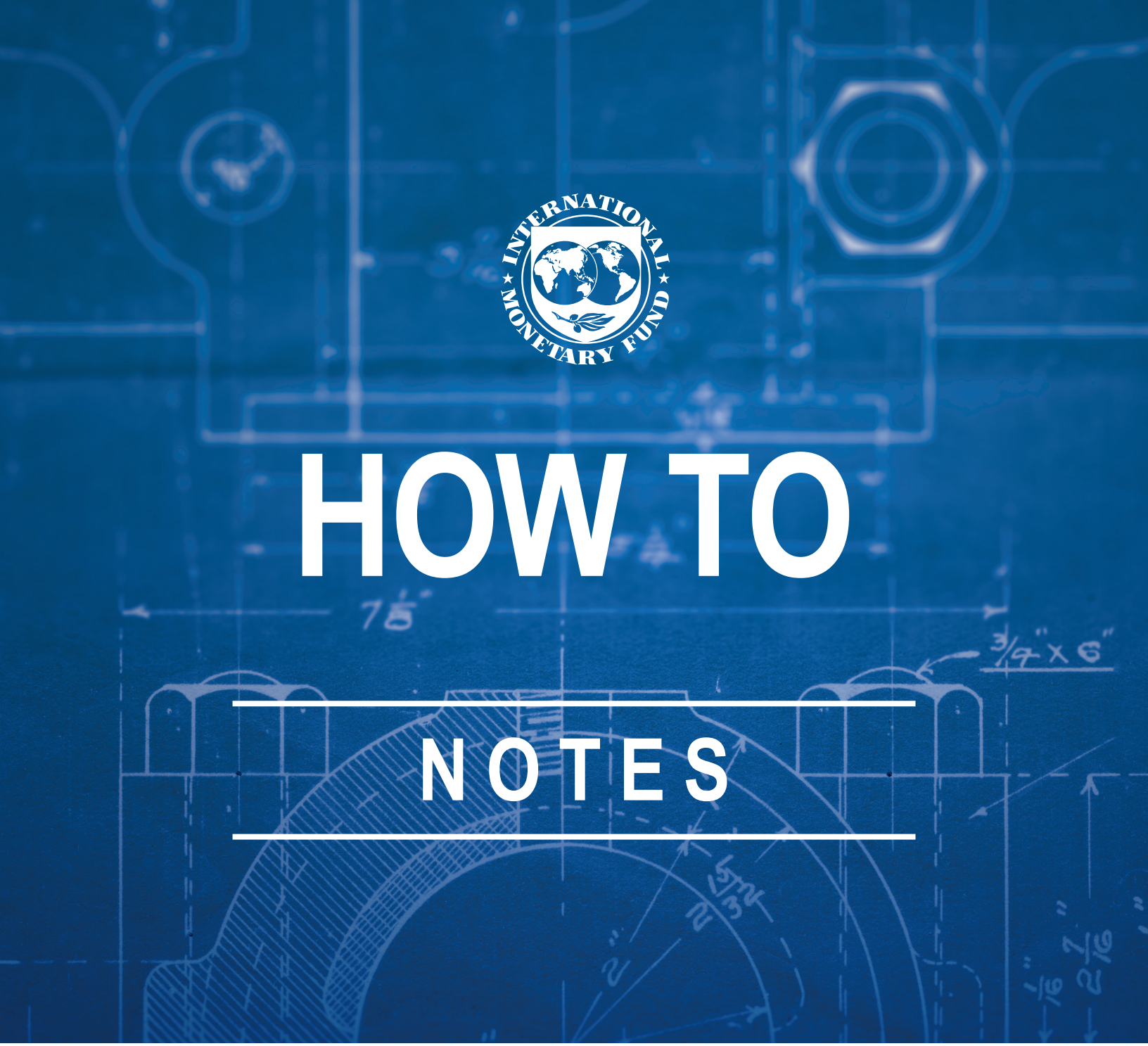

HOW TO

NOTES

How to Summarize and Interpret Income Tax Schedules

Alexander Klemm

NOTE 25/07

How to Summarize and Interpret Income Tax Schedules
NOTE/2025/007

Alexander Klemm

Cataloging-in-Publication Data

IMF Library

Names: Klemm, Alexander, author. | International Monetary Fund, publisher.
Title: How to summarize and interpret income tax schedules / Alexander Klemm
Other titles: How to notes (International Monetary Fund).
Description: Washington, DC : International Monetary Fund, 2025. | Sep. 2025. | NOTE/2025/007. | Includes bibliographical references.
Identifiers: ISBN:
9798229026352 (paper)
9798229026390 (ePub)
9798229026420 (WebPDF)
Subjects: LCSH: Income tax. | Tax administration and procedure.
Classification: LCC HJ4629.K5 2025

RECOMMENDED CITATION: Klemm, Alexander. 2025. “How to Summarize and Interpret Income Tax Schedules.” IMF How to Note 2025/007, International Monetary Fund, Washington, DC.

Publication orders may be placed online, by fax, or through the mail:

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How to Summarize and Interpret Income Tax Schedules

Alexander Klemm

September 2025

This note describes how most features of an income tax system (and to some extent social security and welfare) can be described as a combination of lump sums and marginal tax rates and plotted in a summary chart. Although this is by no means a new method, applying it consistently can help tremendously in understanding the effect of tax reforms on tax systems, including by identifying any unintentional humps or notches in tax schedules. This note uses this approach to discuss, for example, universal basic incomes, the issue of whether tax allowances should be phased out, and the difference between tax credits and allowances. It also points to the limitations of the approach, such as conditions that cannot be summarized in such tax schedules.

Introduction

Income (and other) tax systems are complicated, with tax codes and regulations in many countries reaching tens of thousands of pages. Analyzing such systems without missing the forest for the trees requires some way to neatly summarize their key aspects. This note describes how simple measures, such as marginal and average tax rates and graphs thereof, can be used to summarize income tax systems. It also covers the limitations of this approach.

Applying an income tax involves two fundamental steps: first, one needs to define—theoretically and practically—the tax base, that is, taxable income. Second, once taxable income has been determined, one needs to apply the tax rate schedule with all its allowances, credits, and rates. This note focuses on the second of these two steps.[1]

Although applying a tax schedule to a base is the comparatively easier step, it still creates much confusion. For example, when there is a personal allowance that can be deducted from income before applying the rate structure, it may not be obvious that the thresholds used for the rate structure are effectively increased by the personal allowance. At a given income level, an individual may be entitled to some tax credits or allowances, face some surtaxes, and confront the withdrawal of a benefit, the interaction of which can be hard to grasp.

The difficulty in understanding the implications of tax policy features for effective tax rates sometimes leads to policy proposals that may have unintended consequences. For example, it is sometimes argued that personal allowances or child credits should be phased out for people with incomes above a relatively high threshold, because better-off individuals do not need them. But not everyone arguing in favor of such a policy is aware that such phaseout implies that marginal tax rates then increase over some income range, only to fall again for yet higher incomes. This note aims to clarify such effects and contrast them to those of other policy options, so that

[1]While the first step is relevant for many taxes, this second step is particularly important for personal income taxes, which are typically the only or main tax that has a progressive schedule. Corporate income taxes, value-added or sales taxes, and most excises commonly have a flat rate. Inheritance taxes are also sometimes subject to progressive rates and the methods described here can also be applied for them.

people engaged in discussions on tax reform can easily grasp the implications of different reform options, even if they are not tax specialists. Another example of confusion is the increase of personal allowances. It is often overlooked that the greatest monetary benefit of such policy is for taxpayers in the highest tax bracket.

Often income is subject to more than one tax or charge. Labor income, for example, is commonly subject to personal income tax as well as social security contributions (of which some may be notionally paid by the employer and some by the employee). It is often interesting to consider the interactions of all such charges, and this note discusses how this can be done and what considerations need to be taken into account. When focusing on only part of the tax system, it is easy to miss the overall effect of the broader tax and welfare systems and their effect on incentives.

As described in this note, complex tax—and with some limitations social security and welfare—systems can be summarized in simple charts showing marginal and average tax rates as a function of income. Such summaries help tremendously in understanding the implications of tax systems and their reforms. They can reveal unexpected effects and provide a good starting point for a high-quality debate about tax policy. Of course, they are unlikely to settle such debates, as tax policy always entails value judgments, which differ across individuals. But they should help settle the factual effects and focus discussions on such differences in values.

Although the methods discussed here are not new, they are still underused in debates about tax policy, where they can make a powerful contribution. The earliest example of a discussion of marginal and average tax rates can be found in Pigou (1928, pp. 46–51), while their use in graphing tax systems dates at least to Musgrave and Thin (1948). The contribution of this note is not to introduce new measures but to provide a clear and accessible overview of existing summary measures and illustrate how they can be used to illuminate debates over tax reforms. The most closely related paper in the literature is McCrae (1997), which argues in favor of reforming the statutory description of the United Kingdom's tax system – moving away from a complex combination of allowances and tax rates to one based only on thresholds and marginal tax rates. This would simplify understanding of the tax system and avoid unintended consequences of changes to allowances. This note makes similar arguments but goes beyond the examples relevant in the 1990s in the United Kingdom, and moreover, it adds graphical examples and average tax rates.

The note is structured as follows. The "Principles" section covers the principles, describing marginal and average tax rates and why both are important for tax analysis, and what general insights economic theory provides on optimal tax schedules. The "Some Applications" section applies these measures to some obvious and some surprising examples. The "Limitations" section discusses the limitations of the approach, and the "Conclusions" section concludes the note.

Principles

Average and Marginal Tax Rates

Statutory tax rates are those written into the law. A taxpayer reading such law might wonder which of the possibly many rates apply to them and what is their overall effect. Two summary measures of tax schedules are particularly relevant (see Box 1 on how to calculate and plot them):

- The average tax rate is the total amount of tax paid as a share of total income.
- The marginal tax rate is the amount of tax paid on one additional unit (for example, dollar) of income.

The average tax rate is important for welfare comparisons across income groups. How much more tax do people who are better off owe compared to those on lower incomes? It is also important for people deciding on whether to participate in the job market (the "extensive margin"). If they have a job offer with a fixed combination of hours and salary, they will want to know the effect of tax on the net salary before accepting or rejecting such

an offer. Similarly, they may have a choice of working in the formal or informal economy, and again the average tax rate will be a relevant factor.

The marginal rate is important for labor supply decisions regarding additional hours worked. This is most directly relevant for self-employed people, part-time workers with flexible hours, or any workers who have the option to work overtime. In deciding whether to work an additional hour (the "intensive margin"), they will want to know the net income from such additional work. The tax rate on such additional income can be very different from—and under progressive tax systems is typically higher than—the average rate on the already earned income. For people running their own business, the effect is not only through the number of hours but also through the effort put into each hour. The marginal rate also matters for compliance decisions, if the choice is how much income to declare or hide.

Given the labor supply examples in the description of tax rates, it is important to note that based on economic theory, raising the marginal tax rate will always reduce labor supply, because it reduces the value of work compared to leisure ("substitution effect"). Raising average tax rates can, however, increase labor supply, because people may need to make up for the income loss ("income effect"). In practice, tax reforms tend to increase both, as most feasible reforms that raise average tax rates will have to raise at least some people's marginal tax rates.

Box 1. How to Practically Prepare Marginal and Average Tax Charts

The standard approach is to plot income, typically in local currency units, on the horizontal axis, and the tax rates, in percent on the vertical axis.

As the purpose is to simply describe the tax system, no data on income or its distribution are needed (though they could be used for enriching further analysis). One simply needs to choose an income range over which to plot starting with zero and ending with an income that exceeds the highest income threshold, so that the entire tax system can be depicted. Where the highest threshold is extreme, such that the rest of the chart becomes hard to read, it can be useful to show additional charts with smaller ranges. Where the top threshold is very low, however, it can be useful to show income ranging up to the median income at least, to put the low value of the top threshold into perspective. Within the chosen range, income should be split into steps that are sufficiently granular. The examples shown in this note use 1000 income steps, which might sound like a lot but is easy to handle in a spreadsheet and provides good accuracy.

The vertical axis shows the tax rates. For simple systems, the marginal tax rates for each income can simply be read off the statutory rate schedule. But for complex systems, this is not possible, and even finding a mathematical expression to calculate it can be difficult. A practical approach is to calculate the tax liability for each income, although even that will require quite complex expressions with many "if statements" in a spreadsheet formula. Then, the marginal rate can be approximated by dividing the difference in tax liability between two adjacent incomes by the incremental income (the greater the number of intervals into which the income range is split, the more precise this becomes). The average tax rate is simply the tax liability divided by income.

Parameters of Tax Systems

When calculating marginal and average tax rates, it is important to include all relevant features of the tax system. Countries differ in the way they describe their tax systems. Most countries have some system of rising tax rates that apply to income bands (also known as brackets or slabs, depending on the country) defined by lower and upper thresholds (with the upper threshold of a band identical to the next band's lower threshold, and

the final band having no upper threshold). Some countries have flat rates, in which case no thresholds are needed.

Most countries design their tax systems with some part of income remaining untaxed, so that people on low incomes (for example up to the subsistence level) do not owe taxes. This simple feature can be achieved in many ways, including the following:[2]

- Exemption: countries may provide an exemption—often known as personal allowance—for a fixed amount of income. This is deducted from total income and disregarded in the calculation of tax.

- Zero-rate bracket: countries may set the tax rate of the first bracket to zero. This may appear to be identical to an exemption, but there are subtle differences. Some are purely presentational, in that taxable income (though not necessarily tax) will be higher. Others are important in case of changes. An increase in the upper threshold of the zero-rate bracket/starting threshold of the first positive rate will not affect thresholds for any higher rate bands, but an increase in the allowance will automatically imply that all other thresholds are effectively shifted.[3]

- Tax credit: instead of exempting income from tax, countries may offer a credit that offsets the tax bill by the amount of tax paid on the income otherwise exempt. This again appears identical at first sight. However, a personal allowance is worth more to people with higher incomes, because for them the reduction in taxable income reduces the amount subject to the highest rate. A tax credit, however, is worth the same to all taxpayers, except those earning too little to make full use of it.

- Refundable tax credit: this is a tax credit with the additional feature that it is paid out to taxpayers if it exceeds their tax liability. It is thus worth the same for all taxpayers, even those earning little or nothing.

- Universal income: while all previous approaches work through the tax system, it is equally possible to use the spending system. Despite this difference in administration, its effect is essentially the same as that of a refundable tax credit (of course both can be designed in many different ways).

In addition to the basic rate structure, there are no limits to additional features and their complexity that can be added to income tax systems. Some examples are as follows:

- Surtaxes: additional tax is sometimes charged on top of income tax, either for incomes that exceed a certain threshold or for a limited amount of time.

- Tax allowances or credits for specific circumstances: examples are those for children, for education, or for health spending.

- Deductibility or even super-deductibility (that is, at more than 100 percent of the cost) of certain incentivized spending, for example, donations or purchase of environmentally friendly goods.[4]

- Reduced or increased tax rates for certain types of incomes.

- Complex interactions with other taxes, such as options to credit value-added tax paid against income tax.

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[2]An approach not included in the list is the provision of a large standardized deduction. This is not comparable, as it covers costs of taxpayers. Given that their true costs differ, it will not achieve a uniform exemption of a fixed amount of income per person. For people with very high costs, there is usually an option to itemize and deduct them instead of using the standard deduction.

[3]These two points were forcefully made by McCrae (1997).

[4]The deduction of actual costs related to earning an income is not a special feature, but simply part of determining income, that is, the tax base.

Despite the variety of these rules, and the many more that exist around the world, they can all be seen as either lump sums or marginal tax rates. If there is a flat amount paid (or charged) to everyone, it is a lump sum, irrespective of whether it is called a refundable tax credit, an unconditional universal income, or a head tax. Such lump sums have no effect on marginal tax rates but affect average tax rates. Everything else can be modeled as a marginal tax rate, irrespective of whether it is described as such, or it represents the withdrawal of a tax credit or other benefit.

Economic Theory

Economic theory provides some insights into how to set optimal tax rates trading off equity and efficiency effects of taxation. Although the details of how to determine the optimal rate are beyond the scope of this note (see, for example, Saez 2001), some of the more general findings can help interpret tax schedules.

One of the most robust results from the optimal tax literature is that the optimal marginal tax rate is between 0 and 100 percent (Mirrlees 1971). Although this might appear trivial, as will become clear in the examples given later, tax systems do not always follow this principle.

Another result is that the optimal marginal tax rate schedule should be U-shaped (Diamond and Saez 2011), that is, marginal tax rates should be relatively high on low and high incomes and relatively low on middle incomes. The intuition behind this is as follows: raising the tax rate on low incomes brings in much revenue, because it is collected from many people—all those who earn low incomes or more. At the same time, it discourages labor supply through higher marginal tax rates only for the few people whose total incomes are very low, so the efficiency costs are not too high. Medium incomes, however, are earned by most people, so for many of them, the tax rate applicable to medium income will be the marginal one, thus having a large negative effect on labor supply, or in other words, a high efficiency cost. Finally, the tax rate should again be high for large incomes. Although there is not much revenue to gain from raising rates on a relatively small number of people, the efficiency costs are again smaller given the size of the group, and the effect on equity is particularly strong. Although the precise optimal rate schedule depends on the precise preferences for equity and the elasticity of labor supply, the finding of a U shape is pretty general.

It should be noted that the theoretical result favoring high marginal tax rates on low incomes does not mean that people on low incomes should pay high taxes. Despite high marginal rates, their average tax rate could be low or even negative, for example, if a high marginal tax rate is combined with a refundable tax credit or grant.

Moreover, the high marginal tax rate of this theoretical result refers to the entire tax and benefit system. In practice, at the lower end of the income distribution, high effective marginal tax rates are achieved through the withdrawal of benefits rather than the tax system. Hence, when analyzing the tax system in isolation (and unless it is a tax system that covers also the benefit side, for example, through negative income taxes), instead of a U-shaped pattern, a rising marginal tax rate schedule should be expected.

Illustrative Applications

The Baseline: Simple Systems

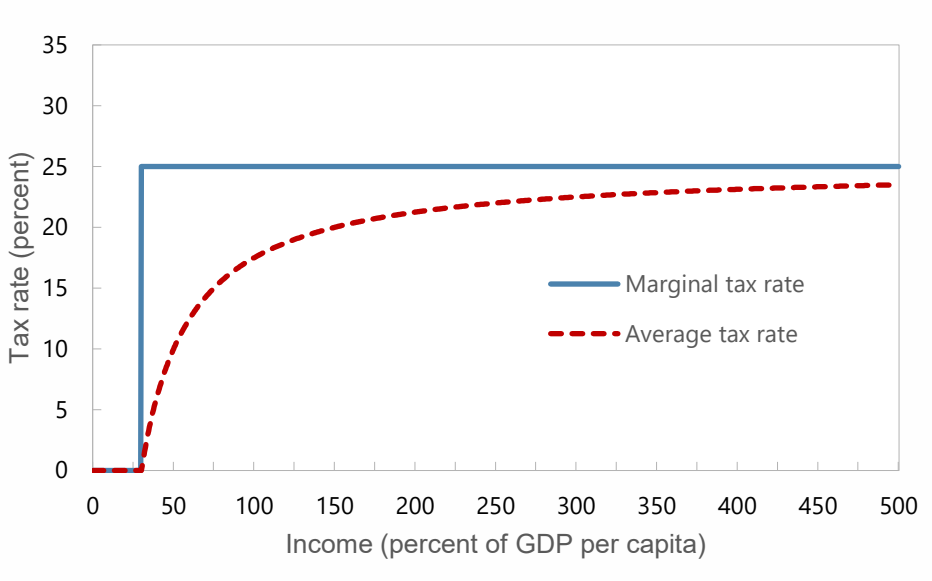
The simplest income tax system would be a flat one, applying the same rate on all income. For such system, the statutory, marginal, and average tax rates are all the same, and there is not much interest in producing a chart of tax rates over income, as it would simplify to a flat line.

Combining a flat rate with a personal allowance implies that there are two marginal tax rates: 0 and the flat rate. To show this graphically, Figure 1 plots the marginal tax rates against income, for an imaginary country with a tax rate of 25 percent and a tax-free allowance set at 30 percent of GDP per capita. Because this is just a

fictionary example, the chart shows the income in percent of GDP per capita, but if prepared for an actual country, it would normally be based on income in national currency.

With such a simple tax structure, the insights gained from looking at the marginal rate schedule on a chart rather than a text or table are not great. However, when considering the average tax rate, the graphical summary is revealing, even in such a simple example. Notably, it shows how the average tax rate rises for incomes exceeding the personal allowance. It thus confirms visually that this is a progressive tax system, where people earning more pay a greater share of their income in tax.

Figure 1. Marginal and Average Tax Rates of a Flat Tax System with a Personal Allowance



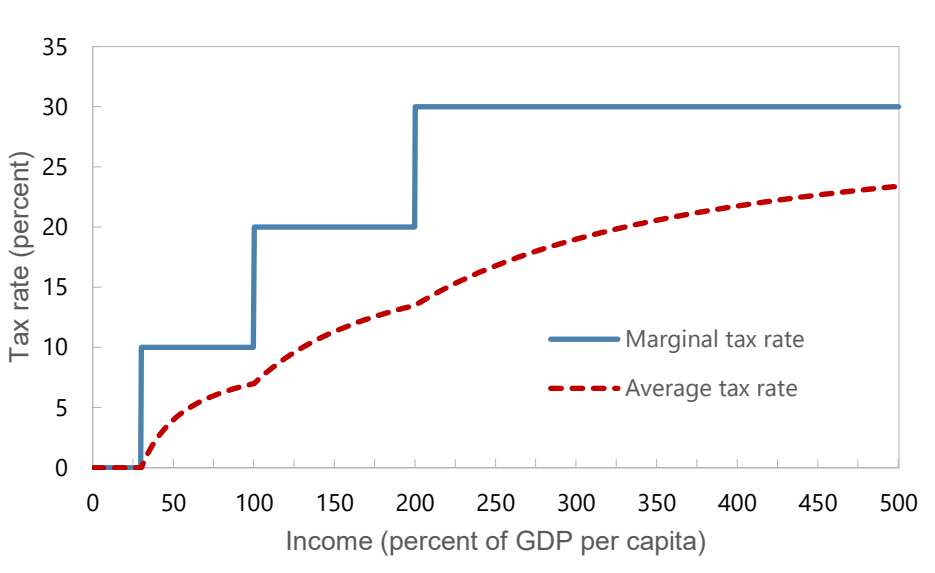
Note: Assumes a tax rate of 25 percent and a tax-free allowance of 30 percent of GDP per capita.

A slightly more complex system will have a rising marginal tax rate schedule, and an example is given in Table 1. This system has three non-zero rates and will from now on be used as the reference system to which various variations can be added. Figure 2 plots the corresponding marginal and average tax rates. The figure clearly gives a much better visual summary of the size of tax bands and the increase in rates over the schedule. For the average tax rates, the figure shows how having multiple rates causes the average tax rate to rise more steeply at the start of each band.

Table 1. Reference Tax System

Lower Threshold	Upper Threshold	Tax Rate
(percent of GDP per capita)		(percent)
0	30	0
30	100	10
100	200	20
200		30

Figure 2. Marginal and Average Tax Rates for a Progressive Rate Tax System



Note: Tax system as in Table 1.

Notches in Marginal Rate Schedules

Although the progressive tax schedule of Table 1 includes thresholds above which tax rates rise, the increased rates only apply to additional income. Countries, however, sometimes have tax provisions whereby passing a threshold leads to a discrete increase in the tax liability. Typical examples are as follows:

- Some countries provide a tax allowance (or lower rate) only for people earning below some income threshold, above which the right to such allowance is forfeited.
- Some countries apply tax rates not just on additional income but on all income when passing a threshold.
- Some countries apply an additional tax on all income (or on tax) when crossing a threshold.
- Equivalently, the right to some benefit can be lost when passing a threshold.
- There could also be a fixed amount of tax becoming payable at a given income level.

The implication of such provisions is that on passing the triggering threshold, the marginal tax rate is extremely high—theoretically even infinite—though in practice, if calculated at the level of earning one more currency unit, it will be finite and can be in the thousands or millions of percent.

To illustrate this, consider again the reference tax system of Table 1, but with a new provision that the personal allowance is lost for people earning three times per capita GDP. This is illustrated in Figure 3, where the vertical axis is truncated to allow showing the graph despite the infinite marginal tax rate.

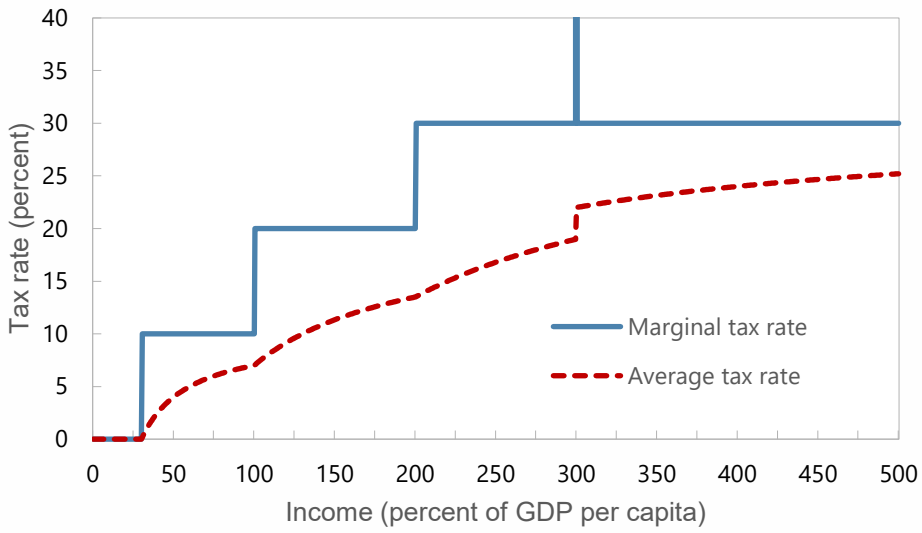
The implication of this is that around the notch, there is a major disincentive effect on labor supply (hours or work effort) as earning one more unit of currency leaves the taxpayer worse off—as can be immediately seen from the jump in the average tax rate.

In this particular example, someone earning just below 300 percent of per capita GDP will have a post-tax income of 243 percent of GDP per capita. Increasing earnings to meet the threshold reduces net income to 234

percent of GDP. Gross income would have to rise to at least 313 percent of GDP per capita for the taxpayer to recover their loss.[5]

Such notches in tax schedules are therefore best avoided. Intuitively they mean that people near them will not benefit from a pay increase, from working more hours, or from putting more effort into work that is paid based on outcomes, unless their additional income is sufficiently large to cover all of the additional tax liability. More formally, they also violate the Mirrlees (1971) result of the optimal marginal tax rate being between 0 and 100 percent. Plotting the marginal rate schedule—though with the slight challenge of not being able to show infinite tax rates—immediately identifies any such points. In the average tax rate schedule, such policies are marked by an upward jump.

Figure 3. Notches in the Rate Schedule



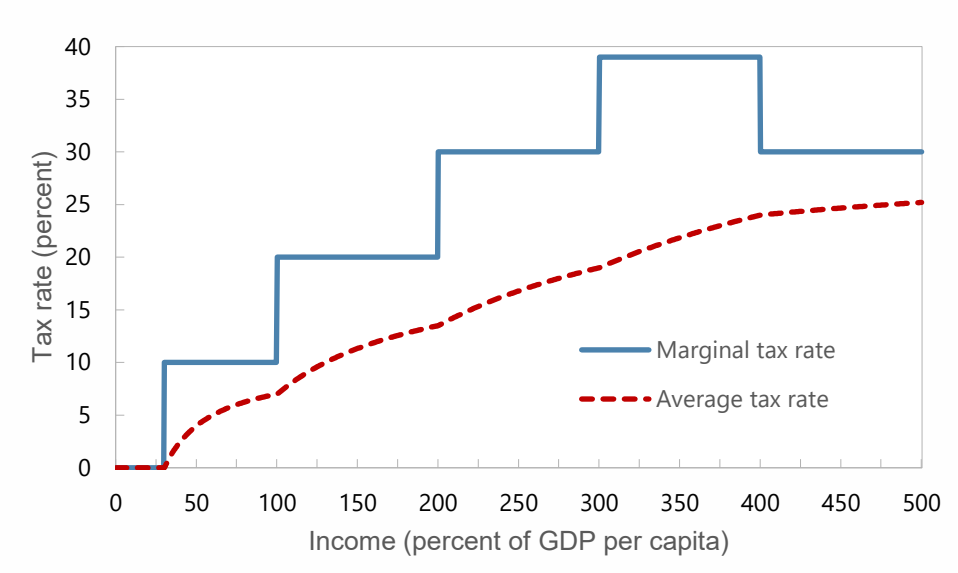
Note: Tax system as in Table 1, except that the tax-free allowance is lost when income reaches 300 percent of GDP per capita.

Withdrawal of Allowances or Reduced Rates

Some countries wish to avoid the notches described in the previous section but still would like to provide certain allowances only to people with low incomes. A typical argument is that well-off taxpayers do not require a personal allowance or that rich parents do not require a child allowance, because they are neither threatened by poverty nor facing difficulties in covering the costs of rearing children. To avoid a notch, one approach is to withdraw the allowance over an income range. This is illustrated in Figure 3 which is based on the reference tax system of Table 1, except that the personal allowance is now withdrawn over incomes ranging from 300 to 400 percent of GDP per capita. Instead of an infinite marginal tax rate at 300 percent of GDP per capita, this causes a smaller increase in the marginal tax rate, in this example by 9 percentage points. As a result of this policy, the marginal tax rate first jumps up and then comes down again. The average tax rate, however, rises without any jumps. Although incentives to supply labor are reduced over this band, at least taxpayers are not any worse off if their incomes rise, avoiding the extreme disincentives created by the notch in the previous example.

[5]Arithmetically, the 30 percent of GDP per capita allowance is worth 9 percent of GDP per capita for a taxpayer in the 30 percent band (0.3 × 30). Gross earnings that provide a net gain of 9 percent of GDP per capita must thus be 13 percent of GDP per capita (9/(1 − 0.3)).

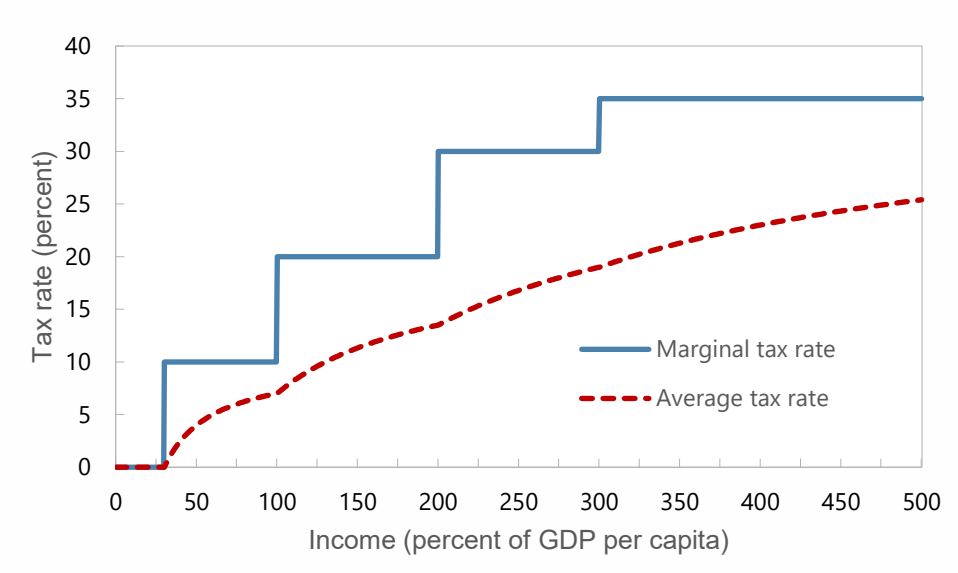
Figure 4. Withdrawal of Allowances



Note: Tax system as in Table 1, except that the tax-free allowance is withdrawn over incomes ranging from 300 to 400 percent of GDP per capita.

As an alternative to removing or withdrawing the personal allowance, one could also introduce a higher top tax rate as illustrated in Figure 5. In this hypothetical example, it is set at 35 percent. In practice, one would need information about the income distribution to calculate the new tax rate that would yield the same revenue as withdrawal of the personal allowance.

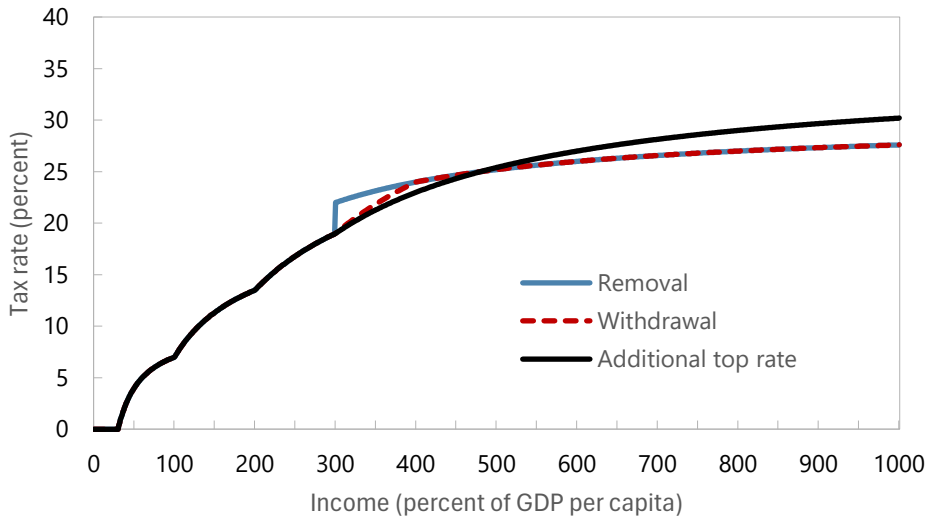
Figure 5. Additional Top Tax Rate



Note: Tax system as in Table 1, except that there is a new top tax rate at 300 percent of GDP per capita.

The narrative of providing a personal (or child) allowance only to people who need it sounds plausible. However, if one abstracts from that explanation and looks at the marginal rate schedules for the options of sudden removal, gradual withdrawal, and new top tax rate, they would probably conclude that the latter option yields the most sensible rate schedule, avoiding any jumps or reversals in marginal tax rates. As noted, economic theory suggests that optimal marginal tax rates rise with income. Although people may disagree on the optimal top rate depending on their relative preference for equity or efficiency, it is hard to come up with an optimization that would have as a result a temporary hump in marginal tax rates. Hence, instead of framing the question narrowly about whether better-off people need a personal allowance, one could ask more broadly, should better-off people pay more tax. If the answer is yes, then an additional top rate is the simpler and more equitable answer. This is also powerfully illustrated in Figure 6, where incomes up to 1000 percent of GDP per capita are shown, revealing that the new top rate keeps raising average tax rates, whereas the effect of any removal or withdrawal of allowances quickly fades out.[6]

Figure 6. Average Tax Rates for Three Reforms to the Personal Allowance



Personal Allowances, Zero-Rate Bands, and Tax Credits

A system with a zero-rate band is very easy to plot, because the chart can directly use the thresholds and tax rates as given in the rates table. If, instead of a zero-rate band, a personal allowance is offered, plotting the system requires increasing all higher rate thresholds by the amount of the allowance. If instead a nonrefundable tax credit is used, it should be divided by the tax rate before plotting the tax-free amount.

Approached from the point of view of a policymaker, all these systems are equivalent in a static tax system as long as the required arithmetic adjustments are made. But despite the equivalence in a static system, changes to these tax features can have very different implications.

To illustrate this, Figure 7 shows the marginal and average tax rate schedules if the reference tax system of Table 1 was characterized by a personal allowance and policymakers decided to double such allowance and compares this to the case of a zero-rate band. Doubling the allowance shifts the entire marginal rate schedule (Figure 7, panel 1) to the right, significantly lowering average tax rates (Figure 7, panel 2) over the income distribution. Doubling the zero-rate band, however, only changes the marginal rate schedule over a narrow range. While also reducing the average tax rate for all taxpayers, the tax reduction is much smaller for people

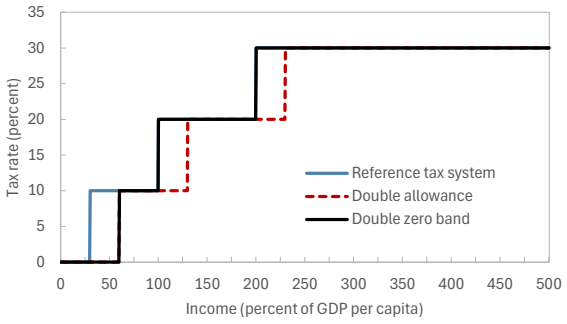
[6]It should be remembered that the revenue-neutral new top rate may be much lower than the additional 5 percent shown here, depending on the income distribution. But unless the only motivation for the new top rate is undoing the effect of the allowance, there is in principle no need to link these aspects, and the top rate can be chosen as a tradeoff between revenue requirements, equity, and efficiency.

earning higher incomes. Changes to a tax credit are comparable to changes in the zero-rate band, in that they have the same effect on all taxpayers and do not effectively shift any upper thresholds. This is particularly important when a new policy is introduced: providing a new tax allowance (for example, for education) provides the greatest benefit to higher rate taxpayers, whereas a new credit is worth the same to all taxpayers (except those already tax-exhausted, that is, already covered by existing allowances, zero bands, and deductions).

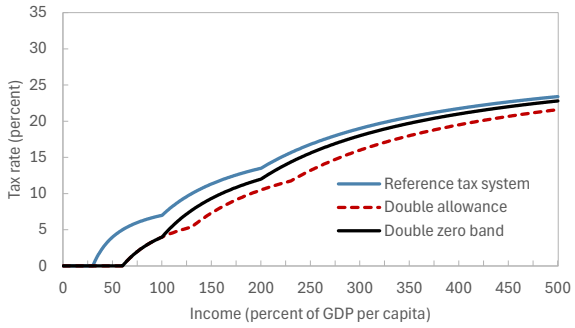
Apart from differences resulting from reforms, there can also be differences due to interactions with other features of the tax and benefit system that is contingent on taxable income. As noted earlier, McCrae (1997) argues in favor of describing the tax system in terms of marginal rates and thresholds, thereby avoiding unintentional effects from changes in allowances (or other provisions). Irrespective of how the tax system is described in the law, preparing a chart showing the effect of reform will be helpful in assessing whether it does what it is meant to achieve. After all, any desired outcome can be achieved irrespective of the starting point, as long as the policymaker is aware of the implications. Figure 7 shows how changes to an allowance have different effects from changes to the zero-rate upper threshold, if nothing else changes. However, if other parameters are also reformed, both systems can achieve exactly the same outcome, if desired. If the system is defined in terms of a personal allowance, but the intention is not to shift the effective thresholds for upper rates, the tax reform could combine an increase in the allowance with corresponding reductions in thresholds for upper rates. Equivalently, if the tax system has a zero-rate band, but the intention is to shift the entire schedule, the tax law can raise all thresholds by the same amount. Plotting the pre- to the post-reform scenario on the same chart will ensure that the policymaker and analyst will have a clear indication of the implications of the reform proposal.

Figure 7. Reforms to Personal Allowances and Zero-Rate Bands

1. Marginal Tax Rates



2. Average Tax Rates



Note: Tax system as in Table 1, except that the personal allowance or zero-band threshold is doubled.

Refundable Tax Credits, Negative Income Taxes, Unconditional Universal Income, and Means-Tested Benefits

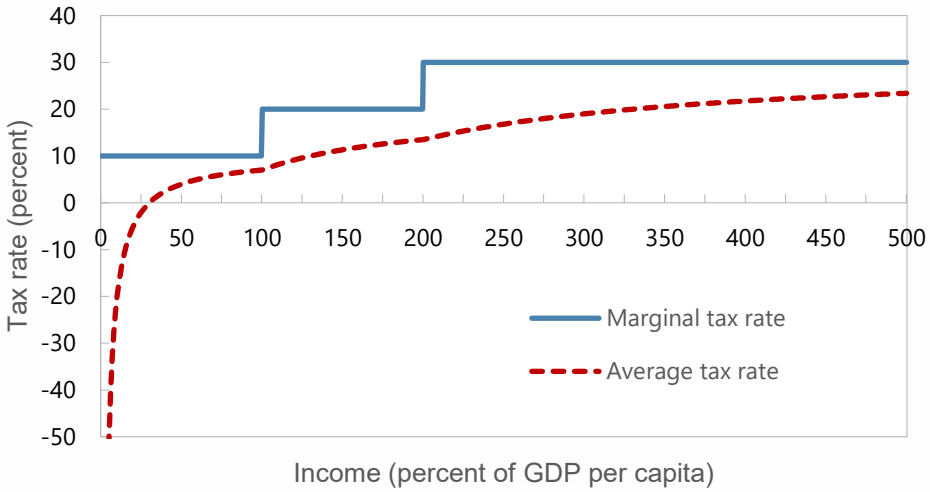
Tax credits can have a very different effect if they are made refundable, that is, if taxpayers' credits exceed their tax liability, they can obtain a net payment from the government. In those cases, they are equivalent to a negative income tax that applies to low incomes. An unconditional universal income would operate through the spending rather than tax side of the budget but would also be equivalent. Finally, even a means-tested benefit is indistinguishable (as long as only contingent on income). How can an unconditional income and a means-tested

one lead to the same figure? For the unconditional income, the withdrawal occurs through the tax system, so we have one lump sum and one marginal tax rate. For the means-tested benefit, the withdrawal occurs through the benefit system, but it can still be modeled as one lump sum and one marginal withdrawal (tax) rate. Although programs may differ in the tax/withdrawal rates they apply, there is thus no fundamental difference in how they affect the structure of marginal rate schedules.

Since they are all undistinguishable, they are all shown in Figure 8. This figure assumes the reference tax system of Table 1, but with the addition of a lump sum (refundable tax credit/negative income tax at zero income/universal income/means-tested benefit) of 3 percent of per capita GDP. With this provision, the starting tax rate is assumed to apply from the first unit of currency earned, since there is no need to provide a zero-rate band, when its purpose is already met by the lump sum (or equivalently, if a means-tested benefit is used, the zero-rate band can be maintained and the benefit withdrawn). The average tax rate tends to negative infinity as income goes toward zero, so the vertical axis was truncated for legibility.

In this example, the lump sum was set so that it exactly makes up for the removal of the zero-rate band. Hence, the average tax rate is lower for any income below the top threshold of the zero-rate band of the reference tax system of Table 1, whereas it is exactly the same for any higher income. As a result, replacing the zero-rate band by a refundable tax credit (or making an existing tax credit refundable) reduces revenue. A revenue-neutral reform would have to make up for this by raising one or more of the other tax rates. Notably, a much higher unconditional universal income that would cover basic needs would likely require much higher marginal tax rates from the start.

Figure 8. Refundable Tax Credit, Unconditional Income, or Negative Income Tax



Note: Tax system as in Table 1, except that there is a refundable tax credit/unconditional universal income/negative income tax/means-tested benefit of 3 percent of GDP per capita, and that the 10 percent starting rate (or benefit withdrawal rate) applies from the first unit of currency earned.

Inflation

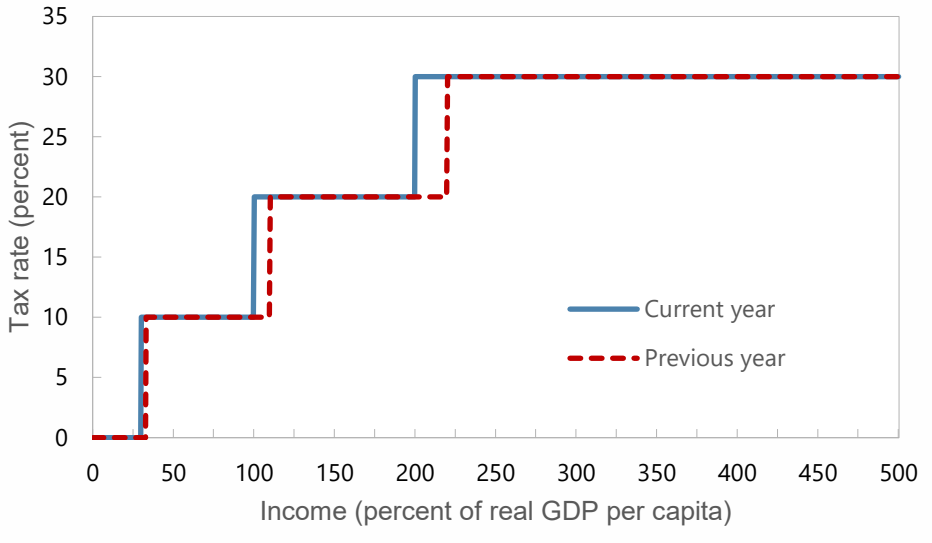
Inflation erodes the value of any feature of the tax system that is fixed in nominal terms, including any allowances and thresholds (for a recent discussion, see Beer, Griffiths, and Klemm 2023).

To illustrate this effect, instead of plotting the tax rate against the nominal income, it should be plotted against real income. By plotting the tax rate of various years, with all thresholds converted to constant currency units, the effect of inflation on the tax system can be revealed.

Figure 9 illustrates the effect for inflation of 10 percent. As before, the approach here is to use the reference tax system of Table1 and to express income in percent of per capita GDP. Hence, to focus on the effect of inflation, the figure assumes that there is no real growth. When using data on an actual country and expressing incomes in constant currency units rather than percent of per capita GDP, there is no need for such no-growth assumption when preparing such a chart.

As shown in Figure 9, inflation effectively shifts the tax schedule to the left, such that tax rate increases apply for lower real incomes, an effect also known as "bracket creep." To avoid this, the simple solution is to index thresholds to inflation.

Figure 9. Marginal Tax Rates after Inflation with Nominally Fixed Thresholds



Note: Expressed in current year prices, with inflation of 10 percent. Assumes no real growth to focus on the effect of inflation.

Limitations

Interactions with Social Security

Looking at the tax system in isolation can be misleading in countries with significant social security contributions. To assess the overall system and its effect on incentives, it can be useful to add up tax and social security. In adding up both systems, a couple of points need to be heeded:

- If social security and tax are fully separate, rates can simply be added. However, if one (more likely social security) is deductible from the other, this must be taken into account when calculating combined tax rates.[7]

[7]With a tax rate of t and a social security rate of s, the combined rate T is then $T = s + (1 - s)t$.

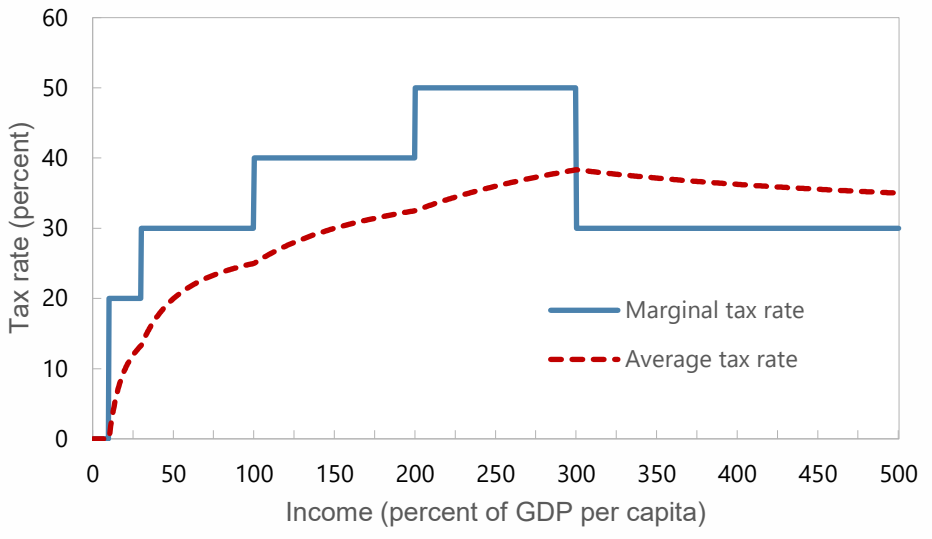
- If there are also employer contributions, it is useful to include them, too. In that case, the combined rate is known as the marginal tax wedge. Because employer contributions are part of the gross cost of employing someone, they should then also be included in the denominator of the average rate.

The shape of the combined tax and social security schedule is often very different from the tax system alone and can reveal surprising interactions. Although every country is different, a typical—though by no means universal—feature is that social security is only collected up to an upper limit. As a result, tax systems that have a progressive rate structure sometimes become regressive at the top when taking social security into account. Sometimes the marginal tax rate also falls, when social security ends, only to rise again, as higher tax rates apply at even higher thresholds.

To give just one example, Figure 10 combines the reference tax system of Table 1 with a flat employee-paid social security contribution of 20 percent that applies on income ranging from 10 to 300 percent of GDP per capita. The resulting hump shape of marginal tax rates—which is the opposite of what the optimal tax literature suggests—and the regressivity at the top are quite common for many systems, although details differ much across countries. Some countries manage to avoid regressivity by aligning the starting threshold of their top tax rate with the upper threshold for social security.

When analyzing such combined systems, one needs to be aware of the limitations. Notably, not all social security is akin to taxes, that is, unrequited payments. Some social security contributions, typically those for pensions, entitle the contributor to future benefits and are therefore similar to forced savings. Paying them therefore will not have the same effect on motivations as paying taxes. Other social security contributions are closer to taxation, for example health contributions, where the quality of care provided is independent of the size of contributions. Hence, simply adding up all social security contributions and tax is an oversimplification. It is nevertheless a useful exercise, revealing overall payments and progressivity over the income range. As long as the caveats are borne in mind, such combined schedules are useful tools of analysis.

Figure 10. Combined Income and Social Security Tax Rates



Note: Tax system as in Table 1, adding a social security contribution of 20 percent, applicable on incomes from 10 to 300 percent of GDP per capita, which is fully paid by employee and not deductible from tax.

Household Taxation

In some countries, taxation does not occur at the individual level, but instead at the household level, with thresholds often different depending on household type (single, married, with or without children). Another aspect that arises is that when the interest is to understand one person's tax schedule and its implied incentives, one needs to take their partner's (or possibly other dependents') income into account.

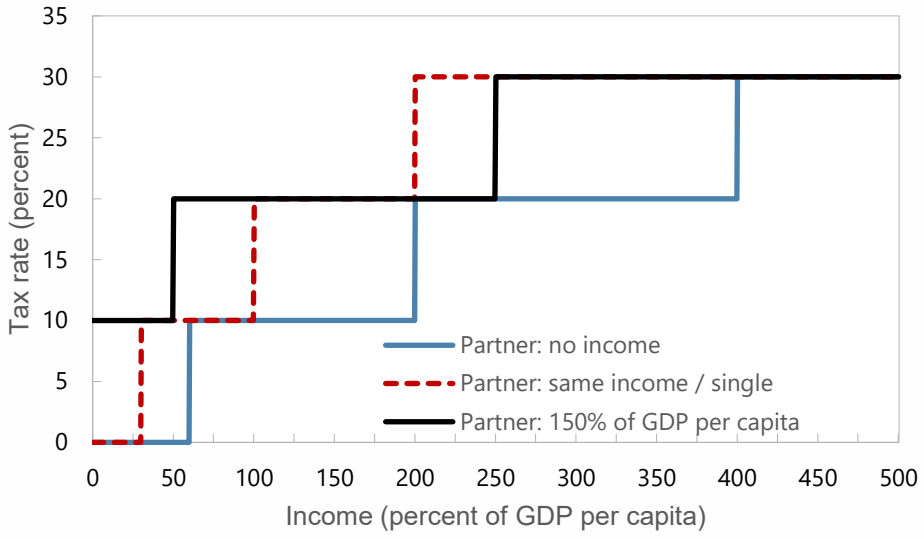
To illustrate this, consider a country with the reference tax system of Table 1, but where married partners are taxed jointly under double the thresholds applicable to singles. As shown in Figure 11, in such a case, if both partners earn the same, then given the doubled threshold, the marginal tax rate schedule for each is exactly the same as shown in Figure 2. For any single (or specifically anyone not married under the definition used for tax purposes), the tax system is also the same.

