



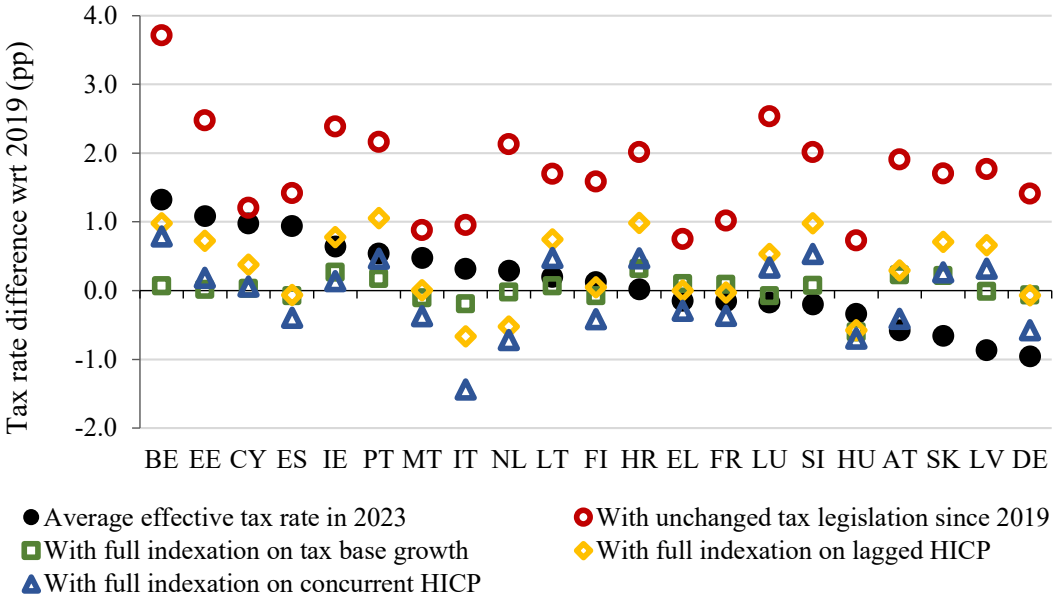
Notes: This figure illustrates the impact of fiscal drag in 2023 across countries and the extent to which it was offset through indexation or other reforms during the period 2019–2023. Graph (a) shows the results of alternative simulations for 2023 under different indexation counterfactuals. Results are expressed in terms of PIT revenue over GDP, normalized by the size of observed PIT revenue to GDP in 2023. Graph (b) expresses the results normalized by the estimated size of potential fiscal drag, which is defined as the difference between the no-indexation counterfactual and the full-indexation counterfactual, and in this graph is normalized to 100. Therefore, 100% corresponds to full offsetting of fiscal drag, values above 100% correspond to an over-compensation of fiscal drag, and values below 100% correspond to partial offsetting. The graph is built based on the average of the three indexation counterfactuals considered. Separate results for each of these three counterfactuals are shown in Appendix Figure A.4. Underlying data is reported in Appendix Table A.6.

Figure 8: Average effective tax rate counterfactuals

(a) Counterfactuals with respect to 2023 observed average effective tax rates



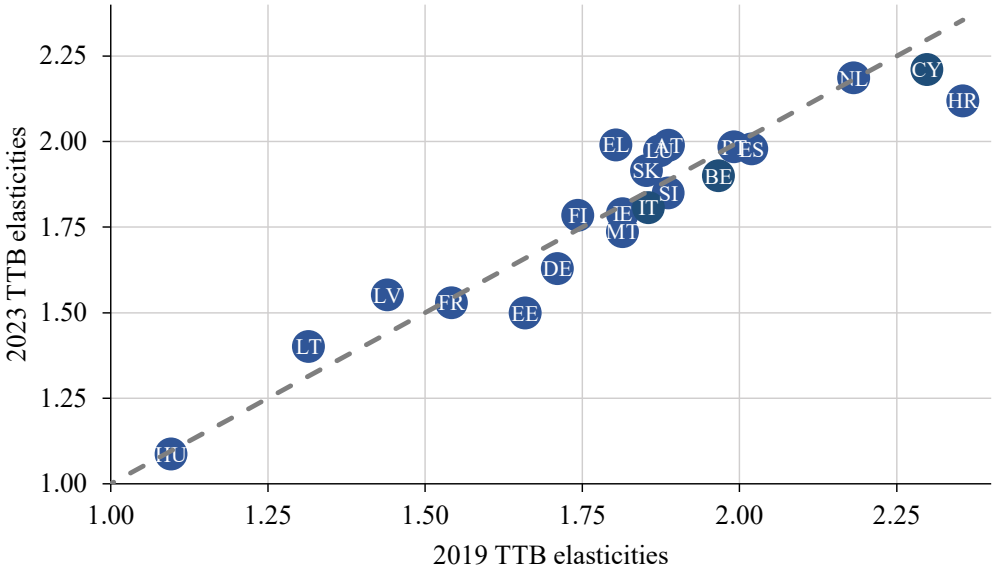
(b) Baseline and counterfactual simulations with respect to 2019 observed average effective tax rates



Notes: This figure shows average effective tax rates across all countries considered for different baseline and counterfactual simulations. Graph (a) shows the tax rate in 2023 under different indexation counterfactuals with respect to the observed tax rate of 2023. Graph (b) shows the 2023 baseline tax rate and the indexation counterfactuals with respect to the 2019 observed rate. Underlying data is reported in Appendix Table A.6.

