DISCUSSION PAPER

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The Tax Attractiveness of EU Locations for Corporate Investments: A Stocktaking of Past Developments and Recent Reforms

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The tax attractiveness of EU locations for corporate investments: a stocktaking of past developments and recent reforms [*]

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Abstract

Tax incentives are a key component of governments' investment policy mix as they directly impact companies' tax burden. In this paper, we illustrate the EU's tax attractiveness as investment location over time in terms of effective average tax rates and evaluate potential tax reform options. Our quantitative assessment of recent tax policies suggests that corporate tax rate cuts, notional interest deductions and R&D incentives reduce the effective average tax rate significantly. However, we argue that targeted measures such as accelerated depreciations and R&D incentives are most suitable for creating an attractive tax environment for business investments, especially in the context of the global minimum tax.

JEL Classification: F21, F23, H25, K34

Keywords: Mannheim Tax Index, effective tax rates, Devereux-Griffith methodology, global minimum tax, tax incentives, investment, location attractiveness

1 Introduction

For years, tax policy has been referred to as location policy. Numerous studies show that the tax framework and, in particular, the effective tax burden at the corporate level are key decision-making factors for multinational corporations when it comes to investment decisions (including Schreiber et al. 2002, Schanz et al. 2017). From empirical studies, it can be concluded that a one percentage point (pp) higher corporate tax rate reduces investment activity by approximately 2.49 percent (Feld and Heckemeyer 2011). Particularly in an integrated economic area such as the European internal market, the existing disparity in the corporate income tax burden can have an impact on the choice of location, the volume of investment, the allocation of profits within the group, and the method of financing investments.

In order to properly classify the trends in the development of the effective tax burdens and to evaluate current tax reforms in the European Union (EU), a brief summary of the general tax policy trends of the past 30 years is setting the scene. Until the 1990s the sole focus of international tax policy was on avoiding double taxation. With the proceeding economic integration and the increase in the mobility of capital, the trend towards falling corporate tax rates began. In particular, when Eastern European countries gained access to the European internal market in 2004, they stood out with comparatively low corporate income tax rates. This induced a dynamic of tax rate cuts also within larger economies (Elschner et al. 2011). These tax rate cuts often came along with tax base broadening reforms (Bräutigam et al. 2019). In the aftermath of the economic and financial crisis in 2008/2009, the trend of cutting tax rates stalled for some years. In the meantime legislators have increasingly focused on highly mobile and highly profitable economic activities (Bührle et al. 2023a): They introduced targeted tax incentives to attract mobile activities ("smart tax competition"). Examples include tax incentives for research and development (R&D) and preferential tax regimes for intangible assets (so-called patent boxes).

At the same time, in response to what is perceived as aggressive tax planning, numerous countermeasures have been adopted. These efforts gained momentum with the publication of the OECD Base Erosion and Profit Shifting (BEPS) report in 2015. Within the framework of the OECD/G20 BEPS project and the Anti Tax Avoidance Directive (ATAD) at the EU level, a large number of measures which hamper profit shifting and tax base erosion were implemented. Concurrently, tax transparency has been increased through initiatives such as Country-by-Country Reporting (CbCR) and the Directive on Administrative Cooperation. On top of these numerous initiatives that curb profit shifting, in July 2021, 137 countries that belong

to the OECD's Inclusive Framework agreed on the introduction of a global minimum tax of 15 percent for large firms (> EUR 750 million turnover) as part of the OECD Two Pillar Strategy. In contrast to other countries, the EU Member States are obliged to implement the global minimum tax by the end of 2023 due to the adoption of the Global Minimum Tax Directive.[6]

Taking all these developments together, it seems to be that at this point, at the latest, the avoidance of double taxation receded into the background as a secondary objective; since the main focus of international regulations has strikingly been shifted to restrict or prevent excessive shifting of tax substrate (Heckemeyer 2022). Consequently, for multinationals, it is now more costly to mitigate the impact of high corporate tax rates in high-tax countries by re-allocating profits to lower taxing jurisdictions. As tax competition among countries is quite pronounced with respect to corporate investment location choice (Overesch and Rincke 2011), the relevance of the effective tax burden is especially increasing in high-tax locations. At the same time, the scope for tax policy makers to create an attractive investment climate in terms of taxes is limited due to the recently implemented anti-avoidance rules. Put differently, due to the global minimum tax, tax incentives might not be effective for large firms if they reduce the firm's effective tax rate below 15 percent.

Against this background, the objective of this paper is twofold. First, we illustrate the EU's tax attractiveness as investment location over time in terms of effective tax burdens. Second, we sketch and evaluate the impact of most recent tax policy actions taken or planned by EU Member States to improve their attractiveness within the boundaries that have been set by anti-tax avoidance measures. This comprehensive analysis of potential tax instruments contributes to a better understanding of the current challenges policy makers face in creating an optimal tax environment for business investments.

To analyse the development of the effective tax burden for corporations, we primarily rely on the data of the Mannheim Tax Index, which benchmarks the tax attractiveness of investment locations by calculating effective tax rates for highly profitable companies. These estimates are based on Devereux and Griffith's (1999, 2003) methodology and go beyond statutory tax rates by incorporating important tax base effects and non-profit taxes.

We find that over the past 20 years, on average, all EU Member States followed a trend of declining effective tax burdens. However, the high-tax EU countries in particular have not been able to improve their relative tax attractiveness. Our quantitative assessment of recent tax

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[6] For a detailed description of the regulations and functioning of the global minimum tax see e.g. Bührle et al. (2023b).

policies suggests that corporate tax rate cuts, notional interest deductions and R&D incentives reduce the effective average tax rate (EATR) significantly. However, the former two measures are particularly costly for the government. In contrast, targeted measures such as accelerated depreciations, R&D incentives and reduced tax rates exclusively for certain qualified investment types have a clear focus on increasing investment activity while simultaneously preventing free-riding. We argue that in the context of the global minimum tax, accelerated depreciations as well as R&D tax incentives will be the most viable instruments to increase a countries' location attractiveness from a tax perspective.

The remainder of this article proceeds as follows. Section 2 provides a brief overview of the methodology that is used to measure the effective tax rates before it evaluates the development of national tax burdens over the last two decades. Section 3 measures the impact of current tax policy developments on effective tax burdens quantitatively and discusses them critically. Section 4 concludes.