However, for someone married to a partner earning no income, tax rates are much lower. The partner with earnings now enjoys twice the zero-rate band, as well as twice all the other reduced tax rates, and reaches the top rate much later. The opposite happens if married to a well-earning partner, for example, someone earning 150 percent of GDP per capita. In that case, their partner will already have used the tax-free band, so that immediately the starting tax rate applies and also the higher rates apply sooner. In the extreme case, where the partner's income alone is sufficient for the household's income to exceed the threshold for the top rate (in this example, 400 percent of GDP per capita), the secondary earner will face the top rate right from the start.

More generally, whenever someone earns less than their partner, marginal rates are raised or at best the same, whereas if someone earns more than their partner, marginal tax rates are lower or at worst the same. Given that in practice partners with lower incomes are often women, such household taxation can have a negative effect on female labor supply (see a recent discussion and further references in Coelho and others 2024). To analyze data from actual countries for such household taxation effects—which can be much more subtle and can be driven by the spending as well as tax side of the budget—the Tax and Benefits Analysis Tool (TAXFIT) database and model can be used (Cots-Capell, Davis, and MacDonald 2025).

These different scenarios are instructive in revealing the effect on taxpayers depending on their family situation. However, the approach reaches its limits in that there is no way to summarize the tax system in one single chart that would be valid for any taxpayer.

Figure 11. Marginal Tax Rate of Married Person under Household Taxation



Note: Tax system as in Table 1, but with married partners assessed jointly under doubled thresholds.

Social Welfare

Going beyond tax and social security, it is also possible and sometimes instructive to add features of social welfare, such as income support or employment tax credits.

But, unless such features are determined purely by taxable income, such a combined schedule might be misleading, because it cannot show the effect of other qualifying conditions. For example, support could depend on age, number of school-aged children, asset ownership, check-ins at the unemployment office, or school attendance of children. In the case of employment tax credits, it could depend on a minimum number of hours worked. Hence, any chart would need to be accompanied with an explanation of the other conditions, so that it is clear under what circumstances a particular combined tax and benefit schedule applies.

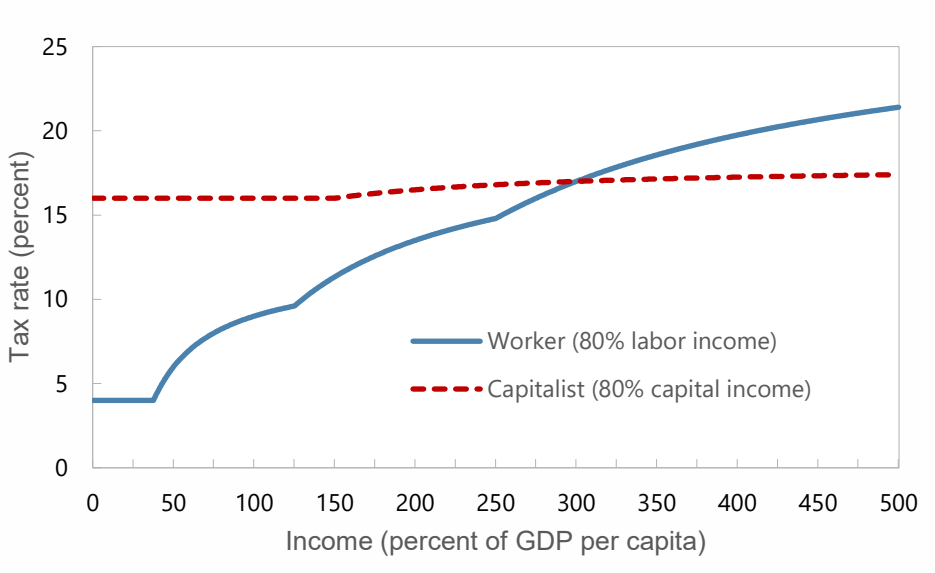
Dual and Schedular Tax Systems

Some countries have dual income tax systems, with different tax schedules for capital and labor income. Some countries go even further and have various defined types of incomes (for example, income from real property, from farming, from savings, from employment, and so on), which may all be subject to different tax schedules. In those cases, one can prepare separate charts or graphs, which will then accurately reveal the marginal tax rates for each income type. However, if the interest is in the average tax rate for total income, one needs to make assumptions about how incomes are distributed across the different types and prepare charts for various scenarios.

An example is provided in Figure 12, which is based on a very simple dual system, in which labor income is taxed under the reference tax system of Table 1 and capital income is taxed under a flat rate of 20 percent. For someone earning only labor income, the schedule is unchanged from Figure 2, and for someone earning only capital income, the tax schedule would be represented by a flat line, so both of these scenarios are not shown. Instead, the figure shows a person labeled “worker” who earns 80 percent of their income from labor and 20 percent from capital, and a “capitalist” where these proportions are reversed. As the chart reveals, for low incomes, such dual income systems are often favorable for people whose main source of income is work. For high incomes, however, people relying mostly on capital income face lower tax rates.

Although such charts are interesting tools to show how average tax rates depend on income levels and types, the underlying assumption of fixed income shares as income rises is not realistic, because high-income earners likely have a different distribution, notably with a greater proportional capital income. Of course, one may assume a rising proportion of capital income, but ultimately this means that the chart does not represent the abstract tax system anymore, but rather a set of either arbitrary assumptions or economy-wide estimates that are necessarily backward looking and not relevant for any taxpayers whose situation is different from average.

Figure 12. Average Tax Rates under a Dual Income Tax



Note: Tax system as in Table 1 for labor income, combined with a flat 20 percent on capital income.

Taxpayers with Foreign Income

Some countries tax the worldwide income of their residents. Typically, they then provide a credit for foreign taxes paid. Hence, as long as foreign taxes are less than domestic taxes, the effective tax schedule is the same whether all income is earned domestically or some of it abroad.

However, if foreign taxes exceed domestic ones, there is typically no refund of any excess credit. Hence, taxpayers in such a situation will face a different effective tax rate schedule. Other countries exempt foreign income. In those cases, the schedule applies only to domestic income, and foreign income is taxed by whatever approach the foreign source country applies. In those cases, it is not possible to represent tax on total income by a simple schedule, as it will depend on the distribution of income across the globe, the various tax systems, and their interactions.

Conclusion

The preparation of marginal tax rate schedules is a critical analytical tool in understanding and designing effective tax systems. It allows the analyst to see the effect of reforms on tax schedules that might have undesirable effects on marginal tax rates, without the risk of getting lost in narratives that may sound plausible. Notably, it reveals any notches and cliffs that may discourage additional earnings or workforce participation. It also allows analyzing interactions between tax and social security, and in some cases even welfare systems, and it can be used to illustrate the effect of household taxation on primary and secondary earners.

In combination with average tax rates, it is also possible to illustrate the progressivity (or its absence in tax systems).

Clearly, the shape of marginal and average tax rates over income cannot settle many of the debates about how to reform tax systems, which reflect differences in values and hence views regarding the many tradeoffs policymakers must face. But at least they can clarify the effect of different reforms, thereby setting the factual background on which a constructive discussion can take place.

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