Appendix A Supplementary Figures and Tables

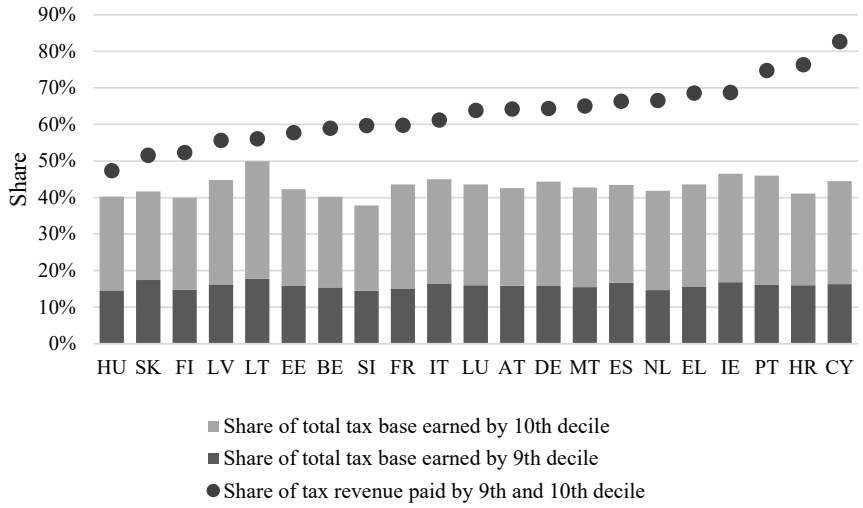
Figure A.1: Comparison between 2019 and 2023 TTB elasticities



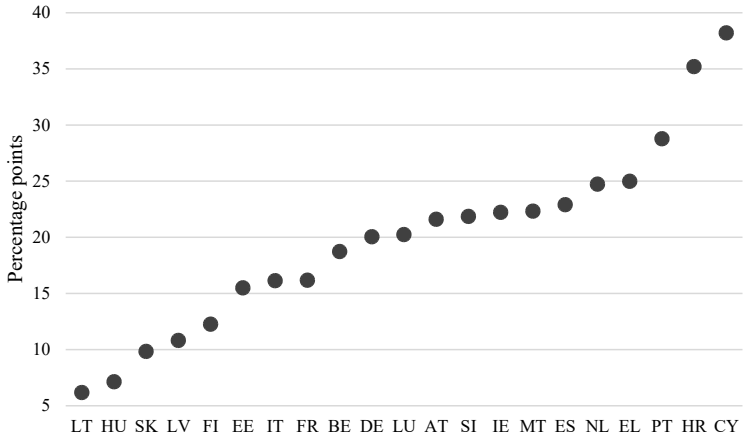
Notes: This figure compares the TTB elasticities calculated with 2019 legislation and 2019 data with those calculated with 2023 legislation and 2019 data updated to 2023. The differences between these two elasticities are mainly due to tax reforms between these two years. A secondary driver of the differences is composition changes due to the differential growth of alternative income sources between 2019 and 2023. Appendix Table A.3 reports the underlying data and estimates by income source.

Figure A.2: Concentration of tax base and tax liabilities at the top

(a) Share of tax base earned and tax revenue paid by the top 20 percent of the tax base distribution



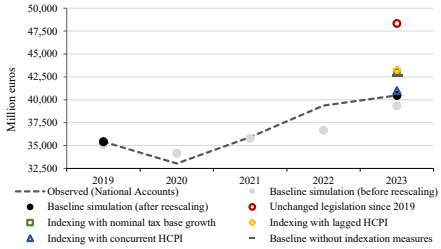
(b) Difference between share of income tax paid and share of income earned by the top 20



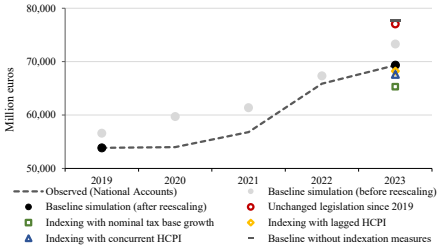
Notes: This figure illustrates the concentration of the tax base and tax liabilities at the top of the distribution. Graph (a) shows the share of the total tax base coming from the top two deciles and the share of tax revenue coming from these two deciles. Graph (b) shows the difference between the share of tax revenue paid by the top two deciles and their share of the total tax base. This difference corresponds to the gap between the marker and the cumulated bar in graph (a). The results show considerable heterogeneity across the countries studied in line with the different progressivity of each tax system.

Figure A.3: Tax revenue evolution, 2019-2023,
Results for all countries other than big 4

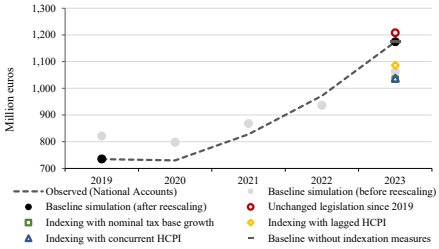
(a) Austria (AT)



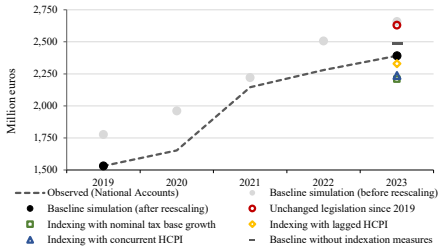
(b) Belgium (BE)



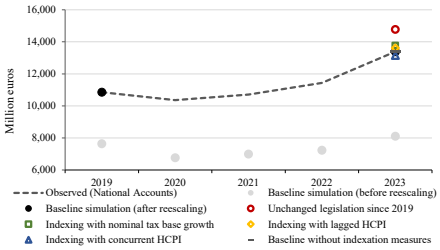
(c) Cyprus (CY)



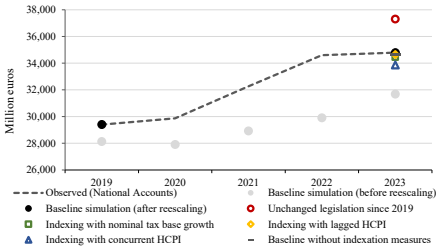
(d) Estonia (EE)



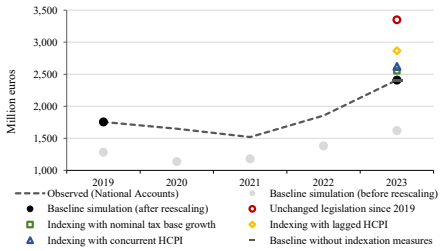
(e) Greece (EL)



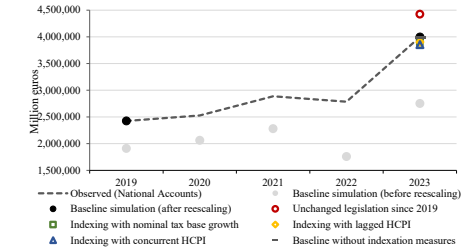
(f) Finland (FI)



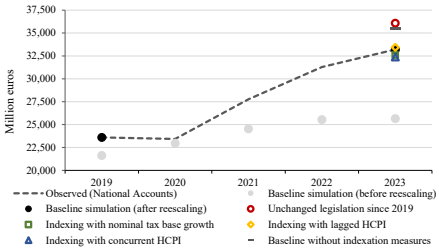
(g) Croatia (HR)



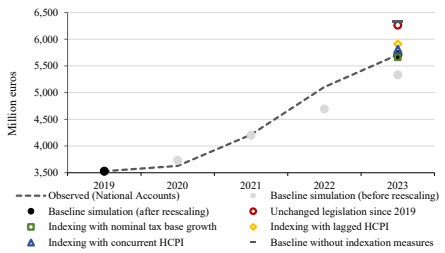
(h) Hungary (HU)



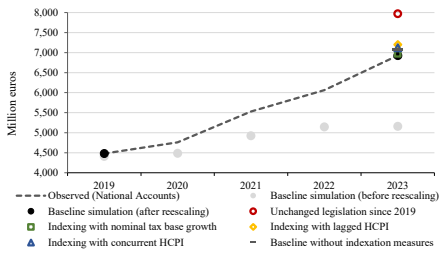
(i) Ireland (IE)



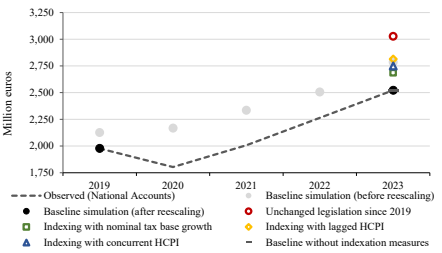
(j) Lithuania (LT)



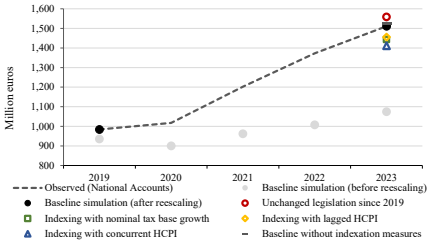
(k) Luxembourg (LU)



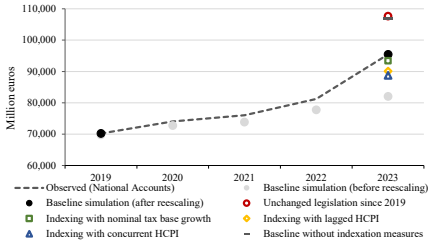
(l) Latvia (LV)



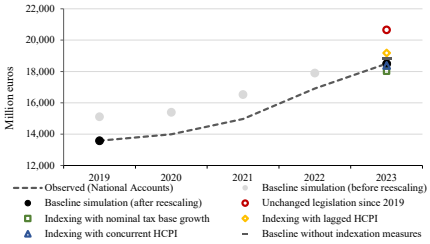
(m) Malta (MT)



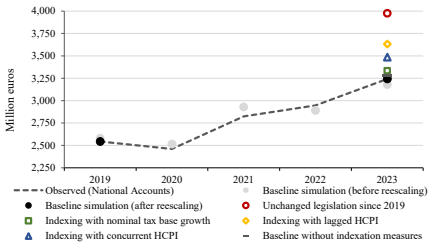
(n) Netherlands (NL)



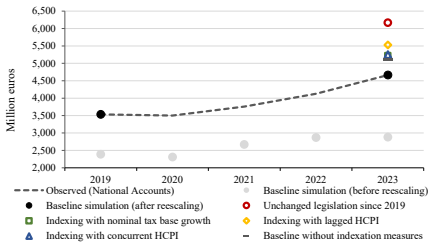
(o) Portugal (PT)



(p) Slovenia (SI)