2   The EU's tax attractiveness as an investment location

2.1   Data and methodology

A simple comparison of statutory corporate income tax rates to assess the tax attractiveness of investment locations would not give the whole picture, as reductions of corporate income tax rates are often accompanied by changes in the tax base (Bräutigam et al. 2019). Therefore, we rely on the Mannheim Tax Index[7] to analyse the tax attractiveness of the EU Member States for the manufacturing sector. This index benchmarks all countries of the European Economic Area as well as major international competitors (such as Switzerland, Türkiye, North Macedonia, the United Kingdom, Canada, Japan and the United States) from a corporate tax perspective.[8]

The benchmarking of the local tax attractiveness of the Mannheim Tax Index relies on the well-established forward-looking effective tax measures developed by Devereux and Griffith (1999, 2003). These comprehensive effective tax rates take the statutory tax rates into account and incorporate the most significant features of the underlying corporate income tax system, e.g. tax allowances, (notional) interest deductibility, local profit tax rates, surcharges, and non-income tax charges. [9] Comparing effective tax rates over time (2005-2022) provides an intuition

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[7] For more details, please refer to https://www.zew.de/en/mannheim-tax-index (accessed 13/10/2023).
[8] In the following figures, we will use the ISO 3166 ALPHA-2 abbreviation for the sample countries.
[9] We assume that the manufacturer makes its investment and its profits in the same jurisdiction and in the same entity. Thus, we do not take into account tax planning or profit-shifting activities. In addition, the Devereux-

about common trends, possible interdependencies between locations, as well as the tax distortion of investment location decisions (Jacobs and Spengel 2000).

As we aim at analysing the effect of corporate taxes on countries' tax attractiveness as investment location, i.e. on multinational companies' decision whether or not to choose a specific investment location, we rely on the EATR. The EATR is especially relevant when companies decide on the geographical allocation of economic returns (Devereux and Griffith 2003, Spengel 2003). When choosing from a set of mutually exclusive investments with an identical pre-tax real rate of return, a company will favour the alternative with the highest post-tax net present value, where the EATR is lowest.

2.2 Trends in the development of effective tax burdens in the EU and selected third countries

Figure 1 shows pronounced variations in investment location attractiveness among the countries examined, particularly within the EU. Already in 2005, Spain, Germany, and France showed the highest EATRs among the EU27 Member States with 36.5 percent, 35.8 percent, and 34.8 percent, respectively, and are still the top three high-tax countries in the EU in 2022 (29.0 percent, 28.8 percent and 24.4 percent). In our sample, only Japanese corporations face a higher effective tax burden in 2022, whereas former high-tax competitors such as the United States and Canada significantly reduced their EATRs over the last decade. Yet, they still have above-EU average EATRs. This is in line with the theory that large economies have on average a higher tax burden than smaller economies (Sorensen 2004).[10]

Griffith methodology does not allow, without further simplifying assumptions, to account for more stringent anti-avoidance measures (e.g. interest deduction limitation rules, controlled foreign corporation rules).

[10] See Figure B1 in Appendix B for an illustration of the mentioned relationship among our sample countries for the year 2022.

Figure 1: EATRs for corporations in 2005 and 2022 (in percent)
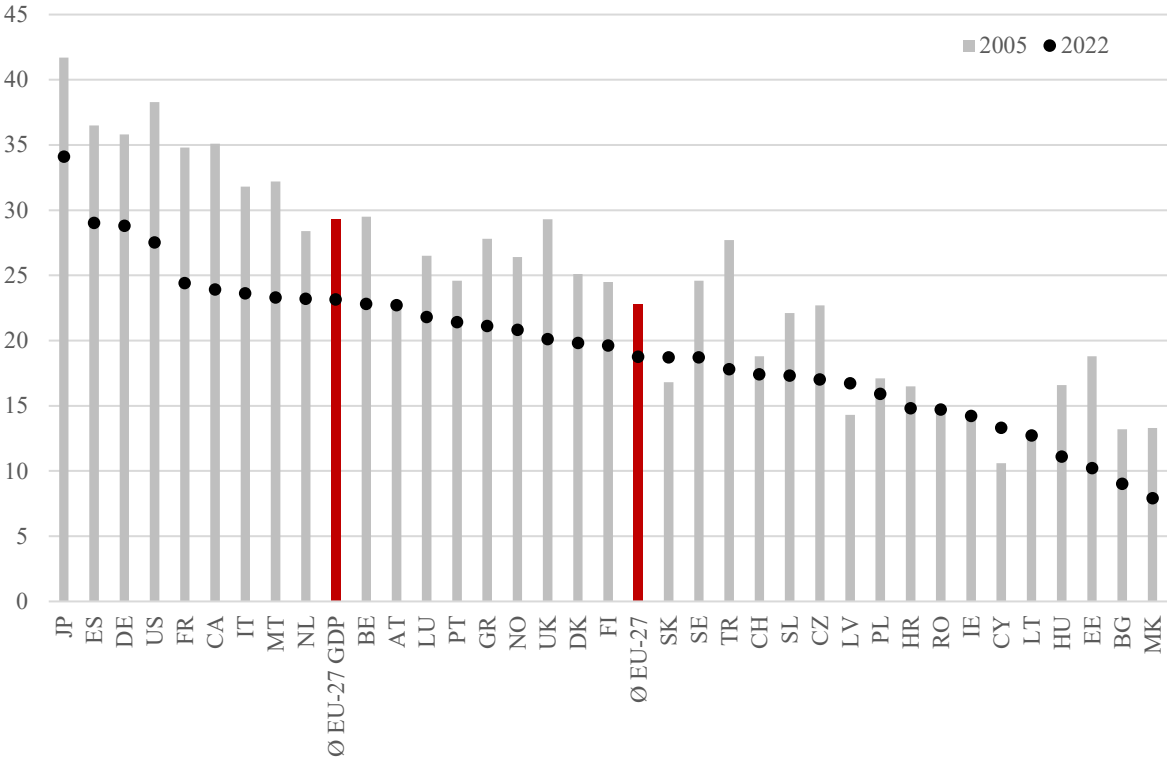
Notes: The figure displays EATRs for corporations in 2005 (grey bars) and in 2022 (black dots) in percent. The red bars represent the GDP-weighted and the unweighted average EATR in the EU27.
Source: Mannheim Tax Index (2023) / Authors' contribution.

A glance at the timeline of the EATR (based on the comparison of 2005 and 2022) shows a significant downward trend for most of the countries considered. However, the degree of reduction in the effective tax burden varies considerably between these countries. Notably, countries with a higher-than-average EATR in 2005 exhibited more significant reductions. In addition, we find that the tax competition witnessed was primarily driven by countries outside the EU27, as they show the greatest reductions during our sample period: Canada (-11.2 pp), the United States (-10.8 pp), Türkiye (-9.9 pp) and the United Kingdom (-9.2 pp).[11] In contrast, the unweighted (GDP-weighted)[12] average tax burden in the EU27 has decreased by merely 4.1 percentage points (6.2 pp) within the same time span. Thus, we observe a significantly lower dynamic in tax rate cuts in the EU as of 2005 in comparison to earlier observation periods (Elschner et al. 2011).

To gain further insights into the dynamics of EATRs and their main drivers, Figure 2 illustrates the development of average EATRs and average statutory corporate income tax rates relative

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[11] Within the EU Member States only FR, as an exception, had a similar reduction in its EATR by 10.4 pp during the observation period.
[12] To calculate the average EATR weighted by GDP, we use the GDP (total) data of OECD (2023), measured in Million US dollars.

to the base year 2005. Thereby, we differentiate between EU27 Member States and countries outside the EU27. In doing so, Figure 2 allows us to draw conclusions about the heterogeneous development of average effective tax burdens over time between the EU and non-EU countries. In addition, the comparison of the relative development of average EATRs (solid lines) and statutory corporate income tax rates (dashed lines) illustrates the influence of tax base measures in tax competition.

Figure 2: Development of the average tax rates in relation to the base year 2005
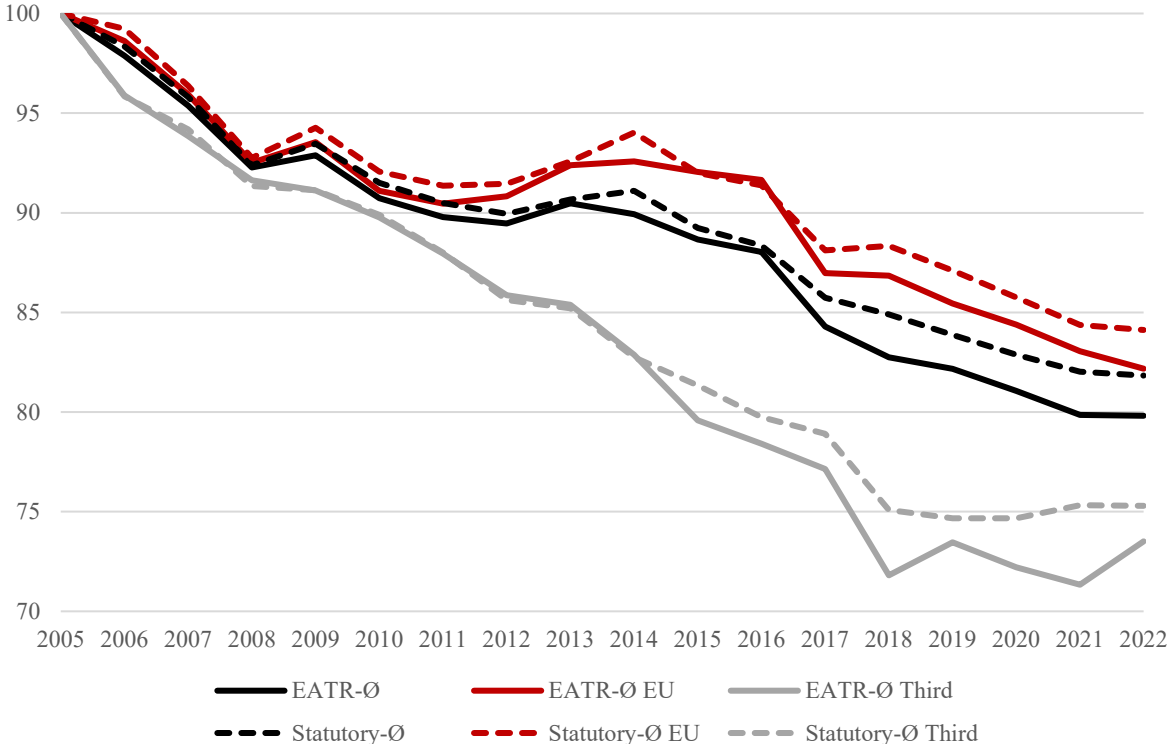
Notes: The figure displays the development of average EATRs and average statutory corporate tax rates relative to the base year 2005, i.e. 2005 has a value of 100 percent. The black lines represent all countries, while the red (grey) lines take into account the average EATR of the EU27 (third countries) separately.
Source: Authors' contribution.

The development of the average effective tax burden in the EU can be broken down into three phases. In the first phase, from 2005 to 2008, both EU27 Member States and third countries were characterised by an on average declining effective tax burden. The reduction in EATRs was slightly more pronounced in third countries, but was driven by statutory corporate tax rate cuts in both groups of countries, as highlighted by the missing spread between the solid and dashed line.

In the second phase, from 2008 to 2016, a diverging EATR-trend can be observed between third countries and the EU. While the average effective tax burden in third countries continued to fall, it nearly stagnated in the EU due to opposing developments within EU Member States. The

fluctuation in the European effective tax burden can be explained as follows: In the years following the financial crisis, several EU Member States increased their statutory corporate income tax rates and thus their effective tax burden. Yet, the majority of these increases in the corporate income tax rate were only temporary and (largely) reversed in the following years.[13] Simultaneously, some EU Member States reduced their corporate income tax base by introducing notional interest deduction regimes, resulting in an initially lower EATR.[14] However, due to the development to a low-interest environment in the EU, corporate tax bases started to increase again as notional interest deduction rates were often closely linked to the general interest environment. In addition, our analysis shows that alongside the reduction of statutory corporate income tax rates, for both sets of countries, tax base measures have become an important instrument for making an investment location more attractive (as indicated by the gap between the solid and dashed line).

The third phase captures the development as of 2016. Since then, the average EATR for the EU shows a clear downward trend, while the effective tax burden for third countries stagnates after 2020. Thereby, countries still rely on generous tax rate cuts (e.g. France, Belgium). However, the increasing spread of the solid and dashed lines highlights that countries more heavily rely on complementary tax base measures to increase their investment location attractiveness. The increase in the EU spread is mostly driven by the introduction of very generous notional interest deduction regimes (e.g. in Portugal and Malta). In addition, EU Member States regularly use accelerated capital allowances to improve their location attractiveness for corporate investment from a tax perspective.[15] This instrument allows them to encourage investment in certain types of assets either on a permanent basis or temporarily as a stimulus in times of economic crisis.[16]

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[13] We observe final increases in CY, LV, PT and SK. For an overview of the historical development of statutory corporate income tax rates, see Section A, Table A-1 in Spengel et al. (2022).

[14] During the sample period, notional interest deductions were introduced in BE (2006-2017), LV (2010-2013), IT (2011), CY (2015), TR (2015), PT (2017), MT (2017) and PL (2019). For the impact of notional interest deductions on effective tax burden measures and their development over time, see Section B.7 to B.13 in Spengel et al. (2022).

[15] For an overview on the applicable capital allowances for industrial buildings, machinery and acquired intangibles, see Section A, Table A-6, A-7, and A-8 in Spengel et al. (2022).

[16] The Mannheim Tax Index does not encompass tax incentives that are introduced temporarily due to its focus on reflecting tax competition's long-term evolution. To give an example, both DE and AT introduced an accelerated depreciation during the Covid-19 pandemic. While the measure was implemented permanently in AT, it was of temporary nature in DE. Thus, the Mannheim Tax Index only incorporates the Austrian regulation. For a comprehensive analysis of how accelerated depreciation affects the EATR, please refer to section 3.1.

3 Evaluation of potential tax reform options to stimulate corporate investment

## 3.1 Current tax policy developments and their impact on effective tax burdens

After having evaluated past developments in effective tax burdens, this section focuses on the most recent tax reforms and reform plans by EU Member States to improve their tax attractiveness for corporate investments. As pointed out above, numerous anti-tax avoidance measures limit the scope for tax policy actions. In particular, the implementation of the global minimum tax as of 2024 reduces the potential for tax rate and tax base cuts. In the following, we briefly outline selected policy actions recently taken as well as tax reform proposals discussed by Member States. In addition, we estimate their potential impact on effective tax burdens for companies to evaluate to what extent countries can improve their attractiveness within the boundaries of current EU legislation. In our analysis, we mainly focus on long-standing high-tax countries to highlight their potential for becoming more attractive investment locations.

Tax rate cut and dual corporate income tax regime

A common measure to attract corporate investments is a reduction in the statutory corporate tax rate. To give an example, France has continuously decreased its corporate tax rate from 33.3 percent in 2019 to 25 percent in 2022. In addition, the French legislator decided to gradually abolish the contribution on the value added of companies (CVAE) to increase the competitiveness of French companies.[17] Figure 3 shows the effect of the tax rate cut in France on the EATR. The decrease in the statutory corporate tax rate of 8.3 percentage points translates into a decline in the EATR of 7.6 percentage points (from 32 percent to 24.4 percent).

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[17] *Projet de loi de finances pour 2023*, Article 5, available at https://www.assemblee-nationale.fr/dyn/16/textes/l16b0273_projet-loi (accessed 13/10/2023).

Figure 3: Impact of a tax rate cut and a dual corporate income tax regime on the EATR (in percent)
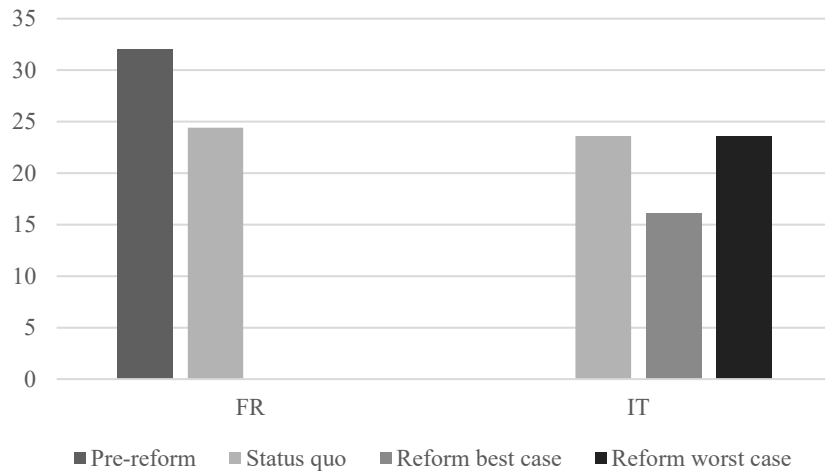
Notes: The figure compares EATRs of corporations under the status quo in 2022 with EATRs incorporating the reform options discussed in Section 3.1 (*Tax rate cut and dual corporate income tax regime*). In contrast to IT, FR already implemented the reform. *Reform best (worst) case* refers to a 100 (zero) percent qualified investment. *Source:* Authors' contribution.

As opposed to a general corporate income tax rate cut, Italy decided in favour of a split rate system with a reduced corporate tax rate on certain qualified investments and a regular tax rate (dual corporate income tax regime).[18] The aim of the reform, which was approved in 2023, is to stimulate economic growth and ensure greater international tax competitiveness.[19] Although the specific tax rates are not yet known, the reduced tax rate is expected to align with the global minimum tax rate of 15 percent. When modelling the reform, we assume that the regular tax rate remains at 24 percent. Figure 3 depicts the EATRs for two extreme scenarios, i.e. 100 percent qualified investments ("best case") and zero percent qualified investments ("worst case"). In case of qualified investments only, the reduced tax rate of 15 percent would result in an EATR of 16.1 percent. In contrast, the EATR would remain at 23.6 percent if the firm did not perform any qualified investment. However, in reality, the effective tax burden might lie between these extreme values.

In sum, Figure 3 illustrates that the corporate income tax rate is the main driver of the EATR. This can be attributed to the fact that the EATR measures the tax burden on a highly profitable investment, i.e. the profit tax has a large impact compared to other non-profit taxes and tax base regulations.

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[18] The reduced tax rate is supposed to precede the execution of the investments, i.e. companies are subject to the reduced tax rate in the first place and in case they do not perform a qualified investment, they have to pay back the difference between the regular rate and the reduced rate in subsequent periods.

[19] *Legge 9 agosto 2023, n. 111, Delega al Governo per la riforma fiscale*, Article 3, available at https://www.gazzettaufficiale.it/eli/id/2023/08/14/23G00122/sg (accessed 13/10/2023).

Accelerated depreciation

As mentioned in Section 2, countries are also implementing accelerated depreciation schemes to boost economic activity. To highlight the impact of this measure on the EATR and thus on countries' tax attractiveness as investment location, we focus on two countries implementing different accelerated depreciation schedules.

First, the German legislator plans to temporarily introduce a declining-balance depreciation with a rate of 25 percent instead of a linear depreciation scheme for tangible assets.[20] Figure 4 shows that the impact of this reform proposal on the EATR is only marginal.[21] The small decrease of 0.2 percentage points results from the fact that in the model applied for the calculation of the effective tax burden, the more favourable depreciation scheme would apply to machinery, which represents only 20 percent of capital employed. Moreover, the current German legislation allows companies to depreciate machinery linearly over its useful life. Assuming a useful life of seven years, the difference between the status quo and the reform proposal is relatively small. A larger reduction in the EATR may only be achieved with more generous depreciation rules.

Figure 4: Impact of accelerated depreciation schemes on the EATR (in percent)
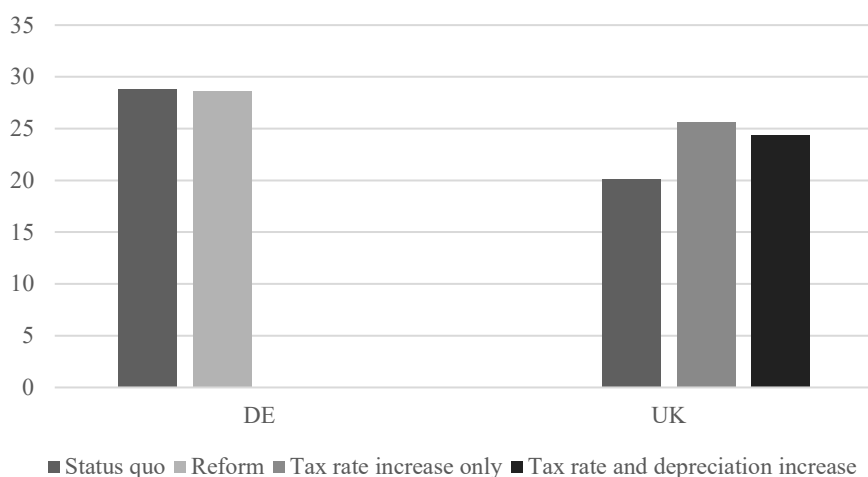
Notes: The figure compares EATRs of corporations under the status quo in 2022 with EATRs incorporating the reform options discussed in Section 3.1 (*Accelerated depreciation*).
Source: Authors' contribution.

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[20] *Entwurf eines Gesetzes zur Stärkung von Wachstumschancen, Investitionen und Innovation sowie Steuervereinfachung und Steuerfairness*, Article 4, available at https://dserver.bundestag.de/btd/20/086/2008628.pdf (accessed 13/10/2023).
[21] Note that the tax base only has a minor effect on the EATR and therefore is less relevant for location choices than the tax rate. However, tax base elements can have a significant impact on the effective marginal tax rate (EMTR) and thus on the volume of investments. For more details on the EMTR, see Appendix A1.

In contrast, the United Kingdom is an example for introducing more generous depreciation regulations. In 2023, the corporate income tax rate was increased from 19 percent to 25 percent, but at the same time full expensing, i.e. a 100 percent capital allowance on qualified plant and machinery investment, was implemented on a temporary basis. Prior to the reform, machinery had to be depreciated on a declining-balance basis at a rate of 18 percent. Figure 4 displays the impact of both reform elements separately. As mentioned above, a change in the corporate income tax rate has a large impact on the EATR. The six percentage point increase in the statutory tax rate raises the EATR from 20.1 percent to 25.6 percent. However, when also taking into account the possibility of an immediate write-off of machinery, the EATR decreases to 24.4 percent. Taken together, both measures have opposing effects on the effective tax burden.

Notional interest deduction

Another policy option that is currently discussed is the introduction or even harmonisation of notional interest deduction regimes. As outlined in Section 2, some EU Member States already apply notional interest deductions. However, the notional interest rate and the specific design of the regime differs across countries. In 2022, the European Commission presented the so-called DEBRA proposal that aims at reducing tax-induced distortions between equity and debt financing.[22] One of the proposed measures is the implementation of an allowance on equity using a (currency-specific) harmonised notional interest rate. If the DEBRA proposal is adopted, countries that already have a notional interest deduction regime in place will have to apply DEBRA's provisions instead of their domestic regulations.[23]

Figure 5 illustrates the heterogeneous impact the DEBRA proposal has on Member States' effective tax burdens based on two example countries. While Spain currently does not apply a notional interest deduction and represents a high-tax country, Portugal has a very generous regime in place with a notional interest rate of seven percent. For the simulation of DEBRA we use an interest rate of 4.092 percent.[24] The implementation of the aforementioned measure would decrease the EATR in Spain by four percentage points, while the EATR in Portugal would increase by almost three percentage points. Thus, depending on the generosity of the current national regime, the DEBRA proposal can have heterogeneous effects on the effective

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[22] Proposal for a Council Directive on laying down rules on a debt-equity bias reduction allowance and on limiting the deductibility of interest for corporate income tax purposes (11 May 2022), COM(2022) 216 final.

[23] However, there is a grandfathering rule that allows these countries to defer the application of DEBRA's provisions up to ten years.

[24] This is the 10-year risk-free interest rate published by the European Insurance and Occupational Pensions Authority (EIOPA) as of 31 December 2022 to which the directive proposal refers, plus a risk premium of one percent.

tax burden. Compared to the accelerated depreciation schemes shown above, the introduction of an allowance on equity has a larger impact on the EATR. However, the effect is strongly dependent on the exact parameters, i.e. the depreciation rates, notional interest rates and the respective asset and financing weight.

Figure 5: Impact of notional interest deduction regimes on the EATR (in percent)
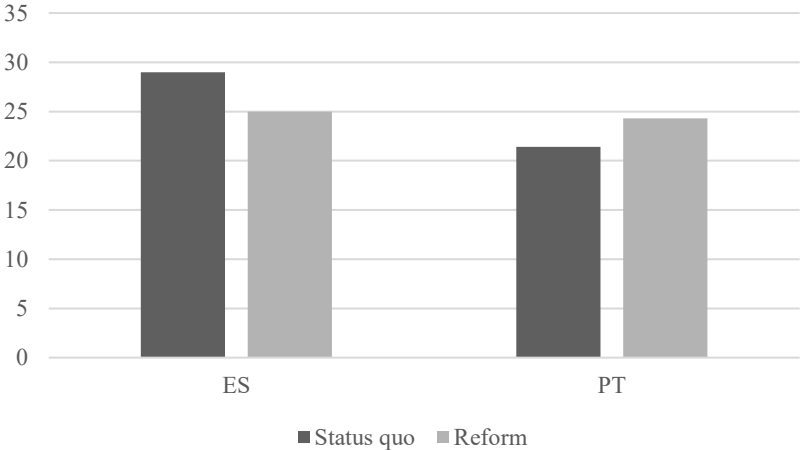
Notes: The figure compares EATRs of corporations under the status quo in 2022 with EATRs incorporating the reform options discussed in Section 3.1 (*Notional interest deduction*).
*Source:* Authors' contribution.

R&D tax incentives

In addition to general measures reducing the effective tax burden, countries grant targeted tax incentives for specific activities. In the context of the so-called "smart tax competition", R&D tax incentives are a widely used measure to attract mobile activities. Here, a distinction between input- and output-based incentives can be made: Input-based incentives refer to more generous tax deductions for R&D expenses (in the form of tax credits, super-deductions and accelerated depreciation for assets used in the R&D process), while output-based incentives grant reduced tax rates for income resulting from the innovation process (so-called patent box regimes).

To examine the impact of these R&D incentives on the effective tax burden, some model assumptions have to be modified.[25] More specifically, we consider a self-developed patent instead of an acquired patent in all of the following R&D incentive simulations. This allows us to model incentives related to different R&D activities within a company, such as expenses for personnel, machinery and buildings. Before analysing the impact of R&D tax incentives on the EATR, we highlight the effect of the modified model assumptions. While an acquired patent has to be capitalised and depreciated over several years, expenses for a self-developed patent

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[25] For more details, see Appendix A, Table A1.

can usually be immediately expensed. To illustrate the effect of these different depreciation schedules, Figure 6 contrasts the EATRs resulting from an investment in an acquired patent versus a self-developed patent in selected countries.[26] While the EATRs of these two scenarios are relatively similar in Germany, Italy and the United States, the effective tax burden from the investment in a self-developed patent is much lower compared to the investment in an acquired patent in Spain, France and the United Kingdom. These heterogeneous effects can be explained by the different length of the underlying depreciation schedules for acquired patents in the aforementioned countries.

Figure 6: EATRs in the baseline scenario and in the R&D scenario without incentives (in percent)
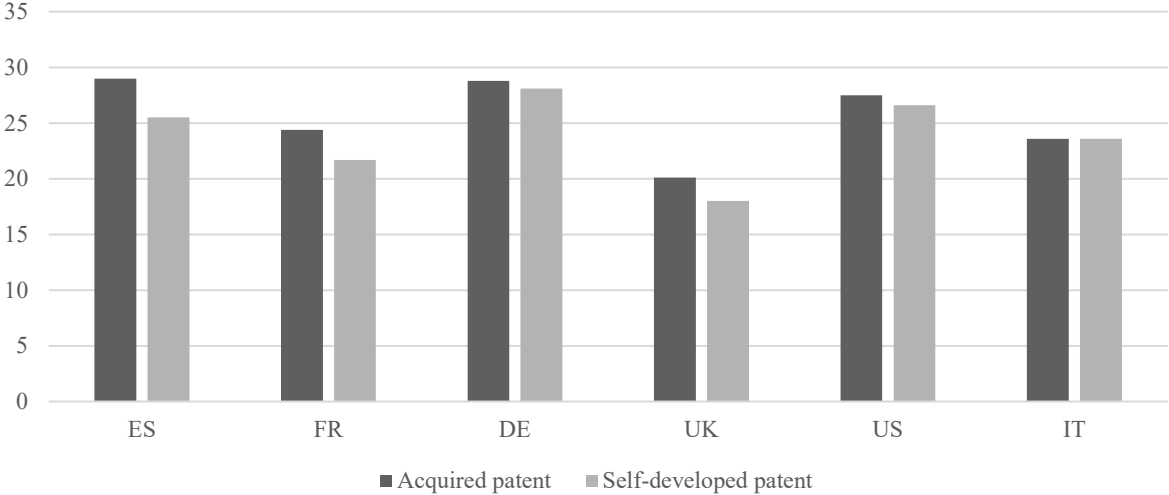
Notes: The figure compares EATRs of corporations in the baseline scenario and the R&D scenario without incentives (in 2022). In the baseline (R&D) scenario, we assume an acquired (self-developed) intangible asset. While the acquired intangible is capitalised and depreciated over several years, the self-developed intangible can usually be immediately expensed.
Source: Authors' contribution.

In the following, we analyse the impact of R&D incentives on the EATR. Figure 7 displays the results of several sensitivity analyses with respect to changes in the generosity of R&D incentives. On the one hand, it illustrates the impact of incentives compared to the ordinary tax burden and on the other hand, it compares the R&D scenario in the status quo with different reform options. [27]

Although Spain and France have a relatively high ordinary effective tax burden (see Section 2), they provide generous R&D tax credits with a broad tax base and a rate higher than the corporate

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[26] Note that in both cases, the patent investment has a weight of 20 percent.
[27] To ensure comparability, we consider only R&D tax incentives that ex ante apply to all taxpayers. Thus, incentives specifically targeting small and medium-sized enterprises, young companies, companies with a strong growth rate, a particular ownership structure or within a specific region, are not included in the analysis.

income tax rate as well as a patent box regime. Moreover, they allow for an accelerated depreciation of tangible assets used for R&D. Figure 7 shows that due to the aforementioned R&D incentives currently in place, the EATR in both countries is reduced by around eight percentage points. Thus, countries can increase their attractiveness significantly by implementing generous targeted tax incentives.

Figure 7: Impact of R&D tax incentives on the EATR (in percent)
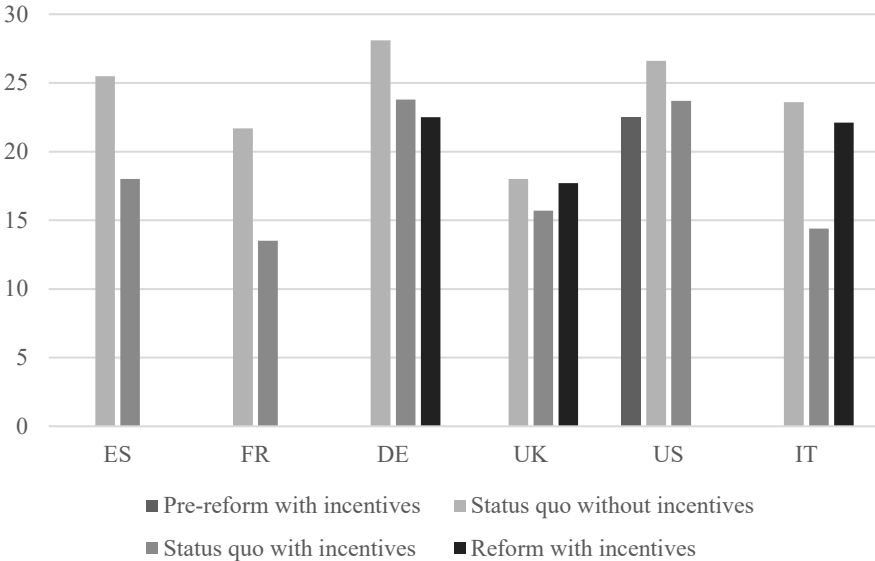
Notes: The figure displays EATRs of corporations with and without R&D incentives in place in 2022 (*status quo*) in percent. The dark coloured bars show EATRs incorporating the reform options discussed in Section 3.1 (*R&D incentives*). In case of the US, the dark coloured bar represents the pre-reform status.
Source: Authors' contribution.

While R&D incentives also have been in place in the remaining countries depicted in Figure 7, they either were recently amended or are planned to be modified. In 2020, Germany introduced a tax credit for eligible R&D expenses amounting to 25 percent. Currently, eligible expenses include R&D personnel expenses only. However, the German legislator plans to extend the assessment basis to expenses for movable fixed assets used for R&D activities. This expansion would decrease the EATR by 1.3 percentage points and thus make R&D investments more attractive. However, the overall impact of R&D incentives on the effective tax burden is rather limited, as apart from the tax credit, there are no other incentives in place.

In contrast to Germany, the United Kingdom provides various R&D incentives such as an accelerated depreciation for qualified assets, a patent box regime granting a reduced tax rate of ten percent for income from intellectual property and an R&D tax credit. As part of the aforementioned reform in the United Kingdom that increased the corporate income tax rate and introduced a more generous depreciation schedule, the R&D tax credit was increased from 13

percent to 20 percent. Figure 7 illustrates that although the tax credit becomes more generous, the overall effective tax burden increases. Thus, the effect of the tax rate increase from 19 percent to 25 percent outweighs the effect of the more generous tax credit. However, without the tax credit amendment the EATR would be even higher.

As mentioned before most countries allow for an immediate expensing of R&D personnel expenditure, even if they do not grant any further incentives. While in the United States in the past, researchers' wages could be immediately expensed in the year they were incurred, since 2022, these expenses are required to be capitalised and depreciated over six years. Although in sum, the same amount of expenses can be deducted from the tax base in both scenarios, the immediate expensing is more advantageous for companies in terms of liquidity. This can also be seen in Figure 7, as the EATR increases from 22.5 percent to 23.7 percent in the capitalisation scenario.

Finally, in the context of the dual corporate income tax reform and against the background of the global minimum tax, the Italian legislator plans to revise and simplify all tax incentives. It is expected that the current tax incentives are gradually replaced by the application of the reduced tax rate for certain investments. To examine the impact of a potential shift from a tax-incentive system to a tax system based on a reduced tax rate for qualified investments, we assume that all R&D incentives are abolished. Instead, R&D activities are regarded as qualified investment and therefore subject to the reduced tax rate. Under the assumption that – as before – R&D investment accounts for 20 percent of the overall investment and the remaining 80 percent are not regarded as qualified investment, we compute a weighted average tax rate of 22.2 percent.[28] In addition, we do not include any R&D incentives in the simulation. Under the status quo, the EATR including the R&D incentives in place is relatively low (14.4 percent) compared to the case without incentives (23.6 percent), suggesting that the incentives are generous. In contrast, under the application of the dual corporate income tax regime without any tax incentives, the EATR increases significantly to 22.1 percent. However, this estimate rather represents a higher bound of the EATR, as the percentage of qualified investments in many cases might be larger.

After having examined different reform options separately, we compare their concrete potential for improving EU Member States' tax attractiveness for corporate investments. Figure 8 provides a comprehensive overview of the effective tax burden in the status quo as well as under

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[28] The regular rate of 24 percent applies to the non-qualified investment (weighted at 80 percent) and the reduced tax rate of 15 percent to the qualified investment (weighted at 20 percent). Thus, the tax rate is calculated as follows: 80%*24%+20%*15% = 22.2%.

the aforementioned reforms.[29] Overall, the implementation of a tax rate cut (as illustrated for Italy and France) can lower the effective tax burden and thus increase the attractiveness of a country significantly. However, the implementation of a dual corporate income system requires a qualified investment in order to benefit from the reduced tax rate. While an accelerated depreciation scheme does not have a large effect on a country's position in the EATR ranking, the introduction of a notional interest deduction – as suggested by the DEBRA proposal – increases the attractiveness for investments significantly.[30]

Figure 8: EATRs under status quo and with reform options (in percent)
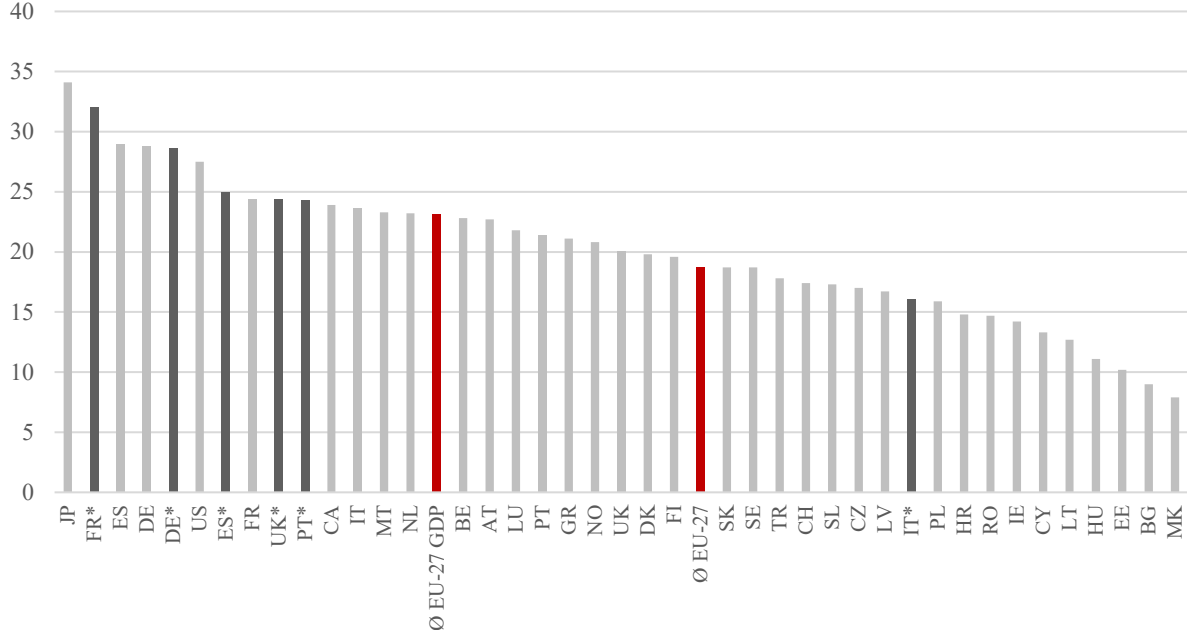
Notes: The figure displays EATRs for corporations in 2022 (in percent). The EATRs of countries marked with an asterisk (dark coloured bars) incorporate the reform options discussed in Section 3.1. In case of FR, the dark coloured bar represents the pre-reform status and the light coloured bar the status quo.
Source: Mannheim Tax Index (2023) / Authors' contribution.

In sum, tax rate changes and notional interest deduction regimes have the largest impact on the effective tax burden as measured by the EATR. In contrast, more generous depreciation schemes only have a minor effect as they usually are only applicable to specific assets. However, the impact on the effective tax burden strongly depends on the specific design of the respective measure.

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[29] Note that Figure 8 does not incorporate R&D incentives and assumes that the patent is acquired. For a ranking of EATRs incorporating available R&D incentives in selected countries, see Appendix B, Figure B2.
[30] The effect of the DEBRA proposal is modelled using the examples of Spain and Portugal. Note that in case of the implementation of DEBRA, all EU Member States would be affected.

3.2 Evaluation of tax reform options against the background of current developments

The previous analysis of prospective reform options reveals that the different measures show a varying impact on the effective tax burden across countries. In order to analyse the potential of each tax instrument to optimise the tax attractiveness of investment locations, we complement the quantitative analysis by a critical discussion of the following aspects: empirical evidence on the ability to promote investment, the cost of the measure in the context of tight national budgets, and a reflection of its usefulness in the context of the global minimum tax.

Tax rate cut and dual corporate income tax regime

As has been shown in the development of EATRs over time (see Section 2), the statutory tax rate is a strong determinant of the EATR, i.e. phases with declining EATRs are often characterised by tax rate cuts. A tax rate cut is typically regarded as a strategy to attract the inflow of foreign direct investment (or prevent its outflow) in order to maintain global competitiveness in the international location competition. An argument in favour of reducing statutory corporate income tax rates is the direct impact it has on the EATR (see Section 3.1, Figure 3). Thus, in terms of tax policy, reducing the statutory corporate income tax rate has a major signalling effect. Against the background of numerous anti-avoidance regulations, the location choice of multinational firms will even more depend on the statutory corporate tax rate as ex-post shifting of profits to lower-tax jurisdictions becomes more costly. This is in line with the finding of Dobbins and Jacob (2016) that prior to the comprehensive anti-avoidance initiatives, domestic firms reacted more strongly to tax rate cuts than foreign owned firms (which were able to shield considerable parts of their profits from high tax rates by relocating them to low-tax jurisdictions). Further studies indicate that a reduction in corporate income tax rates is associated with higher levels of innovation (Falck et al. 2021) as well as an increase in investments, total wages, private consumption and GDP (Dorn et al. 2021).

The advantage of tax rate cuts comes at a cost. Most prominently, tax rate cuts are considerably costly relative to alternative measures as they result in a loss of tax revenues (Dorn et al. 2021). One reason for this is that all companies benefit from a reduced tax rate, including those that do not invest. Therefore, its effect on economic growth and investment is less substantial than that of more targeted measures (Hanappi et al. 2023).

With the implementation of the global minimum tax in the EU starting from January 2024, the EU limits the scope for corporate tax rate cuts. Statutory tax rates below 15 percent become less attractive as they would likely result in effective tax burdens below this threshold and thus

trigger the application of a top-up tax (Ferreira Liotti et al. 2022). However, it is important to note that this minimum tax is applicable solely to large multinationals that have revenues surpassing EUR 750 million. Therefore, significant reductions in tax rates remain a viable option for small and medium-sized businesses. In this context, it is also evident that general tax rate reductions are more appealing to countries with high tax rates as in most cases they still have room to decrease statutory tax rates towards the global minimum tax rate of 15 percent.

An alternative scheme of a tax rate cut distinguishes between favourable tax rates for certain qualified investments and a general rate. Generally, the proposed dual corporate income tax system (as quantified for Italy in Section 3.1) is more targeted at promoting investments, as only those firms that actually invest benefit, while the others have to pay an additional tax at the differential between the beneficial and regular corporate income tax rate. This idea is operationalised in two ways: In the first approach, companies pay the regular corporate income tax to the tax administration, and receive subsequent tax refunds for certain promoted investments. In the second approach, as recently proposed by Italy, a more favourable tax rate is initially applied to all companies, in a way similar to a general tax rate reduction.[31] However, if companies fail to meet the pre-specified investment requirements, they have to pay back taxes. This second approach more closely resembles a general reduction in statutory tax rates.

As only those companies that actually invest benefit from the lower rate, a dual corporate income tax regime encourages investment in a more targeted way and also prevents free-riding. It is a compromise in the sense that it limits the revenue loss. Yet, the benefits primarily comprise those of a tax cut. Particularly in the case of the second approach in which the lower tax rate is applied beforehand, companies should have more liquidity at disposal for investment since lower tax payments occur before potential investment activities. Effectively, this split rate system constitutes an interest-free loan to companies. Again, as for the general tax rate cut, the global minimum tax as well as revenue constraints limit the applicability of this policy.

Accelerated depreciation

Beyond tax rate cuts, tax base measures, such as accelerated depreciation are regularly introduced as investment stimulus (recent examples include Germany and the United Kingdom, see Section 3.1). In these accelerated depreciation regimes, the depreciation allowances are concentrated on the early years of an asset's economic life while the deductions from the tax base are reduced accordingly in later years. Thus, it does not lead to a long-term loss of tax

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[31] For more details see e.g. https://taxnews.ey.com/news/2023-1451-italy-approves-framework-for-major-tax-reform-including-beps-pillar-two-principles (accessed 13/10/2023).

revenue, but rather in a postponement of tax payments into the future (Dorn et al. 2021). This makes it attractive from a government perspective. The tax benefit for the investing firm results from the so called timing effect of taxation: early tax savings yield a value if the interest rate is positive. Again, the postponement of tax payments essentially represents an interest-free loan for companies (Domar 1953).

Several empirical studies corroborate the effectiveness of accelerated depreciation empirically. For example, Eichfelder et al. (2023) and Maffini et al. (2019) find that accelerated depreciation schemes lead to higher levels of investment. These findings are in line with the model calculation of Dorn et al. (2021), where accelerated depreciation has positive effects on the level of investment as well as on wages, consumption and GDP. However, the investment effect size depends on the existence of liquidity constraints. Zwick and Mahon (2017) find a higher investment response if accelerated depreciation results in an immediate cash flow due to tax savings in the same period as opposed to a postponed cash flow (e.g. when a firm is loss making and tax advantages only materialise in the future).[32] From the government's perspective, in the best case scenario, the lower tax revenues will be offset by additional revenues due to successful investments and the resulting increase in economic activity (Goode 1955, Dorn et al. 2021).

Potential side effects of accelerated depreciation include opportunities for tax planning, increased complexity and compliance costs. Opportunities for tax planning, for example, arise due to the presence of multiple, overlapping incentives linked to one asset (Hanappi et al. 2023). In addition, despite the stimulating effect of accelerated depreciations, the quality of investment does not necessarily increase. In fact, Eichfelder et al. (2023) find a decrease in the quality of investments resulting from these types of tax incentives because they diminish the marginal cost of capital. Consequently, while in total more investments are carried out, a part of them is profitable only due to the additional incentive.

As mentioned above, accelerated depreciation schemes allow for higher deductions in the early years of an asset's economic life, which could result in an effective tax rate below 15 percent and thus trigger a top-up tax. However, when calculating the effective tax burden for global minimum tax purposes, not only actual taxes paid but also deferred taxes are taken into account. Deferred taxes arise from temporary differences between the actual tax expense and the tax expense according to financial accounting and thus also include accelerated depreciations for tax purposes. In the context of the global minimum tax, accelerated depreciation schemes or

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[32] When high allowance deductions lead to losses, more generous loss carry-back or loss carry-forward rules allow for a more timely realisation of the tax advantage from depreciation.

immediate expensing can therefore still be used as a measure for stimulating investