OECD Taxation Working Papers

Assessing tax relief from targeted investment tax incentives through corporate effective tax rates

Methodology and initial findings for seven Sub-Saharan African countries

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Abstract

Corporate tax incentives reduce investment costs for businesses, which may affect investment and location decisions. They apply through different designs and interact with countries' standard tax systems, often making it difficult for tax policy makers and researchers to compare their generosity and assess their impacts across countries. This paper develops a methodology to calculate forward-looking corporate effective tax rates (ETRs) summarising tax relief from investment tax incentives into comparable indicators. It presents ETR indicators for seven Sub-Saharan African countries. Empirical results show that tax incentives substantially lower corporate taxation across these countries. On average, tax incentives reduce ETRs by 30% in the food and automotive industries compared to the standard tax treatment. ETRs often differ among taxpayers in a same sector and country - by up to 55%. The most generous tax treatment is typically offered within Special Economic Zones, where tax incentives can reduce ETRs to near zero.

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Executive summary

Tax incentives have the potential to significantly reduce the tax costs of investment and, as a result, may influence business investment and location decisions.

Countries provide a range of different types of tax incentives with design features and targeting strategies varying along several dimensions and these will have varying effects on a firm's tax costs and its incentives to invest in a particular jurisdiction.

Forward-looking corporate effective tax rates (ETRs) are a way of measuring the extent to which tax incentives affect tax costs and influence business investment and location decisions.

This paper draws upon the OECD's forward-looking corporate ETR framework: it incorporates a comprehensive set of tax incentives and design features that are commonly available and shows how this framework can be applied to inform tax incentive policy and design decisions, by allowing for a comparison of the tax costs associated with different tax incentive features.

Using the ETR framework, the paper presents ETR results across seven Sub-Saharan African countries (Angola, Botswana, Eswatini, Kenya, Mauritius, Senegal and South Africa) in two sectors - the food and automotive industries - and in Special Economic Zones (SEZs).

General findings from integrating investment tax incentives in the ETR framework

The paper's conceptual framework shows, for each incentive type:

- How specific design features affect ETRs,
- What interactions with standard tax provisions may arise; and
- How these can affect the overall value of the incentive.

This reveals several – potentially unintended – effects of tax incentive policies on the tax costs of investment and on revenue forgone across the different periods of an investment's lifecycle; in particular, effects relating to carryover provisions, benefit ceilings, and interactions with standard capital allowances or investor- and project-specific characteristics.

This highlights that governments need to consider carefully what provisions and interactions to prescribe in the law, as these can substantially affect the value of the incentives provided.

It also shows that analysing tax incentive policies based on the *most generous* tax treatment available in a country or sector – as is often done in comparative studies – can be misleading, as such an approach does not necessarily reflect key design dimensions and interactions.

Key findings from an initial look at seven Sub-Saharan African countries

Across the seven Sub-Saharan African countries, tax incentives reduce ETRs by 30% on average in the sectors considered.

The most generous tax treatment are typically offered within SEZs, where ETRs are reduced on average by 65% compared to the standard tax treatment. In some specific cases, tax incentives can reduce ETRs to nearly zero.

A range of different ETRs is applicable within each country, depending on the sectors, locations and projects targeted by the incentives.

Even within sectors, different ETRs often apply due to varying investor or project characteristics (e.g. project size, profitability, the taxable income position over the lifetime of the project), specific incentive design provisions (e.g. benefit ceilings, treatment of carryforwards, etc.) and interactions of incentives with standard capital allowances. These features can substantially affect the size of the tax benefit from incentives.

Depending on their design and context, expenditure-based incentives can deliver tax benefits that are as generous as income-based ones.

Conclusions

Across the countries covered in this study, variation in design features and targeting strategies are found to lead to a patchwork of corporate income tax incentives in each country. Interactions between various features of the tax incentives and the standard tax system further increase complexity.

- The existing patchwork of corporate income tax incentives may arise from deliberate policy decisions, but can create a range of distortions by treating taxpayers unequally.
- The complexity of incentive schemes reduces transparency and impedes a clear understanding of their impacts.
- This lack of transparency can make it difficult to properly assess the costs and benefits of the incentives and, as a result, can undermine efforts to identify and reform wasteful and redundant incentives.

This highlights that policy analysis of tax incentives should take a granular look at country-, sector- and activity-specific details and underlines the importance of regularly assessing and evaluating the costs and benefits of tax incentives against their stated policy objective.

Possible future analysis

This paper highlights the importance of taking a granular look at country, sector and activity specific details when conducting policy analysis of tax incentives.

This paper develops a consistent empirical approach to conduct a granular analysis using the forward-looking ETRs framework.

Future work that builds on this methodology and analysis could include the following:

- **Country or sector case studies**. Case studies could assess the complexity of tax incentives further and evaluate their effect on investment, tax revenue and other outcomes.
- **Studies involving regional groupings**. Analysis of regional groupings could contribute to important policy discussions around tax and tax incentive competition and help identify opportunities for cross-country regional cooperation.
- **Studies on the role of SEZs**. A dedicated study could further analyse the differential tax treatment of investors within and outside of SEZs, provide insights over the potential contribution of SEZs to investment and revenue forgone and help inform improved design.
- **Studies involving specific asset-mixes**. The ETR estimates currently consider the same types of investment across all countries composed of a single capital asset. Calculating ETRs calibrated to asset-mixes enables an evaluation of the tax treatment of projects related to a specific activity or sector and their typical asset mixes.

1 Introduction

Tax incentives for investment are frequently used across the world to promote investment in specific activities, sectors and regions, or to increase investment overall. Investment tax incentives can attract investment, with potentially positive spillovers on output, employment and productivity, but they can also reduce revenue-raising capacity, create economic distortions, increase administrative and compliance costs and potentially trigger damaging tax competition. Even when a tax incentive does attract additional investment, there is a risk that the associated costs exceed the benefits. Improved understanding of the effects of tax incentives and how these vary depending on incentive design can help policy makers to make better use of tax incentives from both investment and tax policy perspectives. This paper details how to calculate effective tax rate indicators and illustrates how they can contribute to an improved understanding of the effects of tax incentives and the impact of their design.

Designing an efficient, equitable and attractive tax regime that can secure the necessary revenues for public spending is important, particularly for developing countries given their need to mobilise domestic resources. Following the economic crisis caused by the COVID-19 pandemic, governments have been presented with a number of policy options in respect of investment tax incentives. Some of them could choose to expand the use of tax incentives to support the recovery and increase investment flows at the cost of reduced revenue-raising capacity. Other countries could seize the opportunity to reduce wasteful tax expenditures and increase tax revenues. Against this background, the recent international tax agreement by 137 countries and jurisdictions in the context of the OECD/G20 Inclusive Framework on Base Erosion and Profit Shifting (BEPS) introduces a global minimum corporate tax rate, which is also expected to affect the future use of tax incentives.

While guidelines and principles are available to provide direction on how to efficiently design and implement investment tax incentives and avoid pitfalls, a structured and systematic understanding of how incentives apply across the world, including comparable metrics of their scope and generosity, is lacking. Earlier analyses of investment tax incentives have either focused on detailed country- or region-specific analysis, or on high-level cross-country comparisons. Examples of high-level work include a database on investment tax incentives collected by the World Bank (Andersen, Kett and Von Uexkull, 2017[1]) and the joint work by IMF, OECD, UN, World Bank for the G20 Development Working Group (IMF, OECD, UN, World Bank, 2015[2]), which lays out options for effective and efficient use of tax incentives for investment in low income countries. Cross-country comparisons often focus on the number of different incentive instruments available in a country or sector as a key indicator or on the most generous incentive available, but generally do not focus on indicators that capture the multiple dimensions of tax incentive design

Recent OECD work has increased the scope and granularity of currently available databases. The OECD Investment Tax Incentives database (ITID) systematically compiles novel and granular information on corporate income tax (CIT) incentives for investment along three key dimensions: design features, eligibility conditions and legal basis (Box 1.1). Celani, Dressler and Wermelinger (2022[3]) present the methodology underlying the database, introduce classifications that have been developed to structure the quantitative and qualitative information on investment tax incentives and provide insights from data for 36 emerging economies.

The present paper discusses the integration of investment tax incentives in the OECD modelling framework of forward-looking corporate effective tax rates (ETRs), with a view to analysing how tax incentive design

impacts ETRs. The model extension and general analysis presented in this paper are useful for future country-, sector- or region-specific tax incentive policy analysis. The analysis uses the forward-looking ETR framework to evaluate the generosity of investment tax incentives in providing tax relief, building on prior work including Devereux and Griffith (1999[4]; 2003[5]), Klemm (2012[6]), Hanappi (2018[7]) and OECD (2021[8]). Forward-looking ETRs are a useful metric to capture the multidimensional character of tax incentives in indicators that are comparable across taxpayers, locations, sectors and designs. For example, ETRs can be used to evaluate the effect of a specific incentive scheme across countries, but also across locations within a country (e.g. what are the effective tax costs for a car manufacturer located in a special economic zone compared to one located elsewhere in the country). ETRs are also useful for comparing tax incentive design features (e.g. how does a 10% tax allowance on industrial machinery compare to a 5-year tax exemption in industry, what are the impacts of benefit ceilings).

Previous studies using ETR analysis have focused on evaluating specific investment tax incentive instruments, or have taken a country- or region-specific focus. For example, Klemm (2008[9]; 2012[6]) contributes to the forward-looking ETR framework by incorporating zero CIT rates that are available on a temporary basis. Abbas and Klemm (2013[10]) adapt this contribution to incorporate temporarily-reduced CIT rates at levels different from zero and evaluate them across 50 developing economies. Gonzalez Cabral, Appelt and Hanappi (2021[11]) introduce tax allowances and tax credits to incentivise investment in R&D into the forward-looking ETR framework, and estimate ETRs across OECD economies. Other studies apply the ETR framework on an ad hoc basis to analyse investment incentives, e.g. in Latin America and Africa (Klemm and Van Parys, 2012[12]) or Southeast and East Asia (Botman, Klemm and Baqir, 2010[13]; Suzuki, 2014[14]; Wiedemann and Finke, 2015[15]; Ghazanchyan, Klemm and Zhou, 2018[16]).

This paper studies a comprehensive set of CIT incentive designs commonly available in developing countries within one unifying framework. It covers both income-based incentives (i.e. reduced CIT rates and tax exemptions) and expenditure-based incentives (i.e. tax allowances and credits), as well as their detailed design features and targeting strategies. Common instrument and design choices are identified through the OECD ITID (Celani, Dressler and Wermelinger, 2022[3]). The analysis takes into consideration the standard tax system features of countries available in the OECD Corporate Tax Statistics (CTS) database (Hanappi, 2018[7]; OECD, 2021[8]).

An empirical application to seven Sub-Saharan African (SSA) countries shows the benefits from using ETRs in tax incentive analysis and how they can provide insights into the impact of specific design features. Overall, there is limited empirical work on tax incentives in SSA[1] and only one study has used forward-looking ETRs to analyse investment tax incentives. Abbas and Klemm (2013[10]) compare the generosity of CIT incentives via effective average tax rates (EATRs)[2] across 50 developing economies over 2003 and 2007, including 13 SSA countries. Considering the most generous tax treatment per country, they find that tax incentives drive EATRs down to almost zero in most of these countries. The present application evaluates tax incentives at a more disaggregated level than is usually done in comparative analyses. In particular it goes beyond the typical focus on *the most generous incentive* and instead accounts for sector- and location-specific targeting, additional eligibility conditions (such as minimum investment size or other

[1] Cross-country mapping of incentive design has identified important characteristics of incentives in SSA, such as the narrowing of tax bases (Keen and Mansour, 2010[38]) and a higher share of incentives granted through discretionary processes relative to other regions (James, 2013[44]). Econometric studies on the relationship between duration of tax holiday and standard CIT rates with inward FDI flows in SSA did not find a robust positive correlation (Van Parys and James, 2010[39]; Klemm and Van Parys, 2012[12]).

[2] The forward-looking ETRs measure taxes due over the lifetime of a standardised investment project, expressed as a share of the investment's expected income. EATRs summarise the effect of taxation on the decision to invest in comparable but mutually exclusive projects, assuming that investment projects earn economic rents over their lifetime. Another indicator, the forward-looking effective marginal tax rate (EMTR) evaluates investment decisions at the intensive margin, that is, on how much to invest once the location has been defined, focusing on marginal projects earning zero economic rents. See Section 3.1 and 4.2.3.Annex A for more details on forward-looking ETRs framework.

project- or investor-characteristics) and design features (e.g. benefit ceilings, carryover provisions, interactions of incentives with standard capital allowances).

In this paper, the empirical application shows that tax incentives significantly reduce ETRs, but that their effects vary widely across countries and sectors given complex design features and targeting strategies. Tax incentives in the countries and sectors considered reduced ETRs by on average 30% given modelling assumptions, suggesting that tax incentives can have significant impacts on the ranking of investment locations in terms of tax costs when they apply with sector conditions. A country's most generous treatment typically is offered within an SEZ, with reductions reaching on average 65% relative to standard treatment, but significant preferential treatment is also available outside of SEZs.

Overall tax incentive design and targeting vary widely within countries, which complicates their analysis and an assessment of wider economic impacts. In most cases a range of different ETRs are applicable within one country, depending on the sector of activity as well as other investor- or project-related characteristics. Even within sectors different ETRs often apply. Therefore, analysing tax incentive policy based on the most generous treatment risks reflecting only certain types of incentives and missing out on key policy questions.

The impact of tax incentives on tax revenue or investment will depend not only on the reduction in tax costs, measured through the ETR, but also on behavioural responses to these cost reductions, such as take-up rates or the success in creating additional investment. Evaluating these additional elements jointly with ETRs is key to accurately assessing the effectiveness and costs of tax incentives and supporting countries in making informed decisions on their tax incentive policies. Additional, non-tax related, policy instruments may be in place to support investment that are not included in the ETR measure.

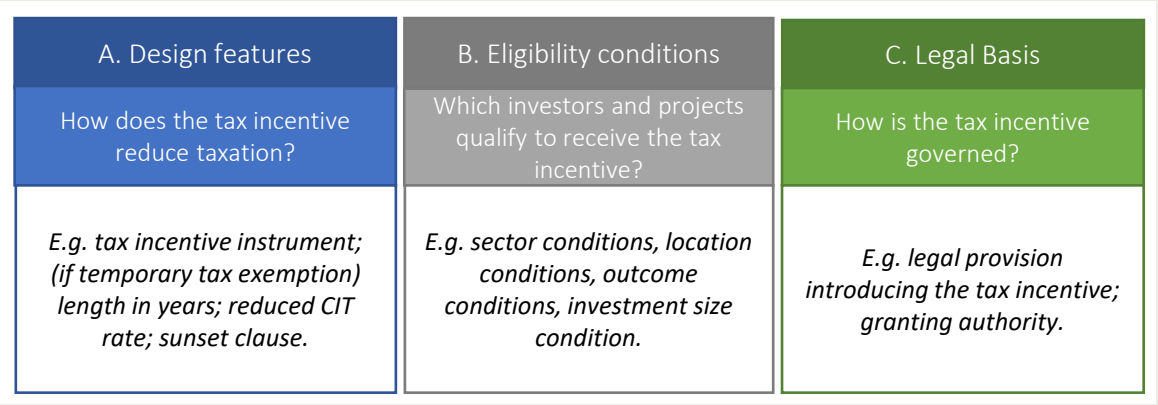
The paper proceeds as follows: Section 2 describes the scope of the analysis, providing definitions of tax incentive instruments, and identifies key design features. Section 3 discusses the integration of the main tax incentives in the general analytical framework of forward-looking corporate ETRs. Section 4 provides an empirical illustration of the analytical framework based on country-specific information for Angola, Botswana, Eswatini, Kenya, Mauritius, Senegal and South Africa.[3] It evaluates ETRs under investment tax incentives in two manufacturing sectors and in SEZs and discusses the impact of certain design features. Readers that are less familiar with the general framework are referred to Annex A, which provides a detailed introduction to the forward-looking ETR framework.

[3] Country coverage derives from the availability of country-specific data in both the OECD ITID and the OECD CTS database.

Box 1.1. Building an investment tax incentives database

The OECD *Investment Tax Incentives Database* (ITID) compiles quantitative and qualitative information on the design and targeting of investment tax incentives across countries, using a consistent data collection methodology. For each tax incentive, the database includes information on three dimensions (Figure 1.1): instrument-specific design features, eligibility conditions and legal basis.

Figure 1.1. Key dimensions covered in the OECD ITID



As of July 2021, the ITID includes investment tax incentives available in 36 developing countries in Eurasia, the Middle East, North Africa, Southeast Asia and Sub-Saharan African.[4] The ITID focuses on CIT incentives introduced through national-level legislation.

Celani, Dressler and Wermelinger (2022[3]) present the methodology and key classifications underlying the ITID and provide first descriptive statistics based on information from the 36 countries: Tax incentive designs are multi-dimensional, complex, and often specific to a certain sector, region or investor within a country. More precise targeting could help increase the effectiveness of tax incentives or limit revenue forgone. However, it often results in complex designs that make incentives less transparent for investors, the policymaker and general public.

Source: Authors based on Celani, Dressler and Wermelinger (2022[3]).

[4] As of July 2021, the database covers: Angola, Armenia, Azerbaijan, Belarus, Botswana, Brunei Darussalam, Cambodia, Côte d'Ivoire, Egypt; Eswatini, Ethiopia, Georgia, Ghana, Indonesia, Jordan, Kenya, Lao PRD, Lesotho, Madagascar, Malawi, Mauritius, Moldova (Republic of), Morocco, Mozambique, Myanmar, Namibia, Nigeria, Rwanda, Senegal, South Africa, Tanzania (United Republic of), Thailand, Tunisia, Ukraine, Zambia and Zimbabwe.

2 Scope of the analysis and definitions

Tax incentives can be described as targeted tax provisions that provide favourable deviations from the standard tax treatment in a country with the objective of encouraging a certain behaviour. Differing views exist on whether certain tax provisions constitute a tax incentive or are a part of the standard tax treatment in a country. Tax incentives considered in this work may take different forms, but share several common features: (i) they are targeted, i.e. available only to a specific group of taxpayers, for example based on the taxpayer's specific activity, sector, location or other investor- or project-specific characteristics; (ii) they result in reduced or postponed tax liability for the taxpayer and consequently forgone tax revenue for the government relative to a scenario without the incentive; and (iii) they aim to incentivise a certain behaviour, e.g. in the case of investment tax incentive. to encourage investment, including foreign direct investment (FDI), or influence the quality and outcomes of an investment.

The present analysis takes a country-specific perspective and defines tax incentives as targeted provisions that deviate from the national benchmark, i.e. from the standard tax rules that apply at the country level to taxpayers irrespective of specific investor- or project-specific characteristics. The approach does not aim to establish a cross-country benchmark to evaluate which provisions constitute a tax incentive and which provisions do not. Typically, standard tax systems differ across countries, meaning that investors may receive more generous standard tax treatment in one country compared to another. Cross-country differences in the standard tax treatment are not considered to be tax incentives in the context of this work.

The forward-looking ETR indicators developed in this work synthesise a country's preferential and standard tax treatment into a comparable measure, taking detailed aspects of incentive design and cross-country differences in tax policy into account (Box 2.1). The ETR indicators measure taxes due over the lifetime of a standardised investment project, expressed as a share of the investment's expected income. It allows an evaluation of how much a comparable investment project effectively pays in taxes across countries, sectors and activities, holding everything else equal. This characteristic helps to isolate the effects of tax incentives on the tax costs of an investment project and to illustrate the impact of specific design features on ETRs.

Box 2.1. How can forward-looking ETRs inform tax incentive design choices and analysis?

Tax incentives seek to incentivise investment by reducing taxation for certain activities, sectors or investors. Complex and multi-dimensional designs of tax incentives and tax systems complicate the comparison of these effects. Forward-looking ETRs can inform tax policy analysis and incentive design choices by answering the following two policy questions. First, when and how much tax benefit does a given tax incentive design provide to an eligible taxpayer compared to the standard tax system and to other tax incentive designs? Second, accounting for differences in country-specific standard tax systems and different aspects of incentive design, how do the effective tax costs compare across countries for a given investment project?

Comparing complex incentive design features

Forward-looking ETRs summarise multiple dimensions of tax incentive design features and allow comparing the tax costs for a given investment under different incentive schemes.

For example, how does (a) a 30% tax allowance on capital expenditure for industrial machinery compare to (b) a 10% reduced tax rate for steel production, or (c) a five-year full tax exemption on manufacturing activities in a specific region of the country? Figure 2.1 Panel A shows ETRs of a simplified investment project under the three incentive regimes holding the underlying standard tax system constant. The project becomes more profitable after tax in the case where the full tax exemption applies, as effective taxation is lowest. The tax exemption results in an ETR of 7% for the specific set of parameters chosen, while the reduced rate and the tax allowance result in an ETR of 10% and 20% respectively.

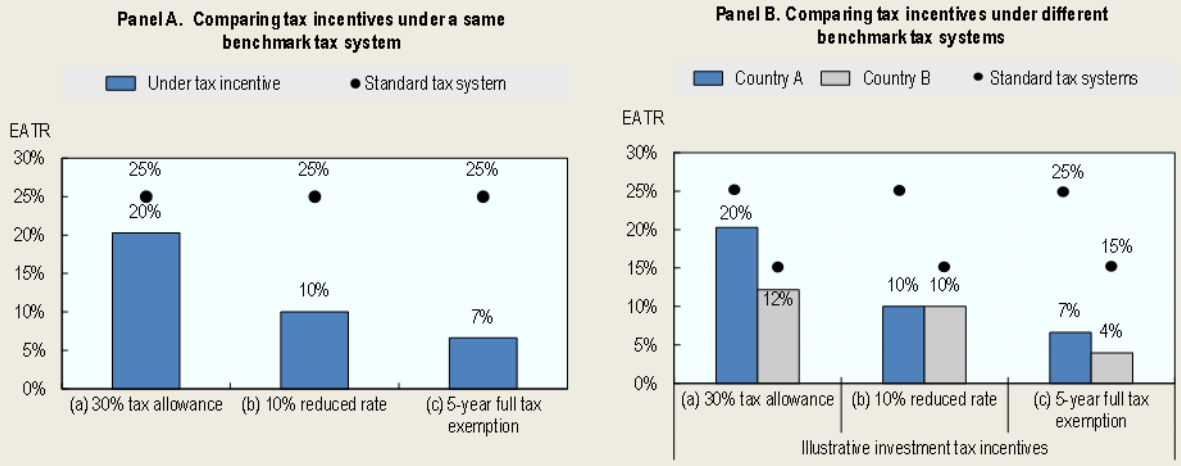
The illustration assumes that the three incentive regimes apply to an investment that is comparable before tax, that is, an investment yielding the same pre-tax return. It further assumes that investment takes place in one single asset type (i.e. industrial machinery) and that a simplified standard tax system applies (i.e. a 25% standard CIT rate with standard capital allowances aligning with economic depreciation).

Analysing the impacts of incentives on effective taxation across countries

Tax incentives do not arise in isolation; they apply in relation to the standard tax treatment of a country. When evaluating the generosity of incentives across countries, it is important to account for these different starting points.

Forward-looking ETR analysis captures the combined effects of tax incentives and the standard system from which they provide relief, thereby allowing for a comparison of the effective tax costs associated with a given investment across different investment locations. Figure 2.1 Panel B replicates the ETRs calculated from Panel A under two different standard tax systems. Effective taxation of an investment project does not only vary with the incentive design that applies, it also varies depending on the underlying standard tax system. For example, a 5-year tax exemption yields a higher gain in absolute terms for the investor in Country A where the standard CIT rate is 25% (18 percentage point reduction) compared to Country B with a 15% standard rate (11 percentage point reduction).

Figure 2.1. Effective tax rates under tax incentives for an illustrative investment



Note: EATR (Effective Average Tax Rate) modelled for investment in a capital asset that yields a constant 20% annual pre-tax rate of return and depreciates at an annual rate of 10%. Standard CIT rate is 25% in Country A and 15% in Country B. Capital cost recovery in Country A and Country B fully aligns with economic depreciation. The annual real interest rate is 3% and inflation is zero. The tax allowance applies in addition to standard capital allowance and tax exempt income qualifies for full standard allowances. Annex C presents the additional parameters used in the calibration.

Forward-looking ETRs are a useful indicator to compare the impact of tax incentives on effective taxation for a stylised investment. However, the actual impacts on tax revenue or investment will depend not only on the reduction in tax costs that are available to eligible taxpayers and measured through the ETR, but also on behavioural responses to these cost reductions, such as take-up rates or the success in creating *additional* investment.[5] Analysing such additional elements jointly with ETRs is key to accurately assessing the effectiveness and costs of tax incentives and supporting countries in making informed decisions on their tax incentive policies.

The analysis in this paper covers four investment tax incentives that provide relief against CIT: reduced rates, tax exemptions, tax allowances and tax credits. These are the most widely used instruments according to the OECD ITID. Table 2.1 provides the relevant definitions used in the present work. At the current stage, the analysis includes tax allowances and credits that provide relief on capital expenditures, as opposed to current expenditures.

[5] The sensitivity of investment flows to tax policy and tax incentives is likely to change across industries and firms (Zwick and Mahon, 2017[43]) and depends on additional circumstances and investment characteristics (e.g. profit rates, rents).

Table 2.1. Main corporate tax incentive instruments covered in the analysis

Incentive instrument	Definitions for the purpose of this work
Reduced rate	A reduced rate refers to a corporate income tax rate that is set below the standard rate. Reduced rates may apply on a temporary[1)] or permanent basis.
Tax exemption	Tax exemptions provide a full or partial exemption of qualifying taxable income. They may apply on a temporary[1)] or permanent basis. Qualifying taxable income may refer to income from specific sources (e.g. export income) or may not be restricted to particular income sources.
Tax allowance	Tax allowances for investment cover a variety of instruments.[2)] They are deductions from taxable income that relate to capital expenditures with a specific target (e.g. activity, firm, location or sector). Qualifying capital expenditures are generally asset-specific (e.g. machinery, buildings, equipment or land).[3)] Tax allowances as defined here differ from standard deductions and allowances, in that they are *targeted* to specific investments.
Tax credit	Tax credits are deductions from the amount of taxes due that relate to capital expenditures with a specific target (e.g. activity, business, location or sector). Qualifying capital expenditures are generally asset-specific (e.g. machinery, buildings, equipment).[3)]

Note: 1) The definition of temporary here refers to incentives that provide preferential treatment over a limited period in time by design, i.e. a specific period in which a tax exemption or reduced rate applies. It does not make a reference to the temporary nature of the incentive's legal basis, e.g. in cases where sunset clauses apply. The definition of permanent here refers to incentives that do not limit by design the period of the preferential treatment even if sunset clauses apply to the legal basis. Sunset clauses may apply to both temporary and permanent incentives.
2) The term tax allowance in this paper covers a variety of instruments that effectively set the schedule for writing-off capital expenditures of an investment or asset over a period of time. The generic term used here encompasses a variety of country-specific denominations, such as investment allowances, initial allowances, first-year allowances, increased depreciation rates, accelerated depreciation schedules etc. For the purpose of this paper, tax allowances only include targeted provisions that are more generous than the standard tax treatment while excluding standard capital allowances and deductions that are not specifically targeted based on project or investor or purpose specific characteristics.
3) Tax allowances and tax credits that apply to current expenditure (such as spending on training of workers, promoting exports at trade fairs, etc.) are not covered in the present analysis.

The tax incentives analysed in the paper are characterised by instrument-specific design features and additional provisions that apply across instruments. Table 2.2 and Table 2.3 summarises those features that are relevant in the calculations of ETRs.

Targeted tax allowances typically *accelerate* the rate at which capital expenditures can be deducted from taxable income compared to the standard depreciation schedule that applies for equivalent investments that are not eligible for the tax incentive. Tax allowances may also *enhance* deductions, allowing business to write-off more than 100% of the acquisition costs. Enhancement arises either explicitly through legal provisions, or as a result from interactions with other tax system features (e.g. when targeted allowances are granted on top of standard allowances). As noted above, the term tax allowance in this paper covers a variety of targeted instruments that effectively set the schedule for writing-off capital expenditures of an investment or asset over a period of time. In addition, tax allowances can prescribe very specific time-distributions for using the deductions (see Box 2.2 for examples).

Carryover provisions shape the value of investment tax incentives in providing tax relief and are typically country-specific. Carryover provisions can directly relate to tax incentives (incentive-specific carryover rules), i.e. they may allow firms to carryover the benefit from the incentive to different periods and are discussed in this paper. Such carryover provisions affect the overall tax benefit firms can obtain from a given investment tax incentive, depending on a firms' profit or loss position as well as on interactions with other elements of the corporate tax system. For example, investment tax incentives often concentrate tax benefits in the initial periods of an investment's lifetime. In the event that investment projects become profitable only after a number of years, they may achieve insufficient taxable income to absorb the full value of tax incentives in the fiscal period where the incentive is provided. As a result, the unused tax benefit from the incentive may be lost.

Table 2.2. Key design features of investment tax incentives

Instrument	Key design feature	Feature detail
Reduced rate	Qualifying income	All income Income from specific sources
	Degree of reduction	Applicable rate (in %)
	Duration[1)]	Permanent Temporary (duration in years)
	Tax treatment after incentive	Standard CIT rate Permanently reduced rate in % (applied after end of incentive period)
Tax exemption	Qualifying income	All income Income from specific sources
	Degree of exemption	0-100% of qualifying income
	Duration[1)]	Permanent Temporary (duration in years)
	Tax treatment after incentive	Standard CIT rate Permanently reduced rate in % (applied after the end of the incentive period)
Tax allowance	Qualifying expenditure	All capital expenditure Specific capital expenditure
	Allowance rate	0-100% of qualifying expenditure or enhancement (>100%) Time-distribution of the allowance
	Interaction with standard deductions and allowances	Tax allowance applies on top of standard allowances Tax allowance triggers a reduction in standard allowances
Tax credit	Qualifying expenditure	All capital expenditure Specific capital expenditure
	Credit rate	0-100% of qualifying expenditure

Note: Based on the main instruments and design feature identified through the OECD Investment Tax Incentives database.
1) The definition of temporary here refers to incentives that provide preferential treatment over a limited period in time by design, i.e. a specific period in which a tax exemption or reduced rate applies. It does not make a reference to the temporary nature of the incentive's legal basis, e.g. in cases where sunset clauses apply. The definition of permanent here refers to incentives that do not limit by design the period of the preferential treatment even if sunset clauses apply to the legal basis. Sunset clauses may apply to both temporary and permanent incentives.

Table 2.3. Provisions that may be available across instruments

Instrument	Key design feature	Feature detail
All covered instruments	Benefit limitations	Ceiling Sunset clauses
	Treatment of unused claims	Carryover provisions Refundability

Note: Based on the main instruments and design features identified through the OECD Investment Tax Incentives database.
Ceilings establish a cap on the amount of tax benefits that can be granted. Sunset clauses are provisions in a law or regulation stating that sections of it cease to have effect after a specific date, unless further legislative action is taken to extend them. Carryover provisions define whether and to what extent unused tax benefits can be carried forward, or backward. Refundability provisions allow unused tax benefits being transferred directly to the taxpayer, in full or partially.

Carryover provisions also exist in the context of standard tax provisions, e.g. carryover of standard capital allowances and standard loss carryover, but are not discussed in this paper. In cases where incentive-specific provisions do not allow for benefit carryover, it may be beneficial for taxpayers to postpone the use of their standard capital allowances if this is allowed for in the tax rules. Interactions between tax incentives

and carryover of standard capital allowances are further discussed in Section 3. Loss carryover is further discussed in Hanappi (2018[17]).[6]

Based on information from the OECD ITID, Table 2.4 presents the incentive-specific carryover provisions of the key instruments.

Table 2.4. Incentive-specific carryover provisions of tax benefit

Instrument	Benefit carryover provision
Reduced rate	Temporarily-reduced CIT rates do typically not involve carryover tax benefits.
Tax exemption	Benefits from temporary tax exemptions typically cannot be postponed and carried-over for use in future years.[1)]
Tax allowance	Tax allowances that result in enhanced deductions (where business is able to write-off more than 100% of the acquisition costs) often apply with carryover provisions that limit the number of years in which the incentive may be used.[2)] Tax allowances that are not enhanced typically apply under the same carryover rules as standard capital allowances.
Tax credit	Tax credits may or may not apply with carryover limits, or may be refundable.

Note: 1) Tax exempt income may have different interactions with standard capital allowances and eventual declared losses, which differ from the design considerations discussed in this table.
2) For example, Senegal's 30-70% tax allowance on large investments can be carried forward for 5 or 10 years and the 30% tax allowance for renewable energy expenditure can be carried over until the allowance is fully used. South Africa's Section 12I tax allowance (available until 31 March 2020) could be carried forward for three years and Egypt's special regime allowance can be carried forward for seven years (Egypt Investment Law of 2018).

[6] As discussed by Hanappi (2018[17]), the ETR framework can be adapted to model the interaction of investment tax incentives and loss carryover provisions, by taking into account loss-making firms. Net operating losses may or may not be carried forward depending on the underlying tax provisions and investor decisions. Hanappi (2018[17]) analyses the effect of loss carryover provisions on the tax base. This may be particularly relevant for newly-established business, including SMEs. It may also benefit businesses investing projects that are likely to yield returns only over long periods.

Box 2.2. The time distribution of tax allowances: examples from the seven countries

Tax allowances differ in how they prescribe the time distribution of the deductions. For example, *initial* allowances concentrate deductions in the first year of an asset's useful life. They can go from providing partial deductions of expenditures (<100% of acquisition costs), up to full expensing (100% of acquisition costs) and even enhancement (>100% of acquisition costs). For example, Botswana and Eswatini provide sector-specific full expensing of capital expenditures in the first year for farming and mining investments. Enhancement can either be achieved explicitly through the legal provision, or result from interactions with other tax system features (e.g. when targeted allowances are granted on top of standard allowances). For example, Mauritius provides a 200% tax allowance for certain qualifying capital expenditure in the initial year and South Africa a 112% allowance for qualifying gold mining expenditures. By comparison, Senegal's tax allowance scheme combines a 30% initial allowance that applies in addition to the 100% regular deduction under the standard capital allowance schedule.

Beyond initial allowances, different time distributions may be prescribed in the law. Angola's special regime accelerates capital write-off by allowing a firm to expense capital through standard capital allowances 50% higher in the initial 4 years after the investment occurs, i.e. as opposed to a higher rate in only the first year. South Africa implements specific accelerated depreciation schedules for machinery used for the production of bio-fuels or generation of electricity from renewable sources, namely a 50-30-20 schedule compared to a 40-20-20-20 schedule that applies to machinery used in other activities.

3 Investment tax incentives and corporate ETRs

This section provides a formal discussion of how investment tax incentives can be incorporated in the standard ETR framework. Section 3.1 introduces the ETR modelling framework and derives the key equation that is necessary to formally integrate the tax incentives described in Section 2: reduced CIT rates (Section 3.2), CIT exemptions (Section 3.3), tax allowances (3.4) and tax credits (Section 3.5). Annex A provides an in-depth description of the modelling framework.

3.1. The forward-looking ETR framework in the context of investment tax incentives

The standard theoretical framework to model forward-looking ETRs was developed by Devereux and Griffith (1999[4]; 2003[5]). This framework has been widely used and adapted to analyse effective taxation across a range of countries, firm types and policies. It is also the basis for the ETR data series that are maintained by the Oxford Centre for Business Taxation (Bilicka and Devereux, 2012[18]), the Centre for European Economic Research (Spengel and et al., 2016[19]) and others. In addition, national authorities often apply this framework to evaluate corporate tax reforms. The OECD model underlying the ETR data series in the OECD CTS builds on a similar theoretical framework and incorporates several additional modelling features (Hanappi (2018[7]) and OECD (2021[8])). The OECD model retains the flexibility to address emerging tax policy issues (Hanappi, 2018[17]; Dressler, Hanappi and van Dender, 2018[20]; Hanappi and González Cabral, 2020[21]), as well as country-specific tax policy questions (OECD, 2017[22]). A detailed description of the ETR framework is provided in Annex A. It presents the relevant features of the OECD model as well as the key equations required for the modelling of targeted investment tax incentives.

When integrating investment tax incentives in the standard analytical framework, two considerations deserve particular attention. First, the present analysis focuses on discrete investment decisions. It considers investors that evaluate mutually exclusive projects, e.g. in different locations. The forward-looking effective average tax rate (EATR) is the main tax policy metric of interest in this context, as further discussed in Annex A. EATRs summarise the effect of taxation on the decision to invest in comparable but mutually exclusive projects, assuming that investment projects earn economic rents over their lifetime.[7] EATRs can be used to assess the extent to which tax incentives provide relief from taxation when investing in one project as opposed to another, holding other project-specific characteristics equal.[8]

[7] The rent of an investment project is defined over the entire lifetime of an asset. Losses or zero profits in certain periods can be accommodated in the model, e.g. losses in the initial periods of the investment.

[8] Another indicator, the forward-looking effective marginal tax rate (EMTR) provides a complementary view to the EATR. It evaluates investment decisions at the intensive margin, that is, on how much to invest once the location has been defined, focusing on marginal projects earning zero economic rents.

Second, the temporary nature of some investment tax incentives requires a specific approach to investment decisions when calculating the ETR. Evaluating all relevant instruments in one encompassing framework requires a specific modelling choice regarding investment and disinvestment decisions: the permanent investment case (PIC). Many applications of the ETR framework assume that the firm makes an investment in the first period and fully divests in the second period (one-period investment case, OPC). The standard ETR framework assumes that the standard CIT rate is known to the firm and is *a priori* not expected to change over the lifetime of the investment project.[9] However, investment tax incentive regimes may introduce preferential tax rates on a temporary basis, such that firms know in advance how the applicable tax rates will change over the course of their investment project. Accommodating varying tax rates over the course of an investment project requires use of the permanent investment assumption instead of the one-period case. Using the PIC instead of the OPC is a straightforward adaptation of the standard model as further discussed in Annex A, which derives key equations for the PIC and discusses its relationship with the OPC.

The starting point for modelling investment tax incentives through ETRs is the investor's economic rent and the calculation of total taxes due related to the investment project. The economic rent ($\boldsymbol{R}$) equals the sum of post-tax profit in each period (R_t) over the lifetime of the investment project brought to net present value (NPV) using the nominal interest rate (i), $\boldsymbol{R} = \sum_{s=0}^{\infty} \frac{R_{t+s}}{(1+i)^{t+s}}$.[10] The economic rent can be decomposed into three separate terms:

$$\boldsymbol{R} = \sum_{s=0}^{\infty} \frac{Q_{t+s}}{(1+i)^s} - \sum_{s=0}^{\infty} \frac{\tau_{t+s}[Q_{t+s} - Z_{t+s}]}{(1+i)^s} - \sum_{s=0}^{\infty} \frac{I_{t+s}}{(1+i)^s} \tag{3-1}$$

The first term of equation (3-1) captures the NPV of the investor's revenues net of variable costs, Q_t. The second term captures the NPV of taxes due considering the applicable tax rate, τ_t, and taxable income per period (i.e. net revenue, Q_t, minus available standard capital allowances under standard tax treatment, Z_t). The third term is the NPV of investments as well as potential disinvestments in later periods, such as asset sales. Annex A provides a detailed step-by-step derivation of equation (3-1) and further explanation on key variables.

The second term capturing the NPV of taxes due, henceforth $\boldsymbol{T}$, deserves particular attention as it facilitates the modelling of different types of investment tax incentives.

$$\boldsymbol{T} = \sum_{s=0}^{\infty} \frac{\tau_{t+s}[Q_{t+s} - Z_{t+s}]}{(1+i)^s} \tag{3-2}$$

Different instruments affect $\boldsymbol{T}$ via different channels as will be discussed below. A formal discussion of each tax incentive instrument is presented individually. Interactions among the different instruments (i.e. taxpayers benefiting from multiple incentives at the same time) may exist and can be complex depending on country-specific rules, but are not discussed here. The most prevalent design features for each incentive instrument are identified in the OECD ITID (Box 2.1).

[9] In reality, the standard CIT rate may change *ex-post* during the project lifetime; however, when taking the investment decision the firm is not able to predict future tax policy changes with certainty and it is assumed that firms will consider the current standard CIT rate as the relevant benchmark for forward-looking investment decisions.

[10] The notation in this paper uses bold uppercasing for variables that denote the NPV of a cash flow stream starting from the period in which the investment occurs (period 0, denoted by $s = 0$ where s is the index of summation). Non-bold uppercasing refers to a period specific cash flow in its current value, where the period is specified by the subscript t. For example, R_3 denotes the post-tax profit in the 3rd period after the investment occurs. The NPV of a cash flow stream equals the sum of all period-specific cash flows brought to present value, using the relevant discount rate. Economic rent uses the nominal interest rate (i) for discounting.

The analysis differentiates between standard and preferential tax treatment. Here, the standard tax treatment captures, for example, the standard CIT rate and all allowances and deductions that are not targeted, but are available to firms irrespective of their sector of activity or any other investor- or project-specific characteristics. Preferential tax treatment corresponds to instruments targeted to specific policy objectives, which apply to specific firms or investment on top of the standard rules. The remainder of this section discusses targeted investment tax incentives, taking standard capital allowances, captured in Z_t, as given. It only elaborates on potential interactions between standard allowances and investment incentives where relevant. Annex A, as well as Hanappi (2018[7]) and Gonzalez Cabral, Appelt and Hanappi (2021[11]) provide additional detail on Z_t. Standard tax provisions are identified through the OECD CTS database (Hanappi, 2018[7]; OECD, 2021[8]).

Based on equation (3-1) the EATR is calculated as the difference in pre-tax economic rent ($\boldsymbol{R}^*$)[11] and post-tax economic rent ($\boldsymbol{R}$) divided by the NPV of pre-tax net income ($\boldsymbol{Y}^*$):[12]

$$\boldsymbol{EATR} = \frac{\boldsymbol{R}^* - \boldsymbol{R}}{\boldsymbol{Y}^*} \tag{3-3}$$

3.2. Reduced CIT rates

A reduced rate refers to a CIT rate set below the standard rate. Rates may be reduced on a permanent or a temporary basis. Permanently reduced CIT rates typically target specific sectors, locations or activities. For example, a lower CIT rate may apply over the lifetime of an investment inside a Special Economic Zone (SEZ) or on investments in the agricultural sector compared to other activities. Temporarily reduced CIT rates apply over a limited period of time (e.g. a lower CIT rate applies for a five-year period).

Temporarily and permanently reduced CIT rates are used respectively by 50% and 53% of the 36 countries covered in the OECD ITID (Celani, Dressler and Wermelinger, 2022[3]). Countries that apply preferential CIT rates generally do not reduce them to a zero rate. Overall, only 7% of the temporarily and permanently reduced CIT rates in the ITID were zero rates. Rate reductions to zero have a similar effect on taxes due as full tax exemptions, but provide relief via different mechanisms, as can be seen from the difference between equations (3-4) and (3-6). Temporarily reduced CIT rates typically apply immediately after the period in which investment is undertaken.

3.2.1. Permanently reduced CIT rates

Permanently reduced rates can be integrated into the analytical framework by substituting the standard CIT rate for the reduced CIT rate ($\tau^{reduced}$) in each period over the lifetime of the investment.

$$\boldsymbol{T} = \sum_{\boldsymbol{s=0}}^{\infty} \frac{\tau^{reduced}[Q_{t+s} - Z_{t+s}]}{(1+i)^s} \tag{3-4}$$

[11] Pre-tax rent can be derived from equation (3-1) by setting all tax system parameters to zero.

[12] The NPV of pre-tax net income ($\boldsymbol{Y}^*$) differs from pre-tax economic rent ($\boldsymbol{R}^*$) in that the latter is defined as net of the economic depreciation of the asset and of investment investments. See more details and equation (A-8) and (A-9) in Annex A.

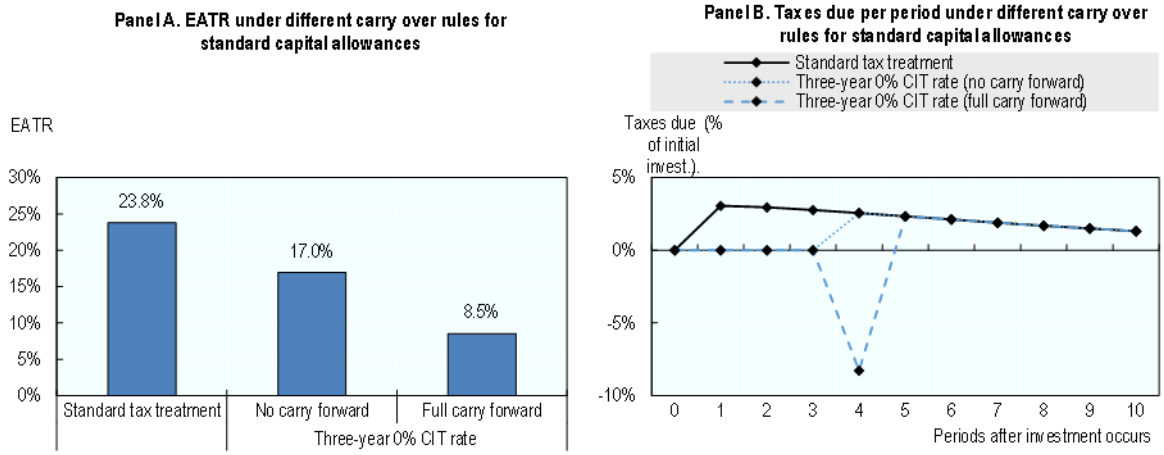
3.2.2. Temporarily reduced CIT rates

Modelling temporarily reduced CIT rates implies that firms expect CIT rates to vary over the lifetime of the investment and therefore become period-specific (τ_t). For example, consider a firm is taxed at a temporarily reduced CIT rate ($\tau^{reduced}$) for x years after the investment occurs, while the standard rate ($\tau^{standard}$) applies as of year $x+1$.[13] Under such preferential tax treatment the NPV of taxes due can be shown as:

$$\boldsymbol{T} = \sum_{s=0}^{x} \frac{\tau^{reduced}[Q_{t+s} - Z_{t+s}]}{(1+i)^s} + \sum_{s=x+1}^{\infty} \frac{\tau^{standard}[Q_{t+s} - Z_{t+s}]}{(1+i)^s} \tag{3-5}$$

Reduced CIT rates not only reduce taxes due on net revenue before deductions (τQ_t), but they also reduce the value of standard allowances in the given period (τZ_t) compared to a situation where the full rate applies. Such interactions of reduced rates with standard capital allowances can restrict the additional tax benefit from a reduced CIT rate, particularly in situations where standard allowances are generous. The effect is limited, when investors can carryforward standard allowances and deduct them against income in periods where the full CIT rate applies, and results in a more generous benefit by combining lower tax rates on income with capital allowances valued at higher tax rates.

Figure 3.1. Effective average tax rates under a three-year zero rate and different assumptions on standard capital allowance use



Note: EATR modelled for investment in a capital asset that yields a constant 20% annual pre-tax rate of return and depreciates at an annual rate of 10%. Standard CIT rate is 25% and capital cost recovery aligns with economic depreciation. The annual real interest rate is 3% and inflation is zero. The calculation assumes that the investor is not tax exhausted, i.e. that they can fully use available deductions when they become available, which explains the negative value of taxes due in period 4 in Panel B. *Full carryforward* considers a case where standard capital allowances are carried forward to be fully deducted once the standard CIT rate applies. *No carryforward* assumes standard capital allowances must be deducted in the period in which they arise. Annex C presents the additional parameters used in the calibration.

Provisions prescribing the carryover of standard capital allowances can significantly affect the size of the tax benefit provided through reduced rates. Figure 3.1, Panel A presents EATRs for a simplified investment project under standard tax treatment and under a zero CIT rate that applies in the first three years of the project. It considers two cases of carryforward provisions in the tax incentive scenario. In the first case, investors immediately deduct the available standard allowances (no carryforward). In the second case, investors carryforward the allowances and deduct them against income in the first period in which the

[13] Other cases may arise, for example, situations in which more than two temporarily reduced CIT rates apply sequentially. Various reduced CIT rates sometimes apply sequentially and progressively raise the applied CIT rate to the headline rate.

standard rate applies (full carryforward). The example shows that the zero CIT rate reduces the EATR substantially compared to the EATR under standard tax treatment (23.8%), but to a much more significant extent when full carryforward is available (8.5%) compared to the case of no carryforward (17%).

Panel B shows how tax liability evolves over time and provides some explanation of the different channels at play. It also provides insights about the timing when governments could expect forgone tax revenue to arise. The solid black line shows taxes due under standard tax treatment and the dotted lines when the same investment benefits from a zero CIT rate in periods 1-3. Under full carryforward of standard allowances (blue dashed line), firms do not lose the standard allowances accrued in period 1-3 but use them in future periods (here in period 4). What is more, the forwarded allowances yield an additional benefit as they are valued at the relatively higher standard CIT rate. For comparison, the blue dotted line depicts taxes due for a case with no carryforward of standard allowances. Note that tax liability in period 4 is allowed to become negative under the assumption that the investor can fully use all deductions when they become available, for example, by offsetting income from other sources (i.e. the investor is not tax exhausted). The accumulated deductions exceed net revenue in the specific example and a re deducted against income derived from other activities by the same investor.

Considering the evolution of taxes due in the two extreme cases of benefit carryforward, Panel B also demonstrates how other investor and project characteristics can influence the opportunity to benefit from tax incentives. In this illustrative example, projects that require deep capital investments and which have little or no taxable income in the early periods where the zero rate applies, will not be able to gain the same advantage from the incentive as projects with taxable income in the first periods. This may be the case when carryforward of capital allowances is restricted and when the business is effectively tax exhausted, i.e. when it does not generate enough revenue to take advantage of the full value of allowances and cannot offset income from other sources.

3.3. CIT exemptions

CIT exemptions exclude a share of qualifying income from taxation. Full exemptions allow the qualifying income to be fully deducted from the tax base (i.e. 100% of the qualifying income), while a partial exemption allows only a share of qualifying income to be deducted (e.g. 50% of the qualifying income).

Additional design dimensions of CIT exemptions concern the type of income targeted by the instrument and its duration. Qualifying income may refer to a business' income from any source (i.e. all income) or be specific to certain income sources (e.g. income from exports or sales of agricultural products). In addition, tax exemptions can apply on a permanent basis (i.e. throughout the lifetime of the investment) or on a temporary basis (i.e. for a specific period of time).

Information from the OECD ITID shows that 25 out of 36 countries implement CIT exemptions. Permanent exemptions typically do not apply to all income, but focus on specific income sources and involve additional targeting, such as taxpayer, sector or location conditions (e.g. a permanent CIT exemption may apply to export income of firms located within SEZs). Temporary exemptions, on the other hand, often apply to all income independent of the source and involve additional conditions (e.g. a 5 year exemption for businesses that invest at least USD 50 million). Temporary CIT exemptions that allow qualifying income to be fully deducted are commonly referred to as tax holidays[14] and are the most common type of exemption identified in the database. Overall, they cover 83% of all CIT exemptions in the database.

[14] Typically, the term 'tax holidays' refers either to temporary full tax exemptions or to temporarily reduced zero CIT rates. This paper avoids the term 'tax holiday' to avoid confounding two incentive instruments that may reduce effective taxation via different channels.

3.3.1. Full versus partial exemptions and qualifying income

Tax exemptions can be integrated into the analytical framework considering that they reduce the income on which taxes are paid in each period. How much income is exempt in each period depends, first, on the degree, $\vartheta_t \in [0;1]$, to which the exemption applies (where $\vartheta_t = 1$ denotes a full exemption and $\vartheta_t < 1$ a partial exemption) and, second, on the share of qualifying income, $d_t \in [0;1]$,[15] that is targeted (where $d_t = 1$ indicates that the exemption applies to all income and $d_t < 1$ indicates that only a share of qualifying income is exempt from taxation).[16]

The amount of the tax exempt income in each period equals the product of the two rates and net revenue, $\vartheta_t d_t Q_t$. Consider a firm that obtains 30% of its revenue from exports in a given period and qualifies for a 50% tax exemption on its export income. The amount of the exempt income equals 15% of the firm's net revenue in the given period.

3.3.2. Permanent versus temporary exemptions and standard allowances

Tax exemptions imply that taxable income is reduced by the amount of the exemption as outlined in equation (3-6). Permanent exemptions yield a constant degree of exemption throughout the lifetime of the investment ($\vartheta_t = \vartheta \ \forall t \geq 0$).

$$\boldsymbol{T = \sum_{s=0}^{\infty} \frac{\tau[(1 - d\vartheta)Q_{t+s} - Z_{t+s}]}{(1+i)^s}} \qquad \textbf{(3-6)}$$

The interaction of tax exemptions with standard capital allowances can substantially affect the additional benefit from introducing a tax exemption depending on country specific tax rules.[17] The present case assumes that standard capital allowances are authorised (Z_t) when tax exemptions apply such that firms have the opportunity to accumulate benefits from both tax provisions. In contrast, tax rules may prescribe that standard capital allowances are proportionally reduced or waived when tax exemptions apply. For example, in cases where standard capital allowances are reduced at a rate that is proportional to the value of the exemption, the equation would be adapted as follows: $\boldsymbol{T = \sum_{s=0}^{\infty} \frac{\tau[(1-d_t\vartheta_t)(Q_{t+s}-Z_{t+s})]}{(1+i)^s}}$.[18]

The additional tax benefit from implementing tax exemptions in the presence of standard capital allowances also depends on country-specific carryover rules. In the most generous case, standard capital allowances may be inflation-adjusted and carried forward until fully utilised. Therefore, a temporary tax exemption would not limit the benefit from standard capital allowances. In the opposite case, where unused standard capital allowances cannot be carried forward, standard allowances that accrue during an exemption period will be forgone, limiting the additional tax benefit provided through the exemption.

Similarly to reduced rates, investor and project characteristics matter for the actual tax benefit that a business enjoys when receiving a tax exemption. These aspects are not discussed in detail in this paper

[15] The share of qualifying income relates to the income mix of a firm or an investment project (e.g. for an exemption targeting income from exports a certain share of total revenue will be attributed to the exporting activity) and will enter the calculations exogenously.

[16] For comparability reasons, the share of qualifying income is considered to be constant over time.

[17] For example, Mauritius does not authorise standard capital allowances on expenditure incurred when generating tax-exempt income (Income Tax Act of 1995, article 26(1)(b)). In Eswatini, tax-exempt income in SEZs benefits from a standard capital allowance during the exemption period only for buildings, green technology and R&D, but not industrial machinery (Special Economic Zones Act of 2018, section 20 and first schedule). In Senegal, partially exempt income that benefits from article 253 is considered to also benefit from capital allowances.

[18] The accumulation of benefits could also imply that the capital allowances can be carried forward (adjusted for inflation and the risk-free interest rate) and subsequently deducted against future taxable income at the standard CIT rate.

but understanding them is necessary when designing incentives. For example, whether an investor can expect taxable income or not during the period in which income is exempt will significantly affect the ETR in particular when carryforward is restricted. Similarly, whether an investor can use the tax benefit against other income and how the income mix of the project varies, will change the overall tax benefit of the project

To model temporary exemptions, a period-specific exemption rate applies (ϑ_t) that varies over the lifetime of the investment. Temporary exemptions typically immediately follow the period in which a new capital investment is undertaken. For example, consider a firm that receives a CIT exemption on all income ($d_t = 1$) that is partial and applies for x years after the investment occurs ($\vartheta_t = \vartheta^{holiday}\ \forall t \leq x$), while no exemption applies after that period (ϑ_t=0 $\forall t > x$) and assume that standard capital allowances are authorised when tax exemptions apply. Under such a preferential regime total taxation can be calculated by separating tax payments into the periods when the exemption is available and the periods where no exemption applies.

$$\boldsymbol{T} = \sum_{s=0}^{x} \frac{\tau[(1-\vartheta^{holiday})Q_{t+s} - Z_{t+s}]}{(1+i)^s} + \sum_{s=x+1}^{\infty} \frac{\tau[Q_{t+s} - Z_{t+s}]}{(1+i)^s} \tag{3-7}$$

3.4. Tax allowances

Tax allowances[19] allow firms to deduct a higher share of qualifying investment expenditures in the initial periods than would be possible under standard treatment; i.e., leading to an 'accelerated' cost recovery compared to the standard treatment. In the context of the present analysis, tax allowances refer exclusively to targeted allowances that are directed towards, for example, specific sectors (e.g. textiles), locations (e.g. SEZs or areas in specific need), firms (e.g. small and medium-sized enterprises), activities (e.g. R&D), assets (e.g. machinery used for renewable energy generation) or destination of sales (e.g. exports). They exclude standard capital allowances, irrespective of how these compare to real economic depreciation.

Targeted tax allowances accelerate the rate at which capital expenditures can be deducted from taxable income relative to the rates that apply for equivalent investments that are not eligible for the tax incentive. Tax allowances may also enhance deductions beyond the initial acquisition value, allowing firms to write-off more than 100% of the associated expenditures. As with all tax deductions, their value is a function of the applied CIT rate. This differs from tax credits, which provide a deduction from total taxes due, and are discussed in Section 3.5. There are 23 of 36 countries in the OECD ITID that apply at least one tax allowance (Celani, Dressler and Wermelinger, 2022[3]).

Equation (3-8) introduces tax allowances into the standard framework, where a_t denotes the share of the qualifying capital expenditure eligible for deductions and I_0 the qualifying capital expenditure i.e. initial capital investment.[20]

$$\mathbf{T} = \sum_{s=0}^{\infty} \frac{\boldsymbol{\tau}[\boldsymbol{Q_{t+s}} - \boldsymbol{Z_{t+s}} - \boldsymbol{a_{t+s}I_0}]}{(\mathbf{1}+\boldsymbol{i})^s} \tag{3-8}$$

For simplicity, equation (3-8) assumes that the tax allowance will be fully used once it becomes available, denoting an upper bound of the tax benefit from tax allowances. In cases where the tax rules allow

[19] The term tax allowance in this paper covers a variety of instrument designs that effectively set the schedule for writing-off capital expenditures of an investment or asset over a period of time. The generic term used here encompasses a variety of country-specific denominations, such as tax allowances, initial allowances, first-year allowances, accelerated depreciation, etc.

[20] Instead of using qualifying capital expenditure as a base, tax allowances may use alternative bases, e.g. depreciation allowances.

deductions beyond the initial acquisition value, the sum of a_t over time may exceed 100% (enhanced deductions). Depending on the economic context and business decisions, restrictions to carryover provisions may limit the tax benefit and result in a value of the tax incentive that is lower than the maximum value shown in the equation. Legal provisions may prescribe very specific time distributions for using the allowance, e.g. using initial allowances (see Box 2.2).

The extent to which the value of the targeted tax allowance is used also depends on country-specific interactions with standard allowances and other tax system features. Targeted allowances may either come on top of standard capital allowances, allowing the accumulation of tax benefit from both provisions, or could yield a proportional reductions of standard allowances. Most tax allowances covered in the OECD ITID involve a corresponding reduction of the remaining asset value that is to be depreciated under standard fiscal depreciation rules. Consider an investor who makes full use of a targeted tax allowance that is equivalent to 30% of the asset's cost in the first year after the investment. From the following period onwards, the investor would continue to deduct the standard fiscal depreciation allowance considering only 70% of the initial investment as a basis.

Targeted tax allowances sometimes also apply on top of standard capital allowances, thereby increasing the value of overall deductions beyond the acquisition cost of the asset. This is the case for a third of all countries that use tax allowances and are covered in the OECD ITID. Through combining standard and targeted allowances, an investor may effectively deduct more than the total cost of the capital asset over the asset's lifetime.

To illustrate the interactions of tax allowances with standard capital allowances, Figure 3.2 represents the taxes due of a simplified investment period-by-period as a black diamond (T_t). T_t in equation (3-2) is given by net revenues minus allowances available in the period (which are depicted by the grey and blue bars respectively), valued at the applicable tax rate. Available allowances include both standard capital allowances and the targeted allowances. The sum of the black diamonds over the lifetime of the investment project brought to net present value ($\boldsymbol{T}$) is used in the EATR calculation.

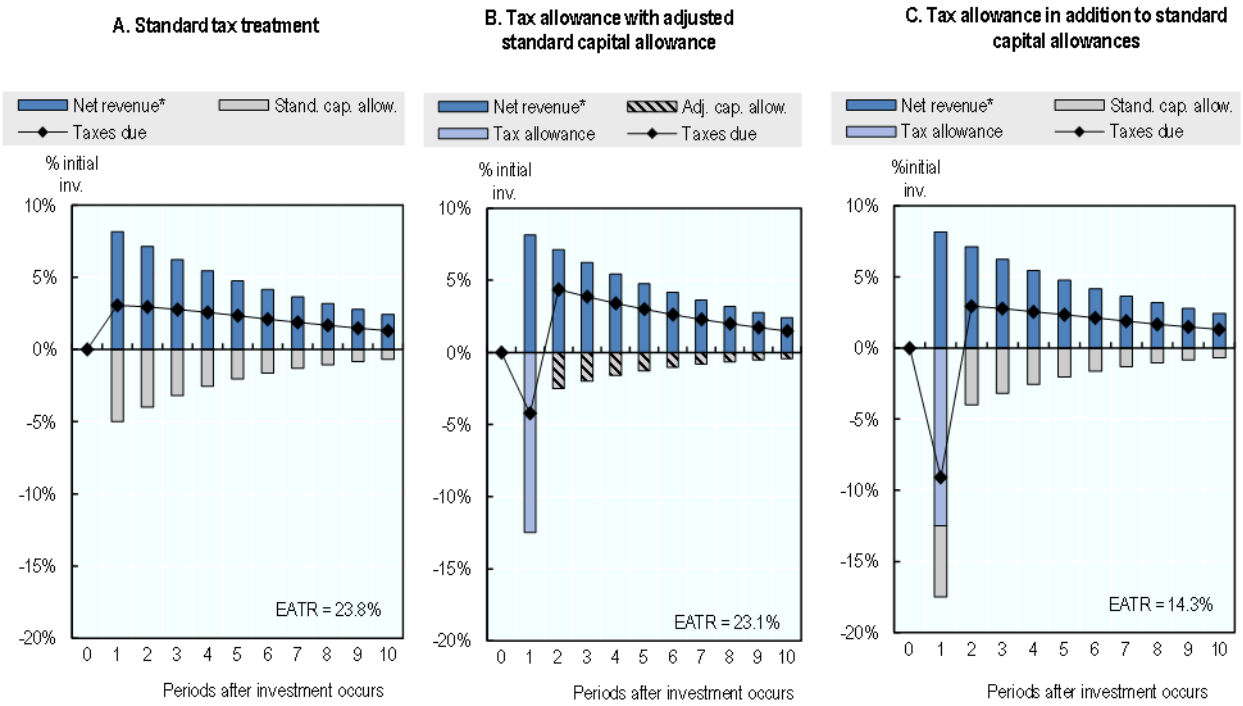
Panel A presents the baseline case: considering an investment under standard tax treatment where the standard CIT rate and standard capital allowances apply. Panel B shows the effects of a 50% tax allowance that triggers a proportional reduction in the standard capital allowance. Panel C models the same 50% tax allowance, assuming it applies in addition to the standard capital allowance. For simplicity it is assumed that the allowance can be (and is) immediately used once it becomes available (i.e. the investor is not tax exhausted or full and inflation-adjusted carryover is possible).

This illustrative example shows that policy design decisions on how targeted and standard allowances interact can significantly influence the effect of investment tax incentives in practice. The EATR differs widely under the two designs and ranges from 14.3% in Panel C to 23.1% in Panel B (compared to a 23.8% in the baseline case) which is solely driven by the difference in the interaction. Note that per-period standard allowances are the same in Panel A and C. No standard allowance applies in the first year in Panel B and the standard allowances in each of the following periods are smaller compared to those in Panel A and C. This is driven by the design feature that the incentive triggers a corresponding reduction in the basis used to determine standard fiscal depreciation, by the value of the targeted allowance (i.e. 30%).

Beyond the incentive-specific and standard tax system features discussed here, the actual benefit from the tax allowance will also depend on investor- and project-specific characteristics. This means that investors with little or no income in early years, or tax exhausted investors, who do not generate enough revenue to deduct the full value of the allowance and cannot offset income from other sources, may only benefit from the allowance to a limited extent if no carryover exists. Also country-specific features such as interest and inflation rates will have an effect on the ETR.

Figure 3.2. Tax allowances for investment and their interactions with standard capital allowances

Black diamonds represent taxes due in each period and the bars are its components



Note: *Net revenue = Revenue net of variable costs; Stand. cap. allow. = Standard capital allowance; Adj. cap. allow = Adjusted capital allowance. EATR modelled for investment in a capital asset that yields a constant 20% annual pre-tax rate of return and depreciates at an annual rate of 10%. Standard CIT rate is 25% and capital cost recovery aligns with economic depreciation. It is assumed that the investor is not tax exhausted, i.e. that they can fully use available deductions when they become available. The annual real interest rate is 3% and inflation is zero. Annex C presents the additional parameters used in the calibration.

3.5. Tax credits

Investment tax credits are deducted from the tax liability associated with the investment. Typically, the credit is determined as a fixed percentage of the initial capital expenditure. Investment tax credits are less widely used in developing economies, having only been identified in 5 out of 36 countries in the OECD ITID (Celani, Dressler and Wermelinger, 2022[3]).

Equation (3-9) outlines how the investment tax credit can be integrated in the analytical framework, where $c_t < 1$ is the credit rate, t is the period the credit becomes available to the investors and I_0 is the qualifying capital expenditure, i.e. the initial capital investment.

$$\mathbf{T} = \sum_{s=0}^{\infty} \frac{\tau[Q_{t+s} - Z_{t+s}] - c_t I_0}{(1+i)^s} \tag{3-9}$$

Investment tax credits reduce tax liability directly (i.e. net of standard allowances and deductions) and are independent from other tax provisions.

For simplicity, equation (3-9) assumes that the investor is not tax exhausted, but can use any available credit when it becomes available (e.g. in activities other than the one directly related to the investment). In cases where tax liability is lower than the value of the credit and a business is not able to use the credit

value for other activities, parts of the credit may be lost. Country-specific rules such as specific provisions on the refundability of credits and the carryover of unused credits (including inflation adjustments) may exist and can be modelled for the purposes of the empirical calibration.

4 An application to seven Sub-Saharan African countries

This section illustrates the use of ETRs for analysing investment tax incentives, including in country and regional case studies, and how they can improve the understanding and the design of these incentives. It applies the analytical framework described in Section 3to investment tax incentives in seven countries in Sub-Saharan Africa (SSA), namely: Angola, Botswana, Eswatini, Kenya, Mauritius, Senegal and South Africa.[21] The section compares ETRs under common targeting strategies across the seven countries, namely sector-specific and SEZ-specific incentives, and provides examples of how design choices can intentionally or unintentionally affect the generosity of tax incentives, namely ceilings and limitations to benefit carryover.

ETR estimates presented in this section show EATRs considering the same simplified investment project (an investment in industrial machinery) throughout the calculations. Economy-specific conditions (such as discount rate and inflation) and investment-specific parameters (such as profitability, economic depreciation) are held constant across countries, sectors and activities and over the lifecycle of the investment project. Box 4.1 describes the main modelling assumptions. Additional information on asset-mixes of investments, project or investor parameters, and country-specific macroeconomic conditions can be incorporated into the model calibration. This can be used to address granular sector- or country-specific tax policy questions.[22]

Section 4.1 provides an overview of the main investment tax incentives available in the seven countries. Section 4.2 presents and analyses the impact of tax incentives on EATRs in two manufacturing sectors (the food and automotive industries) and in SEZs.[23] Throughout, the analysis discusses how key design features can intentionally or unintentionally affect EATRs.

[21] The seven countries were selected based on data availability. They are covered in both the OECD CTS and the OECD ITID databases, thereby ensuring that the necessary information to calculate forward-looking ETRs is available: standard tax system features and targeted investment tax incentives.

[22] Real investment projects are composed of asset mixes (including buildings, machinery, equipment) and that may vary according to the sector of activity. Similarly, countries' economic and profitability conditions often differ. Holding these parameters constant controls for country- and asset-specific variation and allows the derivation of general conclusions about how tax incentives and specific design features affect ETRs.

[23] In this section, automotive industry refers to the economic activities under division 29 of the International Standard Industrial Classification of All Economic Activities (ISIC) revision 4, which includes the manufacture of motor vehicles, trailers, semi-trailers, and parts and accessories for motor vehicles.

Box 4.1. Data sources and modelling assumptions used in the ETR estimates

ETR calculations in this section use data on standard tax system features and investment tax incentives from the OECD CTS database and the OECD ITID, respectively.

ETR calculations involve multiple assumptions on macroeconomic conditions, investment project characteristics, standard tax system features and tax incentive design. ETRs become more complex as additional economic and tax system features are integrated. This first empirical calibration makes certain simplifying assumptions described below.

- **Macroeconomic scenario**: economy-specific parameters, i.e. annual interest rates and inflation, are held constant across countries and over the lifecycle of the investment project.
- **Investment project**: ETR estimates consider the same investment project across all countries. It is composed of a single capital asset, i.e. industrial machinery. The asset depreciates at a constant annual rate. The investment is profitable throughout its lifecycle, generating profits at a constant pre-tax rate on the capital stock per period. The investment is fully financed through retained earnings and the firm does not expand its investment project after the initial investment is made.
- **Standard tax system**: Estimations consider country-specific standard CIT rates, asset-specific capital allowance rates (i.e. capturing fiscal depreciation) and cost recovery methods. No personal income taxes or other taxes apply.
- **Investment tax incentives**: Temporary tax exemptions and reduced rates apply starting in the first year of production. They apply within the limit of country- and incentive-specific tax benefit restrictions, e.g. through ceilings and carryover limits. Investment tax incentives are modelled separately, unless granted jointly under the same regime.[24] The interaction of tax incentives with standard allowances follows country or incentive-specific rules. Tax allowances can proportionally reduce standard allowances or apply in addition to them. For tax exemptions, capital expenditure incurred in activities that generate tax exempt income may (Eswatini[25], Kenya[26] and Senegal[27]) or may not (Eswatini[25] and Mauritius[28]) give rise to a tax deduction. Accordingly, standard capital allowances may or may not apply during the exemption period. For reduced CIT rates and tax credits, no specific interaction with standard allowances is modelled.
- **Tax exhaustiveness and carryforward of tax benefits:** Throughout the analysis, calculations assume that the investing firm can and does make full use of targeted tax allowances and standard capital allowances as they become available - unless these are explicitly limited by country-specific provisions.[29] This assumption is rooted in the idea that firms generate enough taxable income including through activities that are unrelated to the investment and use deductions against such income. The asset-specific ETRs therefore represent a lower bound of the ETR under incentives. In some cases, period-by-period ETRs can become negative.

[24] For example, Angola's Special Regime grants investors both a temporarily reduced rate and non-enhancing tax allowance, which are modelled jointly. In certain cases, businesses may benefit simultaneously from multiple CIT incentives granted through different regimes. Understanding which tax benefits can be accumulated often depends on the interpretation of implementing regulations and tax rulings.

4.1. Overview of investment tax incentives in the seven economies

SSA is a diverse region with large economic potential covering countries in Southern, Eastern and Western Africa. The region has undergone substantial transformation over the past decades. Real GDP per capita growth accelerated over the 2010-2019 period and grew at double the annual global average rate (Annex B, Figure A B.1). However, the COVID-19 crisis weighs on the outlook for coming years, with many economies not expected to reach pre-crisis GDP per capita levels until the end of 2025 (IMF, 2021[23]). At the same time, opportunities exist for growth, regional integration and mobilising investment, such as though the implementation of the African Continental Free Trade Area.

The seven countries analysed are located across SSA and differ in terms of their economic size, growth trajectories and productive structures. They include some of the largest economies in the region, in terms of GDP and population size (South Africa, Angola and Kenya) that together account for a third of regional GDP (Annex B Figure A B.1). The countries are at different stages of economic development. Botswana, Mauritius and South Africa are considered upper middle-income economies, while the other economies are lower-middle income according to the World Bank classification. Economic structures differ too: some economies have relatively large manufacturing sectors,[30] while mining (Angola and Botswana) and agriculture (Kenya) are important in other countries (Annex B Figure A B.2). Finally, FDI differs in importance across countries and only South Africa and Mauritius have FDI-to-GDP ratios above the SSA average. FDI growth is slowing, with the FDI-to-GDP ratio only increasing in Kenya and Senegal in the 2010-2019 period (Annex B Figure A B.3).

All seven countries frequently use investment tax incentives with common targeting strategies and design features. Figure 4.1. presents a top-level view of incentive design (Panel A) and eligibility conditions (Panel B) in the seven countries. The figure summarises the design and eligibility conditions of CIT incentives available on 1st January 2021 identified through the OECD ITID.[31] Blue squares indicate that the corresponding country had one CIT incentive (light blue) or more than on CIT incentives (dark blue) with the respective design or eligibility condition.

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[25] In Eswatini, tax exempt income in SEZs benefits from a standard capital allowance during exemption period only on buildings, green technology allowance and R&D, but does not specify allowances for other capital assets, such as industrial machinery (Special Economic Zones Act of 2018, section 20 and first schedule).

[26] In Kenya, capital allowances, as defined in the second schedule of the Income Tax Act, may accrue within the 10 year period in which the tax exemption applies to enterprises operating within Export Processing Zones as mentioned under paragraph 2(f) of the Third Schedule.

[27] In Senegal, partially exempt income that benefits from article 253 of the General Tax Code is considered to also benefit from standard capital allowances.

[28] Mauritius does not authorise deductions made in respect to "any expenditure or loss to the extent to which it is incurred in the production of income which is exempt income" (Income Tax Act of 1995, article 26(1)(b)).

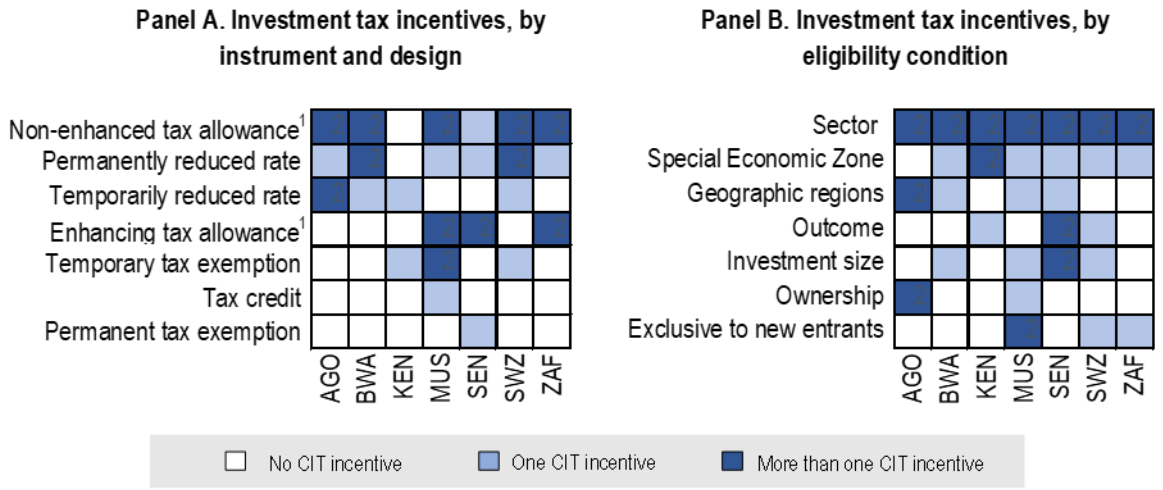
[29] For example: (i) Mauritius' tax credit under section 161A(58A) of the Income Tax Act provides a 5% tax credit to firms for three consecutive years, totalling a 15% tax credit, with a 10-year carryforward limitation. (ii) Senegal's enhancing tax allowance applies with a ceiling that is equivalent to 50% of the taxable income per tax year and a 10-year carryforward limitation.

[30] Mauritius, Eswatini and South Africa are the top three countries in SSA with the highest manufacturing value added (MVA) per capita. When measured in terms of GDP, manufacturing contributes respectively 31%, 17% and 12.3% to GDP in Eswatini, Senegal and South Africa. Manufacturing goods make up the largest share of all countries' exports in goods, except in Angola and Botswana. More details in Annex B.

[31] The data shown considers incentives that could be granted to new investment projects (i.e. open application window) on 1 January 2021. Therefore, it does not consider incentives in the process of phase-out (i.e. for which the window of application has closed, although previously granted benefits continue to apply until fully used or until they expire).

Figure 4.1. Overview of tax incentives by instrument design and eligibility condition in selected SSA economies

Square colour indicates the number of corporate income tax incentives in a country (x-axis) grouping incentives according to the corresponding instrument design (panel A, y-axis) or eligibility condition (panel B, y-axis)



Note: Figure considers investment tax incentives available to investors on 1 January 2021. The classification used in Panel A follows the definitions introduced in Section 3. The classification used in Panel B follows Celani, Dressler and Wermelinger (2022[3]). *Outcome* refers to eligibility conditions that require businesses to achieve certain performance results, such as export-orientation (Kenya and Senegal) and job quality conditions (Eswatini). *Special Economic Zones* eligibility condition refers generically to all types of economic zones, including Special Economic Zones, Industrial Zones, Free Zones, Free Ports, Development Zones, Export Processing Zones, Technology Parks and others.
1) Tax allowances *accelerate* the schedule for writing-off capital expenditures compared to the standard capital allowance rules. This may happen within the limits of the asset's actual acquisition cost (non-enhanced tax allowance) or allow business to write-off more than 100% of the acquisition costs (enhanced tax allowance).
Source: Authors based on the OECD Investment Tax Incentives database.

Countries implement a range of different tax incentive instruments, although the most frequently observed are income-based incentives (reduced rates or exemptions) (Figure 4.1.A). All seven countries grant at least one reduced CIT rate, either on a temporary or permanent basis, and four countries use tax exemptions. Tax allowances are used frequently across the seven countries and apply with very different design features (Box 2.2). Only Mauritius uses tax credits.

Countries use a variety of eligibility conditions that target different types of investments, particularly sector and SEZ conditions (Figure 4.1.B) and several conditions often apply at the same time. All countries have at least one incentive that targets specific economic sectors and five countries have a special CIT regime within SEZs.[32] Other eligibility conditions may also apply. Four countries target specific geographic regions, such as certain provinces and less economically developed areas. Three countries provide incentives for investment projects above a certain threshold or involving a specific ownership structure.[33] Outcome conditions require companies to achieve certain performance results, such as export-orientation, job quality or improving environmental outcomes.

[32] Sector and SEZ conditions were also identified as respectively the first and second most widely used eligibility conditions targeting CIT incentives across a larger sample of 36 developing and emerging economies (Celani, Dressler and Wermelinger, 2022[3]).

[33] For example, only investors that are 100% foreign owned may benefit from Mauritius' temporary tax exemption for large investors. Angola's special regime incentives apply exclusively to projects by private investors, whether it is carried out by domestic or foreign investors.

Sector-specific tax incentives can apply on a broad basis (i.e. the incentive applies across all manufacturing activities) or on a narrow basis (i.e. the incentive targets only a few priority sub-sectors in manufacturing). Table 4.1 lists sector-specific tax incentives for industrial machinery that specifically target manufacturing businesses across the seven countries. The food and the automotive industries most frequently benefit from incentives specific to these industries (Column 3 in bold) and will be the focus of the ETR analysis below. For example, Kenya operates a reduced CIT rate limited to motor vehicle assembly activities. These incentives may also extend to non-manufacturing activities as shown in Column 4. The food industry is an important manufacturing activity across all covered countries as measures by manufacturing value added and, to a lesser extent, exports.[34] The transport equipment sector is relatively small in all countries, except in South Africa.

SEZs are widely used among developing economies with the objective of attracting investment through achieving among other things agglomeration benefits. Six out of the seven countries the subject of the analysis provide preferential tax treatment in SEZs. Table 4.2 lists investment tax incentives that apply in SEZs and which feed into the ETR analysis in Section 4.2.

Table 4.1. Overview of CIT incentives that apply to the manufacturing sector

Investment tax incentives for industrial machinery assets that target manufacturing activities outside SEZs

Country	Tax incentive design and main eligibility conditions	Eligible manufacturing activities	Additional eligible activities and sectors
AGO	Benefit varies depending on the region in which the investment occurs: • Area A: 2-year 20% **reduced CIT rate** • Area B: 4-year 10% **reduced CIT rate** & non-enhancing **tax allowance** for 4 years[1] on machinery and equipment • Area C: 8-year 5% reduced CIT rate & non-enhancing **tax allowance** for 4 years[1] on machinery and equipment • Area D: 8-year 2.5% **reduced CIT rate** & non-enhancing **tax allowance** for 8 years[1] on machinery and equipment	**Food industry**; Textile and apparel; Paper and Wood	Agriculture & forestry; Electricity generation & distribution; Water & waste; Professional, scientific & technical services; Education; Health; Accommodation & leisure; Construction; Telecomm. & ICT, Transportation
	• 2-year 20% **reduced CIT rate**. Business must request benefit with investment authority.	All other activities that do not benefit from the special regime	
BWA	• Permanently **reduced CIT rate of** 15%**.** Business must have a special investment certificate.	Manufacturing activities, with certain exceptions	None
	• 5-year 5% **reduced CIT rate** followed by a permanently **reduced CIT rate** of 10%. Investment projects must be located in the Selebi-Phikwe region and reach at least BWP 250,000 or BWP 500,000 (USD 21-42,000).	Manufacturing activities	Agriculture; Financial and business services; Business process outsourcing; ICT; Transportation and logistics; Tourism and accommodation; Health care services.
KEN	• 5-year **15% reduced CIT rate** • 10-year **15% reduced CIT rate** if local content requirements are met, i.e. more than 50% after 5 years Applies starting from commencement of operations.	**Motor vehicle assembly**	None

[34] Food and beverages account for 80% of MVA in Eswatini, for around 40% in Kenya, Mauritius and Senegal, and for around 20% in Angola, Botswana and South Africa. When looking at overall good exports, food and beverages contribute between 0.2% (Angola) and 25% (Mauritius) to these countries' goods exports.

MUS	• 8-year full **tax exemption** Applies starting from commencement of operations and may require approval from the Economic Development Board or be limited to companies incorporated after a given date.	**Food processing**; Pharmaceuticals; Medical devices; **Automotive parts**; & high-tech goods	None
	• 100% non-enhancing **tax allowance** Applies to investment projects on the Island of Rodrigues.	Manufacturing activities	Other processing of agricultural, fisheries or livestock products
	• 15% **tax credit** distributed over 3 consecutive years on new machinery and equipment Applies to expenditure incurred between 1 July 2020 and 30 June 2023.	Manufacturing activities	None
SEN	• 30% enhancing **tax allowance** for expansion projects • 40% enhancing **tax allowance** for new businesses • 70% enhancing **tax allowance** for new businesses investing outside of the Dakar area. Investment projects must be at least CFA 100 million or 250 million (USD 150,000- 380,000).	Manufacturing activities	Agriculture & fishing; mining; industrial equipment maintenance, Tourism and accommodation services; education services, health services, telecommunication, infrastructure projects
	• Permanent partial **tax exemption** on 50% of taxable income per year. Business must export at least 80% of their production to qualify.	Manufacturing activities	Agriculture and telecommunication services
	• 20% non-enhancing **tax allowance** in first year the asset comes into use (double the standard depreciation rate) for new machinery and equipment or with lifetime of more than 5 years.	Manufacturing activities	Agriculture & fishing, industrial equipment maintenance; transportation services
ZAF	• Non-enhancing **tax allowance** that applies as an accelerated 50-30-20 depreciation schedule.	Production of bio-diesel & bio-ethanol	Electricity generation from wind, solar, hydropower or biomass

Note: Eswatini is not featured in this table because it does not operate an incentive specifically targeted to the manufacturing sector. This table considers manufacturing-specific investment tax incentives available to investors on 1 January 2021 outside of SEZs and targeting expenditures on industrial machinery assets. Manufacturing activities may benefit from incentives that are not sector-specific, but are not included in this table. ICT = Information and communications technologies.

1) Tax allowance applies as an 18.8% capital allowance rate, a 50% increase relative to 12.5% standard rate, for the period.

Source: Authors' elaboration based on the OECD Investment Tax Incentives database.

Table 4.2. Overview of CIT incentives within Special Economic Zones

Investment tax incentives that apply to industrial machinery assets within SEZ

Country	Tax benefit description (by regime)	Year regime was introduced	Economic importance of SEZ
AGO	No CIT incentive[1]	2015	1 Zone, 76 businesses (mostly state-owned factories)
BWA	5-year reduced 5% rate, followed by a permanently reduced 10% rate.	2015, CIT incentives introduced in 2019[2]	2 Zones operational as of 2020 and 6 Zones in planning stage
SWZ	20-year full tax exemption, followed by a permanently reduced 5% rate.	2018	2 Zones
KEN	10-year full tax exemption, followed by a reduced 25% rate for the next 10 years, after which the standard rate applies (**Export Processing Zone regime)**	1990	74 Zones, 137 businesses and directly employing over 60,000 people (2019)
	10% reduced rate for 10 years, followed by a reduced 15% rate for the next 10 years, after which the standard rate applies.	2015	First zones under construction
MUS	Reduced 3% rate applies on export income[3] (**Free port regime**)	2004, last amended in 2018	1 Zone
SEN	Reduced 15% rate	2014, amended in 2017	3 industrial parks
ZAF	Reduced 15% rate and non-enhancing tax allowance on non-residential buildings or building improvements (i.e. 10% instead of 5% rate under straight line capital cost-recovery)	2014	11 Zones, of which 7 operational, and 1 in planning stage **Coega zone**: 20 investors, investment of ZAR 1.13 billion , 3778 direct jobs **East London zone**: 21 investors, investment of ZAR 1.1 billion, 1179 direct jobs **Richards Bay**: ZAR 800 million, 180 direct jobs

Note: This figure considers investment tax incentives available to investors on 1 January 2021. Regime not referred in law as SEZ regime have the Zone regime name added.
1) Angola operated an SEZ regime until 2020, but the regime did not provide CIT incentives.
2) SEZ and regional SPEDU regimes were introduced in different years, respectively 2015 and 2008, and are operated by different authorities (i.e. the Special Economic Zones Authority under the Ministry of Trade and Industry and the Selibe Phikwe Economic Diversification Unit). In 2020, parliamentary discussion were underway to evaluate merging the regimes (SPEDU, 2021[24]).
3) A free port operator engaged in the manufacture of goods meant for local market in whole or in part is taxed at a reduced 3% rate provided that the satisfies prescribes any conditions relating to the substance of its activities.
Source: Author's elaboration based on the OECD ITID, UNCTAD (2019[25]), Dube, Matsika and Chiwunze (2020[26]) and national sources.

4.2. Effective tax rates under investment tax incentives

This section presents EATRs across the seven countries accounting for investment tax incentives highlighted in Table 4.1 and Table 4.2. It focuses on incentives specific to the food and the automotive industries and those in SEZs. It also discusses how design features of tax incentives can affect the relief provided through incentives.

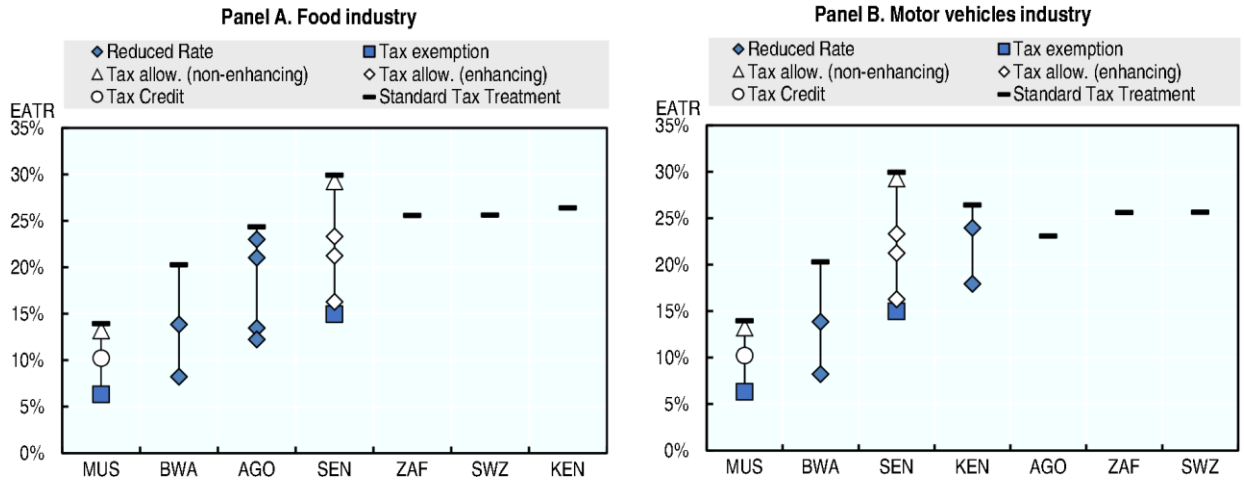
4.2.1. Tax incentives targeting food and the automotive industries

EATRs in the food and automotive industries vary widely across the seven countries, because of differences in standard tax systems, but mainly due to generous tax incentives available in some countries. Figure 4.2 presents forward-looking EATRs for a standardised investment under standard tax treatment (horizontal black marker) and under available tax incentives in the food (Panel A) and the automotive industries (Panel B) across the seven countries. Countries that provide tax incentives in the food and

vehicle industries typically use more than one instrument.[35] The availability of multiple incentives in one industry does not necessarily imply that instruments overlap or are cumulative. Instead, additional eligibility requirements apply frequently and link incentives to additional characteristics of investors or investment projects. For example, in Senegal, the tax allowance only applies to investments above a certain size, while the tax exemption is restricted to export-oriented businesses although both apply in the sectors considered. Therefore, EATRs are presented per incentive, except where simultaneous application is explicitly mentioned, such as in the case of Angola's reduced rate and tax allowance (Table 4.1).

Figure 4.2. EATRs in selected manufacturing industries

EATRs under investment tax incentives considering tax incentives that target the corresponding industry, ordered by generosity of *the most generous* preferential treatment



Note: This figure considers investment tax incentives available to investors as of 1 January 2021. EATRs are calculated for a standardised investment in industrial machinery outside of an SEZ. EATRs under standard tax treatment uses tax system features from the OECD CTS database. EATRs under each tax incentive considers tax incentives with sector conditions targeting the corresponding industry in Table 4.1 as collected through the OECD Investment Tax Incentives databases. EATRs under standard tax treatment may differ from standard CIT rates as they incorporate fiscal depreciation and related provisions. These EATRs do not necessarily align with those presented in OECD CTS as they may reflect different modelling assumptions (see Box 4.1). Annex C presents the additional parameters used in the calibration. Table A D.1 in Annex D presents the EATRs under each tax incentive in this figure.
Source: Author's calculations based on OECD ITID and OECD CTS database.

In some countries, tax incentives significantly reduce the EATR in the given industry. Preferential tax treatment results in EATRs that are up to 55% lower than under standard tax treatment (Mauritius). On average, investment tax incentives targeting the food and automotive industries lower EATRs by around 30%. In addition, tax incentives have the potential to change the ranking of countries in terms of tax costs in the specific industry. The ranking of countries according to their EATR under standard treatment (i.e. before tax incentives) can be different from the ranking when tax incentives are taken into account. Senegal, for example, starts with the highest EATR under standard treatment and achieves one of the lowest EATRs after incentives, when considering the most generous treatment – a partial tax exemption for exporting businesses. Mauritius, on the other hand, starts with a comparatively low EATR under

[35] Some countries do not provide tax incentives that target these industries specifically, such as Kenya's food industry or Angola's automotive industry. Eswatini does not have manufacturing-specific incentives and South Africa has no incentive in either of the respective industries.

standard treatment and remains in this position in the ranking also after incentives, considering its temporary tax exemption, which targets a limited number of industries.

Comparing countries only by the *most generous* preferential tax treatment per sector or per country can be misleading. While the comparison presented in Figure 4.2 provides a significant improvement on estimates in the literature, it is important to note that the figure is not necessarily representative of firms' average tax costs in a given country. First, some incentive may have additional design features beyond those modelled in Figure 4.2. Second, the comparison is also blurred because of country-specific eligibility conditions that businesses need to meet in order to benefit from the most generous incentive should be accounted for when estimating average tax costs in a given country. Such additional conditions can link to the location of the investment, its value, business stage or export-orientation and are not included in the calculation. For example, Angola's incentive in the food industry results in a lower EATR than those in Senegal, but is only available to investment in certain provinces that represent only about 25% of the population (Ministry of Finance of Angola, 2018[27]). Business-specific characteristics, such as loss positions at the early stages of an investment, can further limit the potential for investors to actually benefit from the most generous treatment available, thus affecting country-level averages. For example, Senegal's incentives are subject to an annual benefit ceiling or a benefit carryover limit, which can affect EATRs as discussed in Box 4.2.

Expenditure-based incentives can deliver tax benefits and therefore government revenue losses that are as important as those under income-based incentives, however, there is evidence to suggest that they are likely to be more effective in achieving their investment objectives.[36] Expenditure-based incentives directly relate to investment expenditures, reducing the cost of investing. This tends to better target investment that would not be profitable in the absence of the incentive. On the other hand, income-based tax incentives provide tax relief unrelated to investment expenditures, but based on profit rates of firms, and therefore may have less influence on creating additional investment activities (IMF, OECD, UN, World Bank, 2015[2]). Figure 4.2 shows that tax exemptions provide the most generous tax treatment (blue squares), but that tax allowances (white diamonds) can yield a similar tax benefit depending on their design and context. For the reasons cited above, expenditure-based incentives may have a higher likelihood of promoting additional investment and therefore may represent a better approach.

While tax exemptions result in the lowest EATRs in Figure 1.1, the tax benefit provided by tax exemptions depends importantly on the interaction with standard capital allowances that is prescribed in the tax law and is particularly sensitive to the profitability of firms. In some countries, tax-exempt income can give rise to standard capital allowances during the exemption period, while it does not in others (see Box 4.1). This can result in significantly different EATRs. For example, Mauritius does not allow standard capital allowances to be claimed on assets that result in tax exempt income. Considering this provision, the 8-year tax exemption in Mauritius results in a 6.3% EATR, but it would result in a -3.9% EATR if full standard allowances could be claimed and be fully used as they accrue. In addition, tax exemptions often apply in the early periods of an investment project (see examples from Kenya and Mauritius in Table 4.1. In the event that investment projects become profitable only after a number of years, the tax benefit derived from the exemption could be lost, in particular when carryforward is restricted, resulting in a higher EATR.

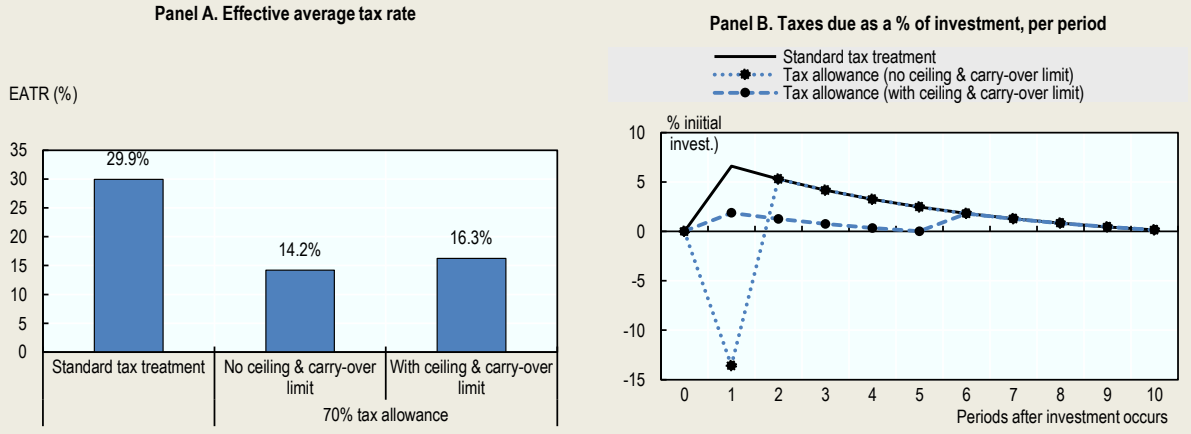
[36] Some literature has suggested limited investment responses to income-based incentives in developing economies (Klemm and Van Parys, 2012[12]). By contrast, there is evidence suggesting that accelerated depreciation and bonus depreciation have increased investment in OECD countries (Maffini, Xing and Devereux, 2019[40]; Zwick and Mahon, 2017[43]; House and Shapiro, 2008[41]; Cohen and Cummins, 2006[42])

Box 4.2. Ceilings and carryover limitations affect generosity and timing of tax incentive benefits: an example from Senegal

Certain tax incentive design features add limitations to tax benefits, such as limits to carry-over and refundability, or benefit ceilings. These features typically depend on the profitability of an investment project and other characteristics. See Section 2 for a discussion of benefit carryover and refundability. This box provides an illustrative example of how these features may affect EATRs using Senegal's tax allowance regime. Senegal operates an enhancing tax allowance of 30-70% of qualifying capital expenditure that is available to investment projects of newly-established enterprises located outside of the capital region of Dakar and exceeding XOF 100 million (USD 170,000). The benefit can only be carried over for five years (after which, unused benefits elapse) and the annual tax benefit cannot exceed an equivalent of 50% of gross income derived from the investment.

The ceiling may help contain the effect of the incentive on public finances, as well as distribute the tax benefit and government revenue forgone more evenly over time. However, it risks that firms with little or no income in early years of the investment cannot benefit to the same extent from the incentive as more profitable comparable firms. Figure 4.3 presents EATRs for a simplified investment project calibrated to Senegal-specific tax parameters under three scenarios: First, the EATR amounts to 29.9% under standard tax treatment when no incentive applies (baseline scenario). Second, implementing a 70% tax allowance yields an EATR of 14.2% assuming that no ceilings and carryover limits apply and the investor makes full use of the tax benefit as it accrues in year 1. The third case considers the same incentive, but additionally models the applicable ceiling conditions.[37] In this case, the tax benefit is distributed more evenly over time in the first five years of the investment and when the ceiling applies. This may be the intended effect as it provides certainty to the investor and to the government when tax revenue (or loss) can be expected. However, under the assumed project characteristics and economic parameters, the project will not be able to make full use of the allowance before it expires in the sixth year. This reduces the tax benefit and results in a 16.2% EATR. This unintended effect depends, amongst others, on the profitability assumption of the investment, which shows how specific incentive designs interact with investor- and project-specific characteristics.

Figure 4.3. Illustrative tax allowance EATR and taxes due for Senegal's 70% tax allowance



Note: Annex C presents the additional parameters used in the calibration.
Source: Author's calculations based on the OECD ITID and the OECD CTS database.

Benefit ceilings that relate to income apply widely across countries (e.g. Armenia, Côte d'Ivoire, Madagascar), but other ceiling designs also exist. For example, the tax allowance in Egypt is capped at the 80% of the paid-up capital at start date.[38] The tax allowance for industrial projects in South Africa, phased out on 31 March 2020, had a ceiling on tax benefits per beneficiary of ZAF 350-900 million (USD 23-60 million).[39] Ceilings may also apply to tax exemptions. The *pioneer investor* incentive in Thailand grants a tax exemption of up to 8 years in which the accumulated exempt income over the periods is capped at an amount that is equivalent to 100% of the capital investment in machinery.[40]

4.2.2. Tax incentives and economic performance

Some countries provide very generous tax treatment to sectors that are already of economic importance in the country. This may indicate that there is room to phase out incentives that risk becoming redundant to recoup revenue forgone, particularly when sectors are maturing and spillovers have been realised. Figure 4.4 presents the degree of preferential treatment per sector, measured as the difference between the EATR under incentives and the EATR under standard tax treatment and expressed as a percentage of the EATR under standard treatment. It relates this measure to indicators of a sector's relative economic importance within a country, such as the industry share in GDP (Panel A) and in goods exports (Panel B). A degree of preferential treatment of 0% indicates that no tax incentive is targeted to the respective industry. Countries that appear in the upper-right quadrant provide generous tax treatment to economically important sectors. For example, Mauritius and Senegal provide a significant reduction in effective taxation in the food industry compared to the standard tax treatment (degree of preferential treatment is above 50%), although the sector already represents a much larger share of GDP than in other countries (4-6% of GDP) and more than 20% of exports.

[37] Ceilings that apply on an annual basis are introduced into the EATR calculation by constraining the maximum value of tax allowance available in each period ($a_{t+s}I_0$) in equation (3-8). Limits to carryforwards are modelled by setting $a_t = 0$ in the respective periods (when the carryforward ended) and by setting a maximum on the overall value of the allowance that can be accumulated over the respective period. For example, a 70% enhancing tax allowance with a five year carryforward limit has $a_t = 0$ for $t > 5$ and $\sum_{s=0}^{\infty} a_t \leq 0.7$, where t indicates the number of periods after the investment occurred.

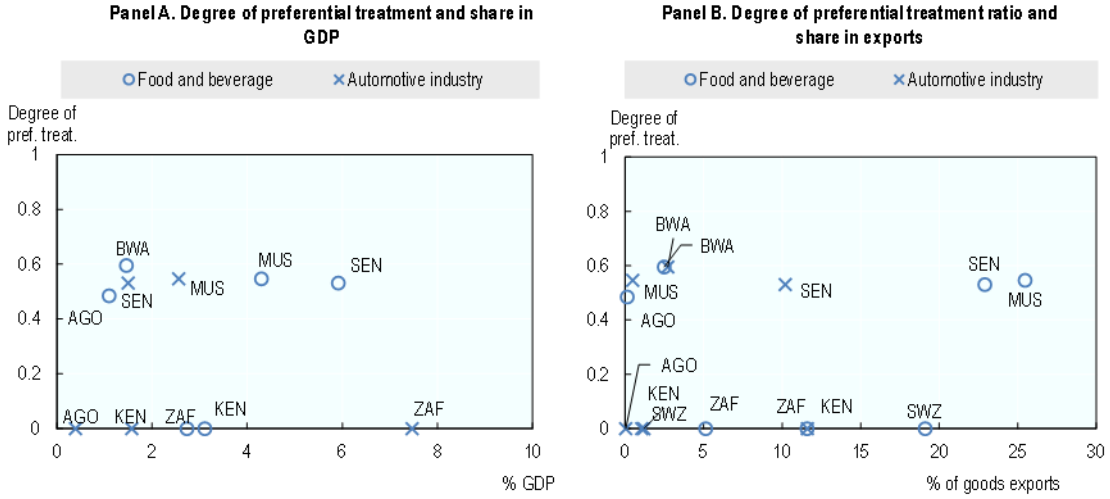
[38] This tax allowance refers to the incentive described in Article 10 of Egypt's Investment Law of 2017.

[39] This tax allowance refers to the incentive described in Section 12I of the Income Tax Act of South Africa of 1962.

[40] This tax exemption refers to the incentive described in Section 31 of Thailand's Investment Promotion Act No. 4 of 2002.

Figure 4.4. Well-established industries still benefit from significant reductions in effective taxation in some countries

Degree of preferential tax treatment relative to each industry's share in GDP (Panel A) and goods exports (Panel B).



Note: Figure considers investment tax incentives available to investors as of 1 January 2021. Degree of preferential treatment (vertical axis) measures the difference between the EATR under standard tax treatment in the country and the most generous tax treatment in an industry expressed as a percentage of the EATR under standard treatment. A generosity of 0% indicates no tax incentive targets the respective industry. Panel A: Industry value added as a share of GDP is estimated multiplying the ISIC Rev.3 industry share in UNIDO INDSTAT 2 by the share of manufacturing in GDP. The food and beverage, and the transport equipment industries are used as proxies for the food and automotive industries' share in GDP and goods exports. Eswatini data is from 2011 and Senegal data is from 2014. Value added data is not available for Angola and 2017 output is used a proxy. Panel B: Data for Angola is from 2018.
Source: Authors' elaboration based on OECD ITID, OECD CTS database (2021[8]), OECD STAN Bilateral Trade Database by Industry and End-use category (2020[28]), UNIDO INDSTAT 2 ISIC Revision 3 (2021[29]) and UNIDO INDUSTAT MVA (2021[30]) databases.

Providing extensive preferential tax treatment to well-established industries risks providing tax relief to projects that will likely occur even in the absence of the incentive, generating windfall gains and resulting in forgone government revenue without an investment benefit. They may also indicate long-standing incentives that were introduced at the early stages of a sector's development but not reassessed and phased-out as the sector advanced to higher stages of development. There is no conclusive evidence, on whether there is a causal relation between preferential tax treatment and the size of a sector and in which direction the potential causality flows (i.e. whether incentives have helped the development of the sector, or whether the established sectors may be able to better negotiate and retain generous incentives). Jointly evaluating tax treatment and the development stage of sectors over time, while controlling for confounding factors that may be correlated with sectoral development but are not picked up in the graph, could provide additional insights on how to improve the effectiveness and efficiency of tax policy.

Regular evaluation of tax incentives against their policy objectives can help avoid providing redundant support. Tax expenditure reporting and monitoring can contribute to identifying and winding down incentives that are no longer needed and improving the efficiency of the remaining incentive toolbox. Regular evaluation allows for continuous reassessment of policy merits, in terms of levels of investment secured, revenue forgone, potential windfall gains and distortions that result from an uneven playing field. Policy re-evaluation also provides an opportunity to consider other targeted and non-targeted investment policies that may deliver superior results.

While reform of redundant and inefficient tax incentives may be challenging to implement, South Africa, Mauritius and Angola provide good examples of countries that have made good recent progress in implementing reforms. South Africa is currently phasing-out the tax incentives under Section 12I that

provided tax allowances for industrial projects. The most generous allowances that applied exclusively to investments within SEZs and in addition to the SEZ-specific 15% reduced CIT rate as well as an additional tax allowance for buildings were no longer available to investors as of 31 March 2020. As of August 2021, Mauritius repealed most of its temporary tax exemptions for new manufacturing business, which provided extensive preferential treatment. More broadly, Mauritius has restructured and rationalised its investment tax incentives since 2006 to re-orient its incentives policy toward improving the business climate, through an enhanced focus on infrastructure development, increasing transparency and enforcement of the regulatory framework for investment (OECD, 2014[31]). In April 2022, Angola's introduction of the Tax Benefits Code brought together all available tax benefits, their rules and conditions into a single Act, increasing their transparency.[41] The CIT incentives previously available to priority sectors described in Table 2.1 remained largely unchanged, while the new Code introduced new incentives. These include targeted tax allowances to support the creation of jobs, internships and professional training, reduced CIT rates on the production and sale of energy from renewable energy sources, and reduced rates within Free Zones.

4.2.3. Tax incentives in SEZs

Six out of seven countries provide CIT relief in SEZs through income-based tax incentives, reduced rates or tax exemptions. This aligns with the general trend identified through the OECD ITID that regimes in SEZs were found to frequently apply income-based tax incentives (Celani, Dressler and Wermelinger, 2022[3]).

SEZ regimes provide the most generous preferential tax treatment in five of the six countries. Figure 4.5 presents the EATR for an equivalent investment project under standard tax treatment (horizontal marker), under tax incentives available within SEZs (as described in Table 4.2) and under the most generous tax treatment in the country independently of whether this arises in an SEZ or not (black crosses). When the white marker overlaps with the black cross, the SEZ incentive is the most generous one in the country. Only Senegal operates an incentive for exporters outside of SEZs that yields lower EATRs than their SEZ regime, although the difference between the EATR under the SEZ regime and under the most generous tax treatment is small.

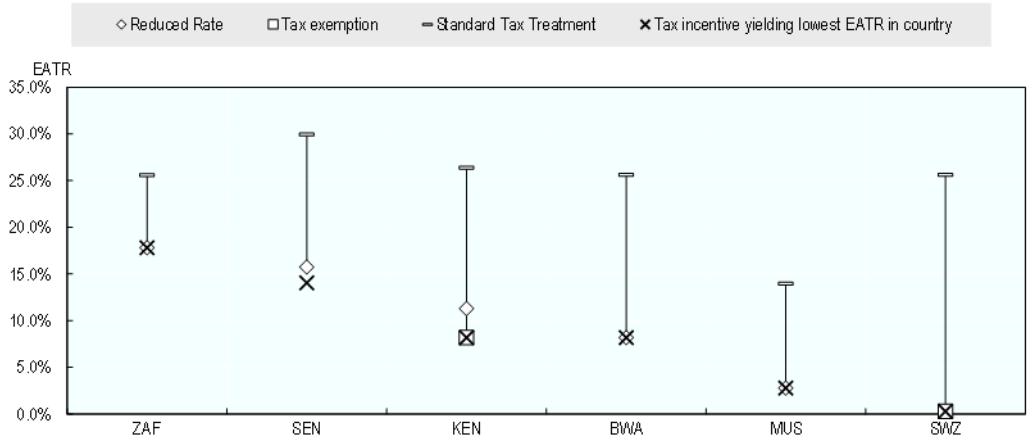
Tax incentives in SEZs often reduce the tax costs significantly**.** In most countries, the EATR differential relative to the standard tax treatment is large. SEZ regimes in Eswatini, Kenya and Mauritius even reduce EATRs to near zero under the given modelling assumptions.[42] Tax incentives within SEZs result in EATRs, on average, that are 65% lower than under the standard tax treatment. In some cases, tax incentives in SEZs result in EATRs up to 99% lower than under standard tax treatment (Eswatini). SEZ regimes often offer additional non-CIT incentives (such as preferential VAT or customs treatment) and non-financial incentives, such as regulatory concessions, high quality infrastructure, or other preferential economic policies. Therefore, evaluating the effectiveness of tax incentives in SEZs requires a broader consideration of these other factors and can result in benefits beyond those captured in the EATR in Figure 4.5.

[41] Upon the entry into force, the Tax Benefits Code repealed certain acts granting tax benefits included in other laws previously regulating tax incentives, including the Private Investment Law of 2018.

[42] EATRs are sensitive to various modelling assumptions. The EATR calculation in Figure 4.5 assumes that taxpayers do not accrue capital allowances during an exemption period or cannot carryforward capital allowance that were accrued during an exemption period. However, country-specific rules may differ and allow capital allowances to accrue during such periods and their deduction against income from non-exempt sources (see Box 4.1). For example, under the most generous case, i.e. assuming that taxpayers make full use of capital allowances accrued during a full exemption period, the EATR for Kenya under the 10-year tax exemption in Export Procession Zones would fall to -14.3% compared to the 8.2% under the current assumptions.

Figure 4.5. Tax incentives in SEZs typically represent the most generous tax treatment in a country

EATRs under tax incentives that apply within SEZs compared to a country's most generous tax incentive



Note: Figure considers investment tax incentives available to investors as of 1 January 2021. EATRs are calculated for a standardised investment in industrial machinery. Angola's SEZ regime does not come with a CIT incentive and is not considered in the figure. Table A D.1 in Annex D presents the EATRs under each tax incentive in this figure.
Source: Authors' elaboration based on OECD ITID and OECD CTS database.

Where tax incentives are exclusively available in SEZs, this can give rise to a tax wedge between the tax treatment of similar investments located inside and outside of SEZs within a country**.** The tax incentives available in SEZs, in terms of design and generosity, do not apply to investors outside of SEZ in any of the countries in the sample.[43] Treating taxpayers within and outside SEZs unequally can create distortions and risks opening opportunities to local and international companies to engage in tax planning activities. These risks can be exacerbated where income-based tax incentives are the most prevalent instrument provided.

[43] Recent policy reform in Mauritius has extended the SEZ incentives to become applicable outside Zones. For example, under the SEZs regimes in Mauritius income attributable to exports is taxed at a 3% CIT rate. As of 2022, the 3% reduced CIT rate also applies to manufacturing companies outside of the SEZ when they engage in medical, biotechnology or pharmaceutical sector, or when they hold a an Investment Certificate issued by the Economic Development Board (section 44D of the Income Tax Act). In addition, the new incentive applies to income from all sources and could result in a more generous tax treatment than within SEZs, depending on firm characteristics.

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Annex A. Analytical framework of forward-looking effective tax rates

Forward-looking corporate effective tax rates (ETRs) summarise corporate tax system features in a set of indicators that measure taxes due over the lifetime of a given investment project, expressed as a share of the investment's expected income. Forward-looking ETRs differ from backward-looking ETRs and are not directly comparable to them. Backward-looking ETRs indicate how much tax a firm effectively pays on their investment in a specific period. They are calculated for a specific fiscal period based on firms' tax returns or accounting data relating taxes paid to some measure of profit capturing the effective ex-post taxation on business activities. Backward-looking ETRs reflect the combined effects of multiple, sometimes endogenous, factors on taxation, such as tax base definition and other tax provisions, investment project characteristics, as well as the effects of possible tax-planning strategies.

Forward-looking ETRs measure effective taxation over the lifetime of a prospective and stylised investment project and do not incorporate information about firms' actual tax payments. Therefore, they can be separated from endogenous investment or production decisions that may influence, for example, the asset mix or financing structures related to an investment, the treatment of profits and losses and so forth. Keeping a stylised approach allows for evaluating the effective taxation of stylised and comparable investment projects[44] under varying tax provisions, everything else equal. This characteristic helps to isolate the effects of investment tax incentives on providing tax relief and allows analysing the generosity of tax incentives. ETRs are also instrumental in illustrating the impact of specific tax incentive design features on effective taxation and the key mechanisms to provide relief.

Two forward-looking ETR indicators are typically derived within the standard framework: the effective average tax rate (EATR) and the effective marginal tax rate (EMTR). Given the focus on discrete choices, EATRs are chosen as the main tax policy metric of interest in this paper. EATRs focus on inframarginal projects, i.e. those earning positive economic rent over their lifetime, and measure the percentage of an investment project's discounted lifetime profit that is paid in taxes. It is a useful indicator to analyse investment decisions at the extensive margin, that is, discrete decisions between mutually exclusive, comparable investment projects, for example, location decision, assuming that investment projects earn non-zero economic rents.

Consider an investor who is evaluating whether to invest in a project located in Country A or in Country B. Assume the project earns the same pre-tax economic rent in either country, the location decision will depend solely on the level of taxation under each country's tax system, including investment tax incentives. In this spirit, the EATR is a useful indicator to compare the generosity of distinct types of preferential tax treatment relative to the standard tax treatment and to assess tax relief from investing in one as opposed to another sector, region or country or to assess the relief provided through specific incentive designs everything else being equal.

[44] The investment project underlying the ETR calculations can be empirically calibrated to a specific asset or a group of assets, including detailed representations of corporate and other tax provisions in a country, sector or region. Depending on the application, the investment project as a whole may or may not earn economic rent over its productive lifetime.

The EMTR provides a complementary view to the EATR that can be useful in evaluating investment decisions at the intensive margin, that is, on how much to invest once the location has been defined. The EMTR focuses on marginal projects and collapses into the EATR in the special case where an investment project earns just enough discounted lifetime profit for the investment to break even after tax. (See Gonzalez Cabral, Appelt and Hanappi (2021[11]) for a discussion on EMTRs).

Finally, the forward-looking ETR framework is flexible to address different types of policy questions. One feature contributing to its flexibility is that it allows for different assumptions about the timing of investment and disinvestment decisions. Broadly speaking, investment decisions are exogenous to the model and, although they can vary across investment projects, they should be kept constant in analytical applications that aim to isolate the impacts of a given tax provision on ETRs. Modelling the whole range of investment tax incentives discussed in Section 2of the main paper, in particular tax incentives that imply tax provisions that vary over the lifetime of an investment project, require specific assumptions on the time structure of the investment.

Previous applications of the ETR framework typically assume that the firm makes an investment in the first period and divests in the second period, such that the capital stock reverts to its original level. In this paper, this specific timing of investment decisions is referred to as the one-period investment case (OPC). The ETR data series introduced in Section 3of the main paper all build on the OPC specification (Bilicka and Devereux, 2012[18]; Spengel and et al., 2016[19]; Hanappi, 2018[7]; OECD, 2021[8]). The OPC is however not suitable for all applications, for example when analysing investment tax incentives that provide a temporary preferential treatment in form of a temporary reduced tax rate or tax exemption that applies on a temporary basis. When firms anticipate that tax provisions change over the lifetime of an investment, assumptions on the investment and disinvestments decisions need to be adapted to the case where a firm makes an investment that is never sold or expanded, but uses the capital stock in production until it fully depreciates. This specific timing of investment decisions is referred to as the permanent investment case (PIC) and was first introduced by Klemm (2008[9]; 2012[6]). The forward-looking ETR framework is able to encompass both the OPC and PIC, while ensuring comparability across applications.

This Annex provides an introduction to the forward-looking ETR model in the context of investment tax incentives. It first derives the general analytical framework of forward-looking ETRs that is used to model the different types of investment tax incentives in Section 3 of the main paper. In a second step, it derives key equations for the PIC and discusses its relationships with the OPC.

1. A forward-looking ETR model to analyse investment tax incentives

The EATR is calculated as the difference in pre-tax economic rent ($\boldsymbol{R}^*$) and post-tax economic rent ($\boldsymbol{R}$) over the lifetime of the investment project, divided by the net present value (NPV) of pre-tax net income ($\boldsymbol{Y}^*$). Assuming that no personal income taxes apply, the EATR is defined as:

$$EATR = \frac{\boldsymbol{R}^* - \boldsymbol{R}}{\boldsymbol{Y}^*} \qquad \text{(A-1)}$$

The post-tax economic rent ($\boldsymbol{R}$) is the key variable in the EATR calculation as it is the element that captures corporate taxation. The post-tax economic rent ($\boldsymbol{R}$) is a function of the revenues and taxes to be paid over the lifetime of an initial capital investment and occurs in period zero, I_0 (see Box 4.3 on notation). The investment increases the firm's capital stock that, in turn, generates the firm's output and revenues in the following periods. The pre-tax economic rent ($\boldsymbol{R}^*$) and pre-tax net income ($\boldsymbol{Y}^*$) refer to the same investment but in a context where there is no taxation, thus serving as a reference to evaluate the tax impact.

The following subsections detail the components feeding into the calculation of the post-tax economic rent ($\boldsymbol{R}$) and provides a general and formal expression for $\boldsymbol{R}$, $\boldsymbol{R}^*$and $\boldsymbol{Y}^*$.

Box 4.3. Notation of cash flows, net present values and exogenous parameters

The notation in this paper uses **bold uppercasing** for variables that denote the NPV of a cash flow stream. **Non-bold uppercasing** refers to the cash flow, in its current value, in each period. That is, for example, $\boldsymbol{Y}^*$ is the NPV of the pre-tax net income stream from the investment project, while Y_t^* is the net income generated in period t. The NPV of a cash flow stream of equals the sum of cash flow in each period brought to present value, using the relevant discount rate. The present case uses the nominal interest rate (i) for discounting ($\boldsymbol{Y}^* = \sum_{t=0} Y_t^* /(1+i)^t$).

Non-bold lowercasing is used for parameters. Some model parameters, such as tax parameters, are period specific and have a period subscript associated to them. This is because in certain tax systems the level of taxation varies over the investment's lifetime. In this case, tax parameter's subscript indicates tax treatment applied in the investment's period t. For example, this is the case of tax holiday in which a 0% CIT rate applies during the first five fiscal periods after the investment is made and a 20% CIT rate applies from period six onwards. If τ_t is the CIT rate in period t of an investment's lifetime, the CIT rate in the 3rd period after the investment is made ($\tau_3 = 0\%$) is different from the rate in the 10th ($\tau_{10} = 20\%$).

Some parameters are held constant over the investment's lifetime, in particular, pre-tax profit rate of the investment (p), economic depreciation (δ) and inflation (π).

Post-tax profit and economic rent

The economic rent ($\boldsymbol{R}$) generated by the initial investment equals the NPV of the stream of post-tax profit associated with the investment (equation (A-2)). Assuming the firm does not emit new debt or equity but finances the investment project entirely through retained earnings[45] and abstracting from personal income taxation at the investor and international level, the economic rent ($\boldsymbol{R}$) equals the sum of the post-tax profit of each period (R_t) brought to present value using the nominal interest rate (i).

$$\boldsymbol{R} = \sum_{s=0}^{\infty} \frac{R_{t+s}}{(1+i)^{t+s}} \tag{A-2}$$

The post-tax profit in each period (R_t) reflects the firm's inflow and outflows of cash, as shown in equation (A-3). The firm's period-level cash flow depends on revenue net of variable costs (Q_t), taxes due ($T_t = \tau(Q_t - Z_t)$) and investments (I_t) in each period. In this general formulation of the model, and which excludes investment tax incentives, the total effect of taxation is thus captured by multiplying the tax rate with the tax base, which is determined by subtracting standard capital allowances and deductions under standard treatment (Z_t) from net revenue (Q_t).

$$R_t = Q_t - \tau(Q_t - Z_t) - I_t \tag{A-3}$$

Revenue, Q_t, and taxation, $\tau(Q_t - Z_t)$, represent a firm's source and use of funds respectively, while investment, I_t, can either represent a source or the use of funds. For simplicity, it is assumed that the firm's revenues are non-negative[46] and, therefore, act as a source of funds (except when they are zero).

[45] Other financing mechanisms, such as debt and equity finance, can be incorporated in the model.

[46] The presentation of the general framework does not consider loss-making firms; impacts of loss carryover rules on the tax base are therefore also not considered. For an analysis of these provisions see Hanappi (2018[17]).

Reversely, taxes due in each period is always a use of funds (or zero when either the rate or the base is zero). Investment (I_t), however may act as either a source or use of funds as the firm can either make an investment, $I_t > 0$, or sell the investment, $I_t < 0$. The initial investment reflects necessarily a use of funds in the first period as the firms acquires a capital asset. In general, investment reflects a use of funds and divestment a source of funds implying additional income and a positive effect[47] on the economic rent.

Capital stock and revenue

The firm's net revenue in each period (Q_t) depends on a production function and the available production factors (equation (A-4)). Abstracting from other factors of production, output is assumed to be a function of capital in the previous period (K_{t-1}) and a pre-tax rate of return on capital net of depreciation (p). The productive value of capital declines by a certain rate of economic depreciation (δ). The price of each unit of output is assumed to be one. Revenue per period is captured net of variable costs in current price. The output price index equals the accumulated inflation from the initial period until t, where π is the annual inflation rate.

$$Q_t = (p + \delta)K_{t-1}(1 + \pi)^t \quad \text{(A-4)}$$

Over each period, the firm's capital stock follows an equation of motion (equation (A-5). Consider the case where an initial investment (I_0) increases the firm's capital stock (K_0).[48] If no subsequent investments take place the capital stock decreases due to economic depreciation (δ). As the initial investment decays over time, a unit of initial capital invested in period zero produces progressively less output in each subsequent period.

$$K_t = K_{t-1}(1 - \delta) + I_t \quad \text{(A-5)}$$

Capital allowances and economic depreciation

Fiscal depreciation is a common feature of corporate taxation that allows the taxpayer to deduct a capital asset's depreciation as an expense, such that only profits net of economic depreciation are subject to tax.[49] Over the lifetime of an asset, its acquisition cost is typically fully deductible as an expense to the firm under general tax treatment, i.e. 100% of the cost can be deducted from the tax base in the form of capital allowances. However, capital allowances are distributed over a number of years, following the asset's useful life, in an attempt to mimic its economic depreciation.[50] If capital allowances accurately reflect economic depreciation, the sum of capital allowances in each period (Z_t), calculated over the asset's useful life, should in nominal terms equal its acquisition cost. This would imply that the ETR on net income is equal to the standard rate.

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[47] Note that in some case the sale of a capital asset may trigger additional tax liabilities related to excess depreciation, e.g. when tax depreciation is accelerated (Klemm, 2008[9]).

[48] Note that in the initial period ($t = 0$), gross profit is zero as no output is produced.

[49] Depreciation deductions refer here to depreciation of tangible capital assets. Depreciation deductions are a common tax feature with respect to tangible capital assets. In certain countries acquired intangible capital can be depreciated, however, this is not the focus of this section. Within this framework, the term tax allowance refers to deductions other than variable cost, as these are already considered in the firm's net revenue (Q_t).

[50] By definition, capital asset have a useful life of more than one year and must be written-off, i.e. depreciated or amortized over more than one year.

The economic value of a capital allowance depends on the applicable CIT rate as well as on the size and timing of the deductions to be subtracted from the tax base in each period (Z_t). Over an investment's useful lifetime, the NPV of capital allowances ($\boldsymbol{A}$) equals the sum of the allowances obtained in each period, valued at the period-specific tax rate (equation (A-6)).[51]

$$\boldsymbol{A} = \sum_{s=0}^{\infty} \frac{\tau_{t+s} Z_{t+s}}{(1+i)^s} \tag{A-6}$$

In the context of this paper, Z_t captures only capital allowances that are not targeted but correspond to the standard corporate tax rules, i.e. those that are available to firms irrespective of their sector of activity or other investor or project specific characteristics. While the general treatment thus excludes targeted tax provisions, such as investment tax incentives, it may include asset-specific fiscal depreciation applicable under the standard rules, even if they are accelerated compared to real economic depreciation.[52] Targeted depreciation schedules, for example, those specific to a certain activity, firm, sector or location, accelerate the fiscal depreciation of assets in the target group relative to a comparable non-target group under standard rules and would be considered an investment tax incentives.

In general, fiscal depreciation rules differ across assets and countries, with a wide range of different capital cost recovery methods used (Hanappi, 2018[7]). Each cost recovery method uses different rules to define how annual depreciation deductions are calculated, the two most common methods being declining balance (DB) and straight line (SL) depreciation.[53] Without loss of generality, period-level tax deductions (Z_t) are defined in this paper as a function of the applicable cost recovery method.[54]

The capital stock for tax purpose (K_t^T) captures the stock of unused (or remaining) capital allowances associated with a given asset (equation (A-7)). Capital investments (I_t) increase the capital stock for tax purposes, while period-level capital allowances reduce it successively. The asset's useful life comes to an end when the capital stock for tax purpose equals zero. The capital stock for tax purpose (K_t^T) equals the firm's capital stock (K_t) in each period when fiscal depreciation is fully aligned with economic depreciation. If capital allowances are deducted at a faster rate than the asset depreciates economically, fiscal depreciation is said to be accelerated.

$$K_t^T = K_{t-1}^T - Z_t + I_t \tag{A-7}$$

Net income and economic rent in the case without taxation

The pre-tax economic rent ($\boldsymbol{R}^*$) and pre-tax net income ($\boldsymbol{Y}^*$) can also be decomposed into the sum of, respectively, pre-tax profits (R_t^*), and pre-tax net income in each period (Y_t^*), brought to present value. Pre-

[51] Equation (A-10) could be rewritten as: $\boldsymbol{R} = \sum_{s=1}^{\infty} Q_{t+s}(1+\pi)^s/(1+i)^s + \sum_{s=1}^{\infty} \tau_{t+s} Q_{t+s}(1+\pi)^s/(1+i)^s + \boldsymbol{A} - \sum_{s=0}^{\infty} I_{t+s}/(1+i)^s$.

[52] Asset-specific depreciation rules are considered, following Hanappi (2018[7]).

[53] Under straight-line depreciation, a fixed share of the investment cost is deducted over its useful life (i.e. the tax depreciation rate is equal is each period), while under declining balance cost recovery, the investment is depreciated at a constant rate on its remaining book value.

[54] Note that in certain countries the standard rules allow for a share of the acquisition cost being immediately expensed, implying that the expense becomes available at the beginning of period zero when the initial investment is made ($Z_0 > 0$). While this possibility is not spelled out explicitly in equation (A-6), it is general enough to accommodate immediate expensing, or bonus depreciation, as defined in Gonzalez Cabral, Appelt and Hanappi (2021[11]). In this case, the deduction in the initial period (Z_0) corresponds to the share of the acquisition cost that is immediately expensed, while the remainder ($1 - Z_0$) is then depreciated under the applicable cost recovery method. If the CIT rate does not change over the useful life of the asset ($\tau_t = \bar{\tau}\ \forall\ t \geq 0$), the NPV of capital allowances can be rewritten as: $\boldsymbol{A} = Z_0\tau_0 + (1 - Z_0)\sum_{s=1}^{\infty}(\bar{\tau} Z_{t+s})/(1+i)^s$.

tax profit in each period can be easily derived by setting all tax parameters in the equation for post-tax profit to zero. That is, setting the CIT rate (τ_t) and capital allowances (Z_t) in each period to zero (equation (A-8)).

Pre-tax net income (Y_t^*) differs from revenue insofar as it is defined net of the economic depreciation of the asset. It, therefore, depends only on the pre-tax rate of return per unit of capital (p) and the capital stock used in production in the previous period, which depreciates over time (equation (A-9)).

$$R_t^* = Q_t - I_t \tag{A-8}$$

$$Y_t^* = pK_{t-1}(1+\pi)^t \tag{A-9}$$

Summing up: General derivation of the EATR

In the previous paragraphs, the key variables required for the EATR calculation have been defined on a period-by-period basis (equations (A-8) and (A-9)). To derive the EATRs, the NPV of each of the underlying variables is calculated to account for all associated cash flows occurring over the lifetime of the investment project. The NPVs of these cash flows are calculated over an infinite number of periods to keep the model as general as possible.[55]

The economic rent ($\boldsymbol{R}$) is given by the discounted sum of post-tax profits and can be decomposed into three separate terms: the NPVs of net revenues, taxes due and investment, where i is the nominal interest rate and s is the index of summation (equation (A-10)).

$$\boldsymbol{R} = \sum_{s=0}^{\infty} \frac{Q_{t+s}}{(1+i)^s} - \sum_{s=0}^{\infty} \frac{\tau_{t+s}[Q_{t+s} - Z_{t+s}]}{(1+i)^s} - \sum_{s=0}^{\infty} \frac{I_{t+s}}{(1+i)^s} \tag{A-10}$$

The first term captures the NPV of revenues net of variable costs.[56] The second term captures the NPV of taxes due, i.e. considering the per period taxable income (i.e. net revenue, Q_t, minus available tax allowances and deductions under general tax treatment, Z_t) and the applicable tax rate, τ_t.[57] The third term is the NPV of investments and disinvestments, including the initial investment in period zero as well as potential disinvestments, i.e. asset sales, in later periods.

The general representation of economic rent in equation (A-10) provides enough flexibility to incorporate different types of targeted preferential treatment in the standard framework. In particular, the second term captures the NPV of taxes due and allows modelling the effects of time-varying tax rates as well as changes to the tax base as defined by capital allowances. Additional deductions from tax liability, i.e. credits, can easily be added too (Section 3of the main paper).

The pre-tax economic rent ($\boldsymbol{R}^*$) can be derived directly from equation (A-10), by setting all tax parameters to zero (equation (A-11)). The NPV of pre-tax net income is given in equation (A-12). Substituting equations (A-10) – (A-12) into equation (A-1) then yields the EATR ($EATR = (\boldsymbol{R}^* - \boldsymbol{R})/\boldsymbol{Y}^*$).

[55]The per period pre- and post-tax profit and pre-tax net income of the investment gradually reduce to zero, as capital stock decays due to economic depreciation. Therefore, accounting additional periods beyond the end of the economic lifetime of the investment (e.g. infinite periods) does not change the value of the NPVs calculations.

[56] No output will be produced in the initial period so that revenue in the initial period is zero ($Q_0 = 0$).

[57] Opening up the brackets in the numerator of the second term shows that this representation is equivalent to the definition of the NPV of standard capital allowances ($\boldsymbol{A}$), as defined in equation (A-6).

$$R^* = \sum_{s=0}^{\infty} \frac{Q_{t+s}}{(1+i)^s} - \sum_{s=0}^{\infty} \frac{I_{t+s}}{(1+i)^s} \quad \text{(A-11)}$$

$$Y^* = \sum_{s=0}^{\infty} \frac{Y_t^*}{(1+i)^s} \quad \text{(A-12)}$$

As indicated above, the EMTR provides a complementary view by focusing on marginal projects, and collapses into the EATR in the special case where an investment project earns just enough discounted lifetime profit for the investment to break even after tax. In the above setting, the EMTR can be derived setting equation (A-10) for the post-tax profit rate equal to the cost of capital ($p = \tilde{p}$)[58] The EATR indicates how much of the profit associated with a project has to be paid in taxes over its entire lifetime and, therefore, measures the effects of taxation on inframarginal projects making non-zero economic rents. The EMTR, instead, indicates the extent to which taxation increases the cost of capital and it is, therefore, associated with marginal projects earning zero economic rents.

2. Deriving key variables under the permanent investment case

The standard ETR framework derived above is flexible and can accommodate investments of different characteristics, economic contexts as well as decisions about timing of investments and disinvestments. To model the whole range of investment tax incentives in one unified framework, the present analysis focuses on the permanent investment case (PIC), which implies that a firm makes an investment in the first period that is never sold or expanded. This specification is different from other timing specifications (e.g. the one-period investment case) and required to capture temporarily reduced CIT rates or tax exemptions that apply on a temporary basis.

In the permanent investment case, the firm invests one unit in the first period, thereby increasing the capital stock that will generate a return. The firm continues to exploit the capital stock, K_t, until it is fully depleted as economic depreciation proceeds, δ. Revenues (net of variable cost) continue to accrue in line with the pre-tax rate of return, p, gross of depreciation, δ, and adjusted for inflation, π. Figure A A.1 describes this time structure period-by-period for the key variables throughout the first five periods after the investment occurs: the firm's net revenue in each period ($Q_t = (p+\delta)K_{t-1}(1+\pi)^t$) and the two variables that it depends on, namely investment (I_t) and capital stock ($K_t = K_{t-1}(1-\delta) + I_t$).

Figure A A.1. Permanent investment case: investment, capital stock and net revenue in each period

	Investment (I_t)	Capital stock (K_t)	Net revenue (Q_t)
Period 0	+1	+1	0
Period 1	0	$(1-\delta)$	$(p+\delta)(1+\pi)$
Period 2	0	$(1-\delta)^2$	$(p+\delta)(1+\pi)^2(1-\delta)$
Period 3	0	$(1-\delta)^3$	$(p+\delta)(1+\pi)^3(1-\delta)^2$
Period 4	0	$(1-\delta)^4$	$(p+\delta)(1+\pi)^4(1-\delta)^3$

Note: p denotes the pre-tax rate of return on capital net of depreciation, δ the rate of economic depreciation and π is the annual inflation rate.
Source: Authors' representation.

[58] The cost of capital ($\tilde{p}$) can be derived by setting the post-tax economic rent ($\boldsymbol{R}$) equal to zero and solving the equation for the pre-tax rate of return ($p = \tilde{p}$).

A one-unit investment occurs in the initial period ($t = 0$) and is not sold nor expanded in the following periods ($I_t = 0 \; \forall t \geq 1$) (column 1). The initial investment increases the capital stock in the initial period by the same amount, which then progressively decays due to economic depreciation (column 2). The firm begins generating revenue in the periods following the initial investment. Over each additional period, net revenue reduces as capital stock decays (column 3) and falls to zero over infinite periods, when the capital stock gradually returns to the pre-investment level ($\lim_{t \to \infty} K_t = 0$).

The economic rent associated with the investment ($\boldsymbol{R}$), pre-tax economic rent ($\boldsymbol{R}^*$) and pre-tax net income ($\boldsymbol{Y}^*$) are thus summarised in the following equations, where τ denotes the standard CIT rate, i the nominal interest rate used for discounting and $\boldsymbol{A}$ the NPV of standard capital allowances. Assuming a constant standard rate, $\bar{\tau}$, the infinite summations yields the following main equations:

$$\boldsymbol{R} = \sum_{s=0}^{\infty} \frac{(p+\delta)(1+\pi)^s(1-\delta)^{s-1}(1-\bar{\tau})}{(1+i)^s} + \boldsymbol{A} - 1 = \frac{(p+\delta)(1+\pi)(1-\bar{\tau})}{i-\pi+\delta(1+\pi)} - (1-\boldsymbol{A}) \quad \text{(A-13-PIC)}$$

$$\boldsymbol{R}^* = \sum_{s=0}^{\infty} \frac{(p+\delta)(1+\pi)^s(1-\delta)^{s-1}}{(1+i)^s} - 1 = \frac{p-r}{r+\delta} \quad \text{(A-14-PIC)}$$

$$\boldsymbol{Y}^* = \sum_{s=0}^{\infty} \frac{(p)(1+\pi)^s(1-\delta)^{s-1}}{(1+i)^s} = \frac{p}{r+\delta} \quad \text{(A-15-PIC)}$$

Several policy applications of the forward-looking ETR framework build on a different specification about the timing of investment and disinvestment decisions i.e. assuming a one period perturbation of the capital stock, following (Devereux and Griffith, 2003[5]). This approach captures the one-period investment case (OPC) assuming a firm invests one unit of capital in period 0 and sells the capital stock in the following period (period 1), at its remaining value accounting for economic depreciation. The OPC specification is based on the assumption that tax parameters remain constant in the future or that businesses do not anticipate a tax rate change in the future when making their investment decisions. Klemm (2008[9]; 2012[6]) has shown that the PIC and the OPC cases collapse as long as the effects of personal income taxation are not taken into account and there is no taxation of excess depreciation upon the sale of the asset. Figure A A.2 summarises the underlying time structure for investment (I_t), capital stock ($K_t = K_{t-1}(1-\delta) + I_t$) and net revenue ($Q_t = (p+\delta)K_{t-1}(1+\pi)^t$).

Figure A A.2. One-period investment case: investment, capital stock and net revenue in each period

	Investment (I_t)	Capital stock (K_t)	Net revenue (Q_t)
Period 0	+1	+1	0
Period 1	$-(1-\delta)(1+\pi)$	$(1-\delta)$	$(p+\delta)(1+\pi)$
Period 2	0	0	0
Period 3	0	0	0
Period 4	0	0	0

Note: p denotes the pre-tax rate of return on capital net of depreciation, δ the rate of economic depreciation and π is the annual inflation rate.
Source: Authors' representation.

Investment occurs in the initial period ($t = 0$) and is sold for its remaining value in the following period ($t = 1$). No additional investments are made ($I_t = 0 \forall \; t \geq 2$) (column 1). The investment increases the capital stock in the initial period, while divestment reduces it to the initial level (column 2). Net revenue depends

on the available capital stock in the previous period and falls to zero as the previous period's capital stock reduces to zero too (column 3).

Post-tax and pre-tax economic rent ($\boldsymbol{R}$ and $\boldsymbol{R}^*$) as well as pre-tax net income ($\boldsymbol{Y}^*$) yield the following simplified equations.[59]

$$\boldsymbol{R} \;=\; -(1-\boldsymbol{A}) + \frac{(p+\delta)(1+\pi)(1-\bar{\tau}) + (1-\delta)(1+\pi)(1-\boldsymbol{A})}{1+i} \qquad \text{(A-16-OPC)}$$

$$\boldsymbol{R}^* \;=\; -1 + \frac{(p+\delta)(1+\pi) + (1-\delta)(1+\pi)}{(1+i)} \;=\; \frac{p-r}{(1+r)} \qquad \text{(A-17-OPC)}$$

$$\boldsymbol{Y}^* \;=\; 0 + \frac{(p)(1+\pi)}{(1+i)} \;=\; \frac{p}{(1+r)} \qquad \text{(A-18-OPC)}$$

3. Tax incentives in the permanent investment case

The post-tax economic rent ($\boldsymbol{R}$) under preferential tax treatment can be represented using the augmented expressions for taxes due derived in Section 3 in equation (A-19). The equations below describe the post-tax economic rent under each of the four investment tax incentive instruments (reduced rates, tax exemption, tax allowance and tax credit). Two equations describe tax exemption, distinguishing between partial tax exemptions (A-21) and temporary full tax exemptions (A-22). Section 3 described the variables and parameters notation used in the equations below.

Temporarily reduced rate

$$\boldsymbol{R} \;=\; \sum_{s=0}^{\infty} \frac{Q_{t+s}}{(1+i)^s} - \sum_{s=0}^{x} \frac{\tau^{reduced}[Q_{t+s} - Z_{t+s}]}{(1+i)^s} + \sum_{s=x+1}^{\infty} \frac{\tau^{standard}[Q_{t+s} - Z_{t+s}]}{(1+i)^s} - \sum_{s=0}^{\infty} \frac{I_{t+s}}{(1+i)^s} \qquad \text{(A-20)}$$

Partial tax exemption

$$\boldsymbol{R} \;=\; \sum_{s=0}^{\infty} \frac{Q_{t+s}}{(1+i)^s} - \sum_{\boldsymbol{s=0}}^{\infty} \frac{\tau[(1-d\vartheta)Q_{t+s} - Z_{t+s}]}{(1+i)^s} - \sum_{s=0}^{\infty} \frac{I_{t+s}}{(1+i)^s} \qquad \text{(A-21)}$$

Temporary full tax exemption

$$\boldsymbol{R} \;=\; \sum_{s=0}^{\infty} \frac{Q_{t+s}}{(1+i)^s} - \sum_{s=0}^{x} \frac{\tau[(1-\vartheta^{holiday})Q_{t+s} - Z_{t+s}]}{(1+i)^s} + \sum_{s=x+1}^{\infty} \frac{\tau[Q_{t+s} - Z_{t+s}]}{(1+i)^s} - \sum_{s=0}^{\infty} \frac{I_{t+s}}{(1+i)^s} \qquad \text{(A-22)}$$

Tax allowance

$$\boldsymbol{R} \;=\; \sum_{s=0}^{\infty} \frac{Q_{t+s}}{(1+i)^s} - \sum_{s=0}^{\infty} \frac{\tau[Q_{t+s} - Z_{t+s} - a_{t+s}I_0]}{(1+i)^s} - \sum_{s=0}^{\infty} \frac{I_{t+s}}{(1+i)^s} \qquad \text{(A-23)}$$

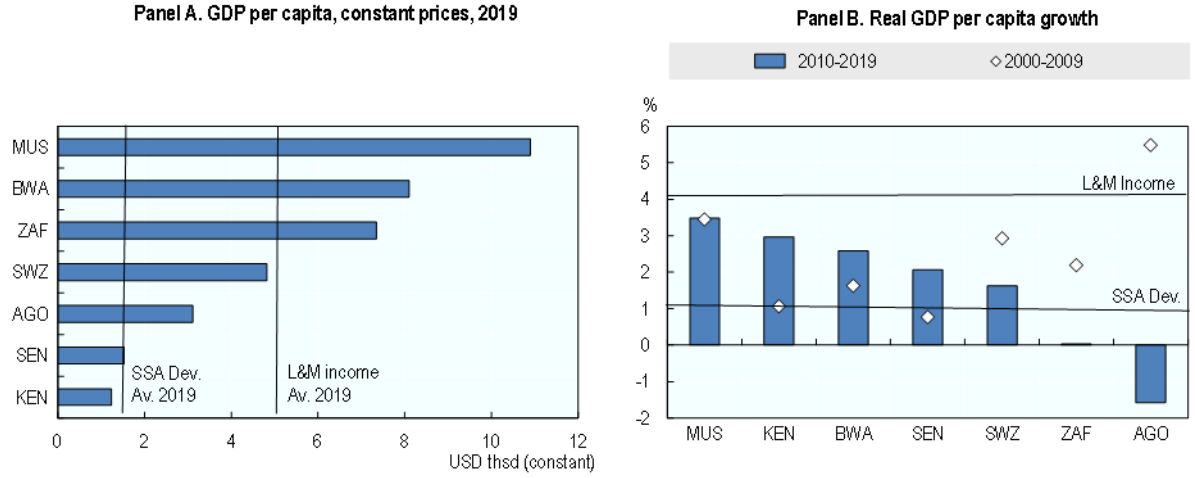
[59] The NPV of tax allowances ($\boldsymbol{A}$) captures capital allowances over the entire lifetime of the investment, while other variables simplify. That is, as investment, capital stock and gross profits fall to zero from period 2 onwards, their NPVs simplify to the sum of the period 0 and period 1 values ($\boldsymbol{R} = R_0 + R_1/(1+i)$). Nominal and real interest rates are linked by the Fisher equation: $(\boldsymbol{1}+\boldsymbol{i}) = (1+r)/(1+\pi)$.

Tax credit

$$\boldsymbol{R} \;=\; \sum_{s=0}^{\infty} \frac{Q_{t+s}}{(1+i)^s} - \sum_{\boldsymbol{s=0}}^{\infty} \frac{\tau[Q_{t+s} - Z_{t+s}] - c_{t+s} I_0}{(1+i)^s} - \sum_{s=0}^{\infty} \frac{I_{t+s}}{(1+i)^s} \tag{A-24}$$

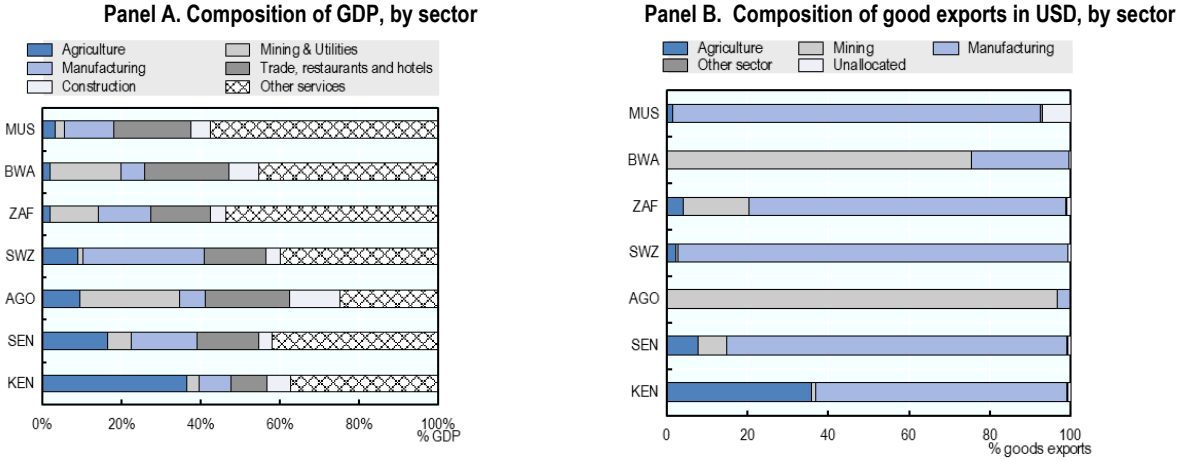
Annex B. Key economic variables in the seven countries

Figure A B.1. GDP per capita and GDP per capita growth, 2000-2019



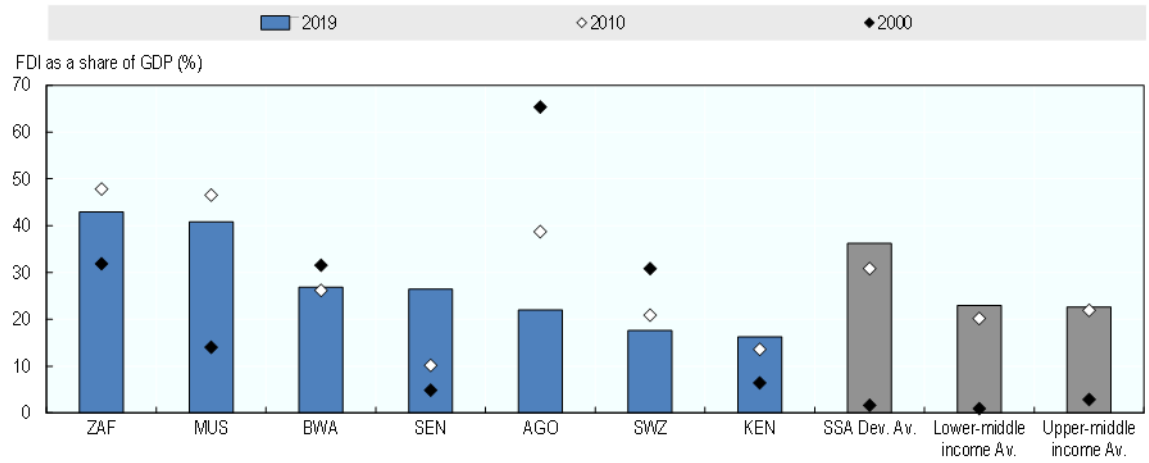
Note: SSA Dev. = Sub-Saharan Africa developing economies average; L&M Income = Low and middle-income country average, 2019 country groups. Panel B: Real GDP per capita growth of South Africa for 2010-2019 is 0.2%
Source: Authors' elaboration based on World Bank Group (2021[32]), *World Development Indicators* (database), http://wdi.worldbank.org.

Figure A B.2. Composition of GDP and exports by sector, 2019



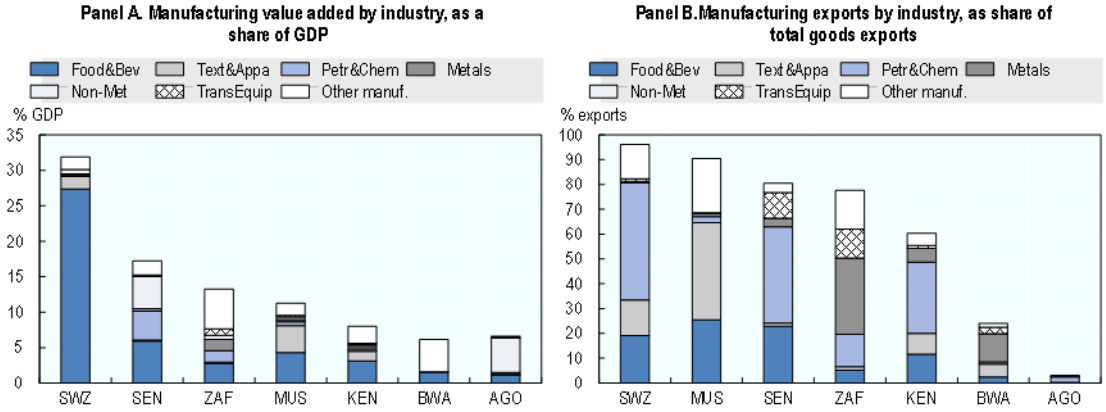
Note: Panel B data for Angola is from 2018 and "other sectors" refers to non-manufacturing goods exports.
Source: UN (2021[33]), *National Accounts Statistics: Main Aggregates and Detailed Tables* (database), https://unstats.un.org/unsd/nationalaccount/madt.asp and OECD (2020[28]), *STAN Bilateral trade database by industry and end-use category*, ISIC Rev. 4 (Edition 2020) (database), https://doi.org/10.1787/1e5ffb3e-en.

Figure A B.3. FDI stock, as share of GDP, 2000-2019



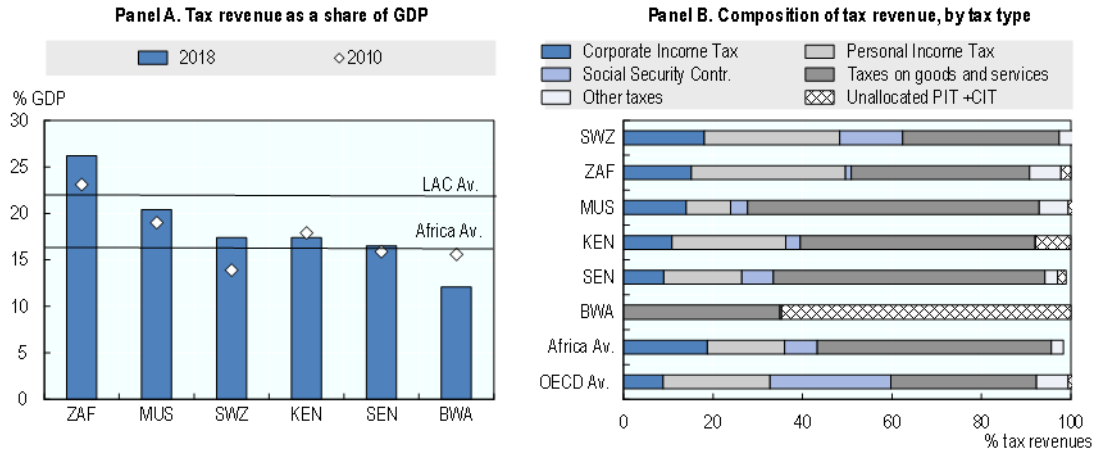
Note: SSA = Sub-Saharan Africa.
Source: UNCTAD (2021[34]) *UNCTAD Stat*, https://unctadstat.unctad.org.

Figure A B.4. Composition of manufacturing value added (MVA) and exports by industry, 2019



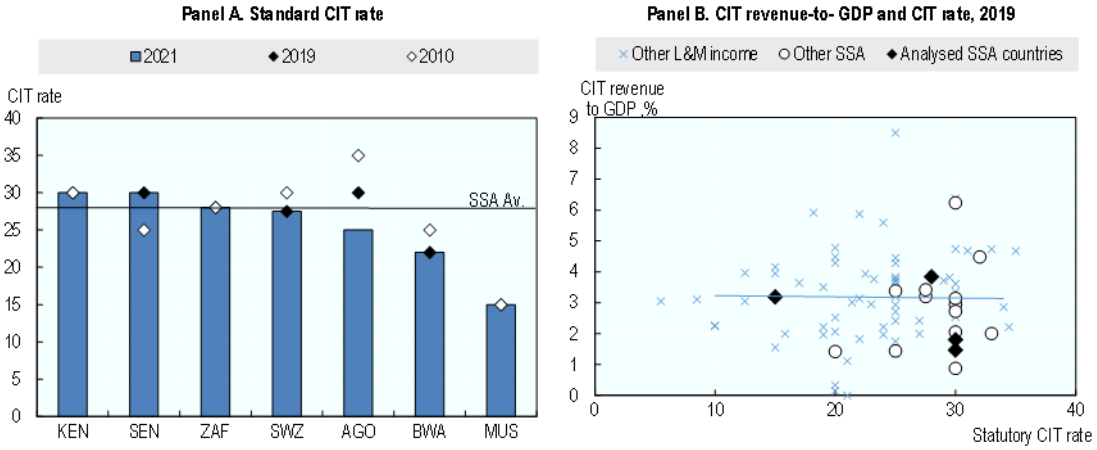
Note: Panel A: MVA = Manufacturing value added of an economy is the total estimate of net-output of all resident manufacturing activity units obtained by adding up outputs and subtracting intermediate consumption. MVA as a share of GDP is estimated applying the available ISIC Rev.3 Industry compositions by the share of manufacturing in GDP. Eswatini data is from 2011 and Senegal data is from 2014. Data for Botswana only available for food & beverage and textile & apparel, other industries are grouped under other. Value added data is not available for Angola and 2017 output is used a proxy. Panel B: Data for Angola is from 2018.
Source: Authors' elaboration based on UNIDO. (2021[29]) *INDSTAT 2 ISIC Rev 3* (database), https://stat.unido.org/, World Bank Group (2021[32]), *World Development Indicators* (database), http://wdi.worldbank.org, and OECD (2020[28]) *STAN Bilateral Trade Database by Industry and End-use category (Edition 2020)* (database), https://doi.org/10.1787/1e5ffb3e-en.

Figure A B.5. Tax revenue and tax composition in selected SSA economies



Note: Tax revenue data is not available for Angola.
Source: OECD (2022[35]) *Global Revenue Statistics* (database), https://stats.oecd.org/Index.aspx?DataSetCode=RS_GBL.

Figure A B.6. Importance of corporate tax rates and bases in selected SSA economies



Note: Panel B: Black diamonds represent KEN, SEN, MUS, and ZAF. CIT revenue-to-GDP data is not available for AGO, BWA and SWZ. Blue fitted line evaluates the linear relation between standard CIT rates and CIT revenue-to-GDP ratios of countries across 52 developing economies. Standard CIT rate are from OECD CTS database, complemented by KPMG Corporate Tax Rates in selected developing economies.
Source: OECD (2022[35]) *Global Revenue Statistics* (database), https://stats.oecd.org/Index.aspx?DataSetCode=RS_GBL, OECD (OECD, 2021[8]) *Corporate Income Tax Statistics*, https://doi.org/10.1787/168deb14-en, and KPMG (2021[36]) Corporate tax rates for 2017-2021 (database), https://home.kpmg/xx/en/home/services/tax/tax-tools-and-resources/tax-rates-online.html.

Annex C. Parameters used in the empirical calibration of EATRs

This annex summarises additional details used in the empirical calibration of the EATRs. Models of ETRs become more complex as more features of the tax system are accounted for. Among them are the inclusion of personal income taxes, other related taxes such as real estate taxation or the consideration of alternative forms of financing for the investment. In this empirical calibration, no personal income taxes or other taxes beyond CIT are assumed and an investment project is assumed to be fully financed by retained earnings.

EATRs are calculated for a same investment in a single asset, i.e. industrial machinery, holding all other parameters except the country-specific tax treatment constant. Asset-level EATRs match the detail of domestic tax codes. They can be used to analyse the neutrality of corporate taxation within a given country or across countries and give indications about the existence and magnitude of tax-induced biases across investments for the specific asset including through tax incentives.

Investment and macroeconomic parameters

The EATR calculation considers a same investment project in a single asset type, i.e. industrial machinery, and with pre-tax rate of return of 20%. The 20% is assumed throughout all calculations, independent of the economic activity or location of the investment project. The industrial machinery asset has a true economic depreciation rate of 12.6% per year. Asset-specific true economic depreciation rates are based on the rate considered in the OECD CTS.

The interest and inflation rates are two of the main economic parameters of relevance. Both of them are linked to the nominal rate of interest by means of the Fisher equation.[60] The empirical analysis is conducted initially for one macroeconomic scenario. Economic parameters are fixed across all countries to facilitate cross-country comparisons and summarised in Table A C.1. The real interest rate is set to 3% and the inflation rate to 1% in line with the low-tax scenario considered in Hanappi (2018[7]) and CTS (OECD, 2018[37]).

Table A C.1. Economic parameters

Economic Parameter	Variable	Value
Real interest rate	r	0.03
Inflation	π	0.01
Nominal interest rate	i	0.0403
Pre-tax real rate of return	p	0.2

Corporate tax is levied on nominal returns, irrespective of the underlying real return. Increases in nominal returns due to inflation, which are not matched by corresponding increases in real returns would, therefore increase effective tax rates. While inflation increases nominal returns, depreciation allowances can be

[60] The Fisher equation establishes the link between the nominal interest rate, i, the real interest rate, r, and the inflation rate, π, as $(1+i) = (1+r)(1+\pi)$.

deducted over the lifetime of the asset at inflated or non-inflated values. In countries with high inflation, inflation can cause an over taxation of investment income when depreciation is not indexed. EATRs in Section 4assume that capital allowances are not indexed to inflation.

Standard tax treatment parameters

Table A C.2 summarises the standard tax rate and capital allowance rates by asset according to specified depreciation methods under standard tax treatment in the seven economies. The table considers tax treatment parameters collected through the OECD CTS that applied on 1 January 2020.

Tax parameters for cost recovery considers the most common method used in each country within a given asset category. Under standard treatment, capital cost recovery schedule depends on the capital cost recovery method that applies (column 3), the availability of initial allowances under standard treatment (column 4) and the capital allowance rate (column 5). Initial allowances or first year allowances accelerate cost recovery of capital investments. When these accelerations are asset-specific and do not apply under additional eligibility conditions, they are considered part of the standard tax treatment.

Table A C.2. Main tax parameters under standard tax treatment

Country	Standard CIT rate	Cost recovery method	Initial allowance	Capital allowance rate
AGO	25%	Straight-line	25%	25%
BWA	22%	Straight-line	NA	25%
KEN	30%	Declining-balance	100%	10%
MUS	15%	Straight-line	NA	35%
SEN	30%	Straight-line	NA	10%
SWZ	28%	Declining-balance	50%	25%
ZAF	28%	Straight-line	40%	20%

Note: Capital allowance and cost-recovery method consider an investment in industrial machinery assets.
Source: OECD CTS.

Additional modelling considerations

EATR incorporating investment tax incentives assume that businesses can make full use of the granted tax benefit immediately once it is available, as well as full standard allowances – except if explicitly stated otherwise. For example, a business benefiting from a full tax exemption also makes use of its capital allowances during this period. The underlying assumption is the modelled business has other profit generating investment against which tax allowances can be deducted and in certain cases, this can result in investment projects with negative ETRs.

Investment tax incentives may or may not be asset-specific depending on their design. Expenditure-based incentives apply at the asset-level or for asset categories (e.g. machinery), while income-based are generally not asset-specific. Calculated ETRs are asset-specific and expenditure-based incentives that apply to the relevant asset modelled are considered.

Annex D. Estimated effective average tax rates for the seven Sub-Saharan African countries in the respective sectors

Table A D.1. Effective average tax rates for the seven Sub-Saharan African countries

EATRs under standard tax treatment and under investment tax incentives that target the food and automotive industries and in SEZs, ordered by generosity when multiple incentives apply under the same targeting

Country	Standard tax treatment	Food industry	Automotive industry	Special economic zones
AGO	23.1%	12.2% (Area D incentive) 13.5% (Area C incentive) 21.0% (Area B incentive) 23.0% (Area A incentive)	12.2% (Area D incentive) 13.5% (Area C incentive) 21.0% (Area B incentive) 23.0% (Area A incentive)	NA
BWA	20.3%	13.8% (Reduced 15% rate) 8.2% (5-year reduced 5% rate)	13.8% (Reduced 15% rate) 8.2% (5-year reduced 5% rate)	8.2%
KEN	26.4%	NA	17.9%	11.3% 8.2% (Export processing zone)
MUS	14.0%	6.3% (Tax exemption) 10.2% (Tax credit) 13.2% (Tax allowance)	6.3% (Tax exemption) 10.2% (Tax credit) 13.2% (Tax allowance)	2.8%
SEN	29.9%	15.0% (Partial tax exemption) 16.3% (70% tax allowance) 21.2% (40% tax allowance) 23.3% (30% tax allowance) 29.3% (20% tax allowance)	15.0% (Partial tax exemption) 16.3% (70% tax allowance) 21.2% (40% tax allowance) 23.3% (30% tax allowance) 29.3% (20% tax allowance)	15.8%
SWZ	25.6%	NA	NA	0.3%
ZAF	25.6%	NA	NA	17.8%

Note: NA (not applicable) = no CIT incentives specifically target the corresponding industry or SEZ in the corresponding country. See Table 4.1 and Table 4.2 for additional details on the CIT incentive design and targeting. This figure considers investment tax incentives available to investors as of 1 January 2021. For Senegal, the EATRs consider incentive-specific ceilings and five-year carryover limit.
Source: Author's calculations based on OECD ITID and OECD CTS database.