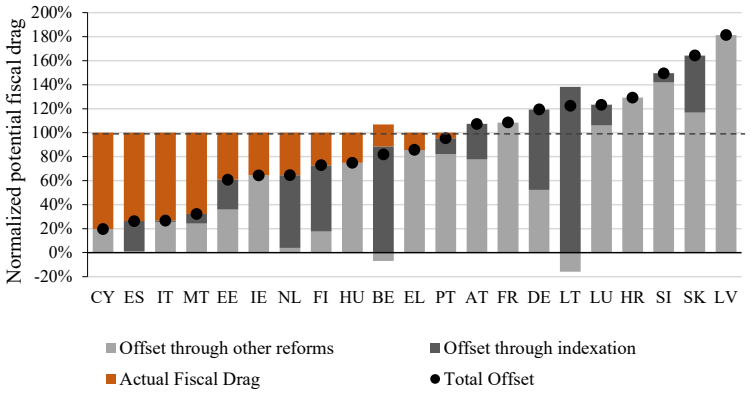
(q) Slovakia (SK)



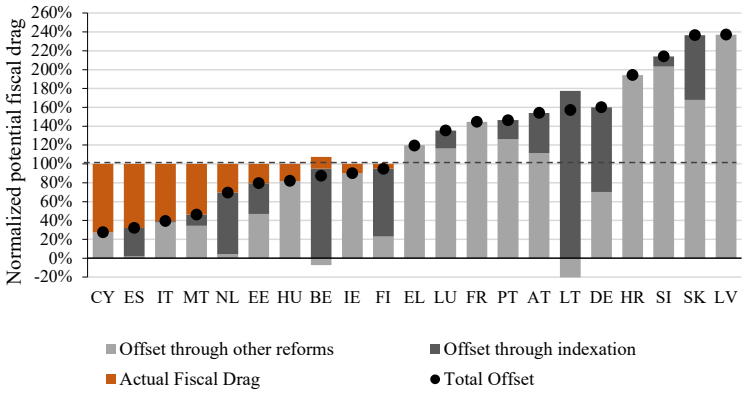
Notes: This figure is a complement of Figure 6 with results for all other countries studied. See notes of Figure 6.

Figure A.4: Actual, potential, and offset fiscal drag through indexation or tax reform measures for each of the indexation scenarios studied

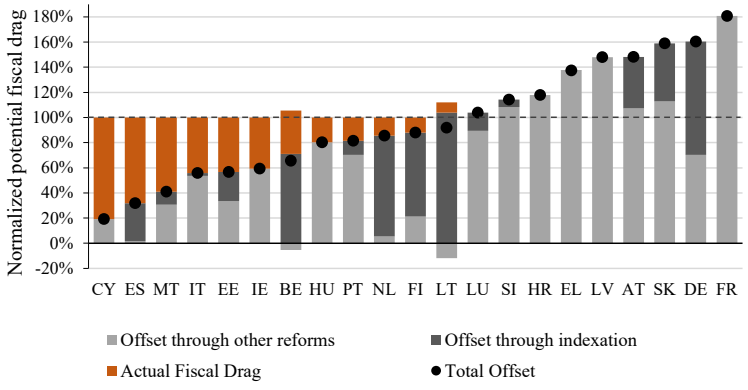
(a) Concurrent HICP indexation



(b) Lagged HICP indexation

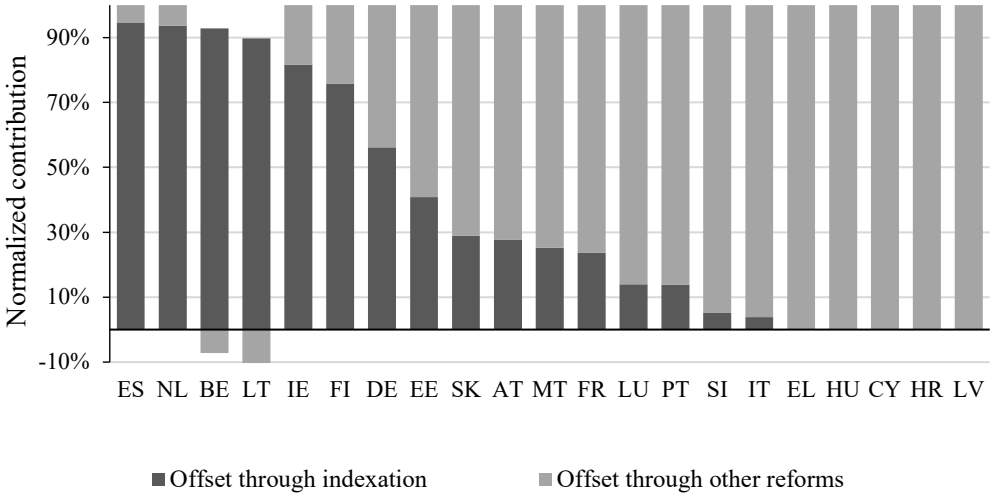


(c) Tax base growth indexation



Notes: These three graphs are equivalent to graph (b) of Figure 7, but each of them is based on a specific full-indexation counterfactual, rather than on the average of the three counterfactuals considered. See notes of Figure 7

Figure A.5: Relative contribution of each type of offsetting measures



Notes: The graph shows the contribution of each type of offsetting measure to the overall offsetting of fiscal drag. The figure is a normalization of the effects shown in Figure 7.

Table A.1: Own classification of policy changes in PIT systems between 2019–2023

Considering PIT changes/reforms that have happened between 2019 and 2023. How would you classify each of those changes?

	Statutory indexation (1)	Discretionary indexation (2)	Other reforms (3)
Austria (AT)	Yes	No	Yes
Belgium (BE)	Yes	No	Yes
Cyprus (CY)	No	No	Yes
Germany (DE)	Yes	Yes	Yes
Estonia (EE)	No	Yes	Yes
Greece (EL)	No	No	Yes
Spain (ES)	No	Yes	Yes
Finland (FI)	No	Yes	Yes
France (FR)	Yes	No	Yes
Croatia (HR)	No	No	Yes
Hungary (HU)	No	No	Yes
Ireland (IE)	No	Yes	Yes
Italy (IT)	No	No	Yes
Lithuania (LT)	No	Yes	Yes
Luxembourg (LU)	No	Yes	Yes
Latvia (LV)	No	Yes	Yes
Malta (MT)	No	Yes	Yes
Netherlands (NL)	Yes	No	Yes
Portugal (PT)	No	Yes	Yes
Slovenia (SI)	No	Yes	Yes
Slovakia (SK)	Yes	No	Yes

Notes: (1) Statutory indexation includes automatic indexation of all parameters by law, or also semi-automatic, frequent indexation that affects all or most of the parameters, even if not compulsory by law. (2) Discretionary indexation includes infrequent/occasional changes introduced that are very similar to indexation. They were implemented with the aim of preventing fiscal drag (or compensating for the effects of income growth). They can affect some types of parameters, not necessarily all, and they might even be implemented together with some reforms in the structure of the tax. (3) Other reforms include other tax changes over the period that were not designed to address fiscal drag (new tax deductions or tax credits, new brackets, an increase in rates, etc.). These reforms are either structural or could be one-off tax measures to answer the recent inflation surge in the euro area.

Table A.2: 2019 TTB elasticities, mechanisms and heterogeneity by income source

		Share explained by:					TTB elasticity by income source			
	TTB elasticity (1)	Bracket Progressivity (2)	Tax benefit #1 (3)	Tax benefit #2 (4)	Other tax benefits (5)	Residual (6)	Labor (7)	Benefits and pensions (8)	Self-employment (9)	Capital (10)
Austria (AT)	1.89	84%	6%	4%	6%	0%	1.82	1.87	2.41	2.06
Belgium (BE)	1.97	37%	44%	15%	1%	3%	2.09	1.76	2.37	1.46
Cyprus (CY)	2.30	100%	0%	0%	0%	0%	2.34	2.37	1.50	2.01
Germany (DE)	1.71	71%	18%	5%	7%	0%	1.87	0.84	2.02	1.78
Estonia (EE)	1.66	0%	95%	3%	1%	1%	1.76	1.23	1.41	1.66
Greece (EL)	1.80	20%	80%	0%	0%	0%	1.93	1.16	2.54	2.15
Spain (ES)	2.02	36%	27%	27%	5%	5%	2.08	1.88	2.07	1.71
Finland (FI)	1.74	48%	15%	15%	21%	0%	1.76	1.80	1.21	1.58
France (FR)	1.54	68%	12%	10%	10%	0%	1.53	1.53	1.50	1.64
Croatia (HR)	2.36	1%	78%	17%	0%	5%	2.69	1.01	3.58	2.19
Hungary (HU)	1.10	0%	100%	0%	0%	0%	1.37	0.02	1.25	1.40
Ireland (IE)	1.81	48%	38%	11%	0%	2%	1.97	0.71	2.12	2.03
Italy (IT)	1.86	33%	35%	16%	10%	6%	1.95	1.86	1.29	2.00
Lithuania (LT)	1.31	24%	73%	0%	0%	4%	1.42	1.07	0.73	1.01
Luxembourg (LU)	1.87	85%	7%	2%	4%	1%	1.90	1.88	1.86	2.14
Latvia (LV)	1.44	12%	68%	19%	0%	1%	1.46	1.33	1.43	1.50
Malta (MT)	1.81	94%	1%	0%	1%	3%	2.00	0.74	2.00	1.63
Netherlands (NL)	2.18	69%	20%	1%	1%	9%	2.47	1.69	2.05	1.45
Portugal (PT)	1.99	44%	29%	7%	14%	6%	2.11	1.66	1.93	2.43
Slovenia (SI)	1.89	36%	51%	13%	0%	1%	2.21	0.76	2.48	2.50
Slovakia (SK)	1.85	0%	84%	1%	0%	14%	2.00	2.38	1.00	1.67

Notes: These TTB estimates are derived from simulations where the tax base grows homogeneously by 1% and tax parameters are kept unchanged. The TTB elasticity of 2019 is based on EU-SILC data corresponding to the incomes received during 2019 and on the corresponding 2019 tax legislation. The share explained by each column (2) to (6) refers to the component of the 2019 TTB elasticity above the proportional effect of 1.

Table A.3: 2023 TTB elasticities and heterogeneity by income source

	2023 TTB elasticities by income source					Difference w.r.t. 2019				
	All incomes (1)	Labor (2)	Benefits & pensions (3)	Self-employment (4)	Capital (5)	All incomes (6)	Labor (7)	Benefits & pensions (8)	Self-employment (9)	Capital (10)
Austria (AT)	1.99	1.94	1.94	2.51	2.25	0.10	0.11	0.07	0.10	0.19
Belgium (BE)	1.90	1.97	1.78	1.74	1.12	-0.07	-0.12	0.02	-0.21	-0.34
Cyprus (CY)	2.21	2.26	2.19	1.49	1.88	-0.09	-0.08	-0.18	-0.02	-0.12
Germany (DE)	1.63	1.69	0.95	2.11	1.84	-0.08	-0.18	0.11	0.09	0.06
Estonia (EE)	1.50	1.61	0.99	1.33	1.47	-0.16	-0.14	-0.24	-0.08	-0.19
Greece (EL)	1.99	2.17	1.04	3.07	2.21	0.19	0.25	-0.12	0.53	0.06
Spain (ES)	1.98	2.05	1.83	2.01	1.60	-0.04	-0.03	-0.04	-0.05	-0.11
Finland (FI)	1.79	1.80	1.87	1.21	1.58	0.04	0.04	0.07	0.01	0.00
France (FR)	1.53	1.54	1.47	1.53	1.64	-0.01	0.00	-0.06	0.03	0.00
Croatia (HR)	2.12	2.38	1.15	2.73	1.84	-0.24	-0.31	0.14	-0.85	-0.35
Hungary (HU)	1.09	1.41	0.01	1.26	1.05	-0.01	0.04	0.00	0.01	0.00
Ireland (IE)	1.79	1.92	0.70	2.16	1.98	-0.02	-0.05	-0.01	0.03	-0.05
Italy (IT)	1.81	1.87	1.82	1.39	2.01	-0.05	-0.09	-0.04	0.11	0.00
Lithuania (LT)	1.40	1.51	1.10	0.83	1.02	0.09	0.09	0.03	0.10	0.01
Luxembourg (LU)	1.97	2.00	1.87	2.03	2.18	0.10	0.10	-0.01	0.18	0.04
Latvia (LV)	1.55	1.65	1.08	1.44	1.61	0.11	0.19	-0.26	0.01	0.12
Malta (MT)	1.74	1.96	0.36	2.01	1.46	-0.08	-0.04	-0.38	0.01	-0.17
Netherlands (NL)	2.19	2.47	1.55	2.17	1.56	0.01	0.00	-0.14	0.13	0.11
Portugal (PT)	1.98	2.12	1.54	1.88	2.26	-0.01	0.01	-0.12	-0.05	-0.18
Slovenia (SI)	1.85	2.18	0.69	2.35	2.55	-0.04	-0.03	-0.07	-0.13	0.05
Slovakia (SK)	1.92	1.89	2.59	2.06	1.50	0.06	-0.10	0.22	1.06	-0.16

Notes: Estimates based on a simulation where all incomes grow homogeneously by 1% and tax parameters are kept unchanged. The TTB elasticity of 2023 is based on the same microdata used for the 2019 TTB elasticities (2019 EU-SILC), updated according to observed aggregates of income growth and on 2023 tax legislation.

Table A.4: 2019 TTB elasticities across the income distribution and mechanisms

	TTB elasticity by decile:										Share of TTB elasticity explained by tax brackets by decile:											
	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	b80-t20	b90-t10
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
Austria (AT)	0.55	39.26	4.83	3.48	2.80	2.40	2.16	2.00	1.76	1.40	0%	69%	72%	77%	79%	83%	86%	87%	90%	92%	1.05	0.88
Belgium (BE)	1.65	34.73	6.56	3.81	2.90	2.42	2.11	1.93	1.75	1.40	15%	23%	25%	30%	33%	36%	37%	40%	44%	47%	1.08	0.92
Cyprus (CY)	0.00	10.17	10.64	5.90	5.32	4.53	3.83	3.27	2.69	1.77	0%	100%	100%	100%	100%	100%	100%	100%	100%	99%	1.90	1.49
Germany (DE)	4.22	5.03	3.52	2.91	2.48	2.10	1.95	1.85	1.70	1.36	14%	24%	51%	55%	61%	71%	72%	73%	80%	81%	0.72	0.66
Estonia (EE)	8.16	9.60	5.01	3.13	2.36	2.08	2.04	1.75	1.47	1.12	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0.98	0.85
Greece (EL)	1.19	2.00	2.56	2.34	2.55	2.64	2.29	2.14	1.96	1.45	0%	0%	0%	0%	1%	3%	5%	4%	11%	54%	0.76	0.75
Spain (ES)	0.33	8.97	6.73	5.07	4.13	2.81	2.48	2.11	1.86	1.55	0%	4%	7%	10%	12%	21%	26%	36%	45%	61%	1.11	0.86
Finland (FI)	0.76	3.10	2.38	2.13	2.02	2.02	1.91	1.80	1.69	1.42	0%	9%	14%	25%	39%	47%	49%	53%	59%	69%	0.49	0.50
France (FR)	0.90	1.18	1.73	1.64	1.62	2.12	1.88	1.66	1.54	1.35	0%	7%	5%	15%	58%	55%	59%	67%	85%	88%	0.35	0.34
Croatia (HR)	0.60	0.45	1.58	4.68	4.92	4.50	4.34	3.21	2.43	1.68	0%	0%	0%	0%	0%	0%	0%	0%	0%	3%	1.86	1.51
Hungary (HU)	1.01	1.12	1.17	1.20	1.17	1.11	1.12	1.10	1.09	1.04	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0.07	0.08
Ireland (IE)	8.04	4.84	3.81	3.66	3.02	2.54	2.35	2.05	1.86	1.41	0%	3%	12%	27%	32%	39%	48%	55%	56%	53%	0.86	0.78
Italy (IT)	10.18	6.61	5.44	2.97	2.56	2.29	2.13	2.13	1.81	1.37	0%	1%	7%	12%	18%	24%	27%	30%	42%	64%	0.85	0.81
Lithuania (LT)	0.00	1.10	2.19	1.82	1.64	1.53	1.45	1.37	1.28	1.09	0%	0%	12%	18%	19%	23%	23%	25%	29%	30%	0.36	0.36
Luxembourg (LU)	-0.71	7.55	4.70	3.51	2.87	2.68	2.46	2.02	1.73	1.36	0%	91%	72%	78%	86%	83%	77%	84%	86%	87%	1.10	0.92
Latvia (LV)	5.26	4.85	3.12	2.31	1.94	1.67	1.48	1.35	1.25	1.14	0%	0%	0%	1%	2%	4%	6%	12%	29%	49%	0.59	0.47
Malta (MT)	3.62	3.98	3.89	3.46	3.04	2.68	2.20	1.87	1.69	1.40	88%	96%	93%	91%	93%	93%	93%	95%	93%	96%	0.95	0.77
Netherlands (NL)	0.80	3.23	3.76	3.28	3.12	3.29	2.96	2.65	2.28	1.62	0%	39%	41%	48%	58%	66%	68%	70%	73%	78%	1.17	1.11
Portugal (PT)	3.94	7.46	5.70	6.09	4.38	3.40	2.79	2.28	1.94	1.53	1%	5%	9%	9%	18%	23%	34%	40%	50%	70%	1.40	1.03
Slovenia (SI)	9.33	5.53	4.06	3.19	2.66	2.37	2.08	1.91	1.74	1.48	0%	1%	5%	16%	25%	28%	34%	38%	45%	58%	0.82	0.70
Slovakia (SK)	0.00	1.86	2.66	2.62	2.28	2.03	2.02	1.89	1.75	1.53	0%	0%	0%	0%	0%	0%	0%	0%	0%	2%	0.49	0.47

Notes: Estimates are derived from simulations where the tax base of individuals in each decile group grows homogeneously by 1% and tax parameters are kept unchanged. The elasticity of each decile group is computed as the relative increase in tax liability from all individuals in a decile group divided by the relative increase in their tax base. Note that individuals whose tax liability remains zero do not impact the elasticity of their decile group. The individual elasticity of these individuals is zero.

Table A.5: PIT revenue observed and simulated in baseline and counterfactual scenarios

	PIT Revenue (Millions Euros)								
	2019	2023							
	Observed	Observed	With 2019 legislation	With 2019 legislation indexed tax base	With 2019 legislation indexed lagged	With 2019 legislation indexed contemp.	Potential FD (wrt average of 3 ind.)	Actual FD (wrt average of 3 ind.)	With 2023 legislation w/o indexation
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Austria (AT)	35,424	40,477	48,323	43,003	43,229	41,006	5,900	-1,946	42,644
Belgium (BE)	53,858	69,325	77,011	65,284	68,224	67,613	9,970	2,285	77,654
Cyprus (CY)	735	1,174	1,208	1,034	1,086	1,038	155	122	1,174
Germany (DE)	339,185	374,828	424,413	393,500	393,429	382,837	34,488	-15,097	402,688
Estonia (EE)	1,532	2,391	2,629	2,209	2,329	2,237	371	132	2,488
Greece (EL)	10,855	13,385	14,768	13,762	13,610	13,153	1,260	-123	13,385
Spain (ES)	99,033	134,371	138,799	124,910	124,993	121,926	14,856	10,428	138,556
Finland (FI)	29,401	34,788	37,290	34,445	34,650	33,856	2,973	471	36,686
France (FR)	224,304	262,680	282,897	266,823	264,787	258,935	19,382	-835	267,482
Croatia (HR)	1,755	2,409	3,349	2,552	2,865	2,621	669	-270	2,409
Hungary (HU) (a)	2,424,565	3,996,321	4,424,433	3,891,185	3,901,761	3,853,066	542,429	114,317	3,996,267
Ireland (IE)	23,599	33,200	36,069	32,587	33,428	32,380	3,271	402	35,544
Italy (IT)	177,340	206,920	213,788	201,479	196,355	188,019	18,503	11,636	207,184
Lithuania (LT)	3,529	5,710	6,259	5,662	5,909	5,810	465	-84	6,330
Luxembourg (LU) (b)	4,479	6,926	7,968	6,965	7,198	7,122	874	-169	7,072
Latvia (LV)	1,978	2,522	3,027	2,686	2,814	2,749	277	-227	2,522
Malta (MT)	984	1,511	1,558	1,442	1,455	1,411	122	74	1,523
Netherlands (NL)	70,225	95,443	107,596	93,996	90,087	88,765	16,846	4,694	106,834
Portugal (PT)	13,580	18,495	20,649	18,008	19,177	18,839	2,125	-30	18,793
Slovenia (SI)	2,544	3,242	3,974	3,333	3,632	3,484	491	-241	3,280
Slovakia (SK)	3,534	4,662	6,164	5,219	5,529	5,250	831	-670	5,098

Notes: (a) Results for Hungary are shown in the national currency (Forint). (b) Observed values for Luxembourg are estimated to reflect taxes paid by residents only, in line with Euromod simulations.

Table A.6: PIT revenue observed and simulated in baseline and counterfactual scenarios

	PIT Revenue (% GDP)									Average Tax Rate (%)					
	2019	2023								2019	2023				
	Obs.	Obs.	With 2019 legislation	With 2019 legislation indexed tax base growth	With 2019 legislation indexed lagged HICP	With 2019 legislation indexed contemp. HICP	With 2023 legislation no indexation since 2019	Potential FD (wrt average of 3 ind.)	Actual FD (wrt average of 3 ind.)	Obs.	Obs.	With 2019 legislation	With 2019 legislation indexed tax base growth	With 2019 legislation indexed lagged HICP	With 2019 legislation indexed contemp. HICP
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Austria (AT)	8.95	8.55	10.21	9.09	9.14	8.67	9.01	1.25	-0.41	13.39	12.82	15.30	13.62	13.69	12.98
Belgium (BE)	11.23	11.63	12.91	10.95	11.44	11.34	13.02	1.67	0.38	20.25	21.57	23.96	20.31	21.23	21.04
Cyprus (CY)	3.14	3.75	3.85	3.30	3.46	3.31	3.75	0.50	0.39	6.93	7.90	8.13	6.96	7.31	6.98
Germany (DE)	9.60	8.96	10.14	9.40	9.40	9.15	9.62	0.82	-0.36	18.86	17.90	20.27	18.79	18.79	18.28
Estonia (EE)	5.38	6.26	6.89	5.78	6.10	5.86	6.52	0.97	0.35	12.92	14.00	15.40	12.94	13.64	13.10
Greece (EL)	5.86	5.94	6.56	6.11	6.04	5.84	5.94	0.56	-0.05	8.82	8.68	9.57	8.92	8.82	8.53
Spain (ES)	7.90	8.97	9.26	8.34	8.34	8.14	9.25	0.99	0.70	13.50	14.44	14.92	13.43	13.43	13.11
Finland (FI)	12.33	12.73	13.64	12.60	12.68	12.39	13.42	1.9	0.17	20.17	20.30	21.76	20.10	20.22	19.75
France (FR)	9.22	9.31	10.02	9.45	9.38	9.17	9.48	0.69	-0.03	15.32	15.17	16.34	15.41	15.29	14.95
Croatia (HR)	3.13	3.15	4.38	3.34	3.75	3.43	3.15	0.88	-0.35	5.10	5.11	7.11	5.42	6.08	5.57
Hungary (HU)	5.06	5.32	5.89	5.18	5.20	5.13	5.32	0.72	0.15	10.31	9.97	11.04	9.71	9.73	9.61
Ireland (IE)	6.49	6.51	7.07	6.39	6.56	6.35	6.97	0.64	0.08	19.58	20.22	21.97	19.85	20.36	19.72
Italy (IT)	9.83	9.72	10.05	9.47	9.23	8.84	9.74	0.87	0.55	18.91	19.23	19.87	18.72	18.25	17.47
Lithuania (LT)	7.17	7.74	8.48	7.67	8.01	7.87	8.58	0.63	-0.11	15.41	15.61	17.11	15.47	16.15	15.88
Luxembourg (LU)	7.17	8.73	10.05	8.78	9.08	8.98	8.92	1.10	-0.21	18.18	18.00	20.71	18.10	18.71	18.51
Latvia (LV)	6.69	6.46	7.75	6.87	7.20	7.03	6.46	0.71	-0.58	14.01	13.15	15.78	14.00	14.67	14.33
Malta (MT)	6.74	7.35	7.59	7.02	7.08	6.87	7.41	0.59	0.36	12.37	12.85	13.25	12.27	12.38	12.00
Netherlands (NL)	8.46	8.94	10.08	8.75	8.44	8.31	10.01	1.58	0.44	14.18	14.47	16.32	14.16	13.66	13.46
Portugal (PT)	6.33	6.92	7.72	6.73	7.17	6.88	7.03	0.79	-0.01	13.39	13.93	15.55	13.56	14.45	13.85
Slovenia (SI)	5.28	5.07	6.21	5.21	5.68	5.45	5.13	0.77	-0.38	10.02	9.82	12.03	10.09	11.00	10.55
Slovakia (SK)	3.74	3.79	5.01	4.25	4.50	4.27	4.15	0.68	-0.55	7.99	7.34	9.70	8.21	8.70	8.26

Table A.7: Growth rate of alternative indexation indices considered. 2019–2023

	Growth rate		
	Nominal tax base (1)	Lagged HICP (2)	Concurrent HICP (3)
Austria (AT)	17.07%	14.86%	21.89%
Belgium (BE)	21.59%	15.80%	16.98%
Cyprus (CY)	13.37%	9.92%	13.61%
Germany (DE)	12.56%	14.13%	19.34%
Estonia (EE)	38.04%	26.82%	35.31%
Greece (EL)	7.84%	9.09%	13.06%
Spain (ES)	12.16%	12.07%	14.99%
Finland (FI)	11.95%	11.05%	14.57%
France (FR)	8.51%	10.08%	14.82%
Croatia (HR)	25.88%	14.56%	23.19%
Hungary (HU)	49.03%	29.65%	46.71%
Ireland (IE)	14.89%	11.11%	15.83%
Italy (IT)	7.95%	11.41%	17.15%
Lithuania (LT)	48.87%	28.49%	36.59%
Luxembourg (LU)	18.16%	13.76%	15.19%
Latvia (LV)	39.60%	24.46%	32.11%
Malta (MT)	10.62%	9.37%	13.71%
Netherlands (NL)	15.19%	19.18%	20.83%
Portugal (PT)	17.48%	9.31%	14.72%
Slovenia (SI)	25.76%	13.14%	19.28%
Slovakia (SK)	31.60%	20.87%	30.53%

Notes: Growth of the nominal tax base is calculated from EUROMOD. HICP is computed from EUROSTAT.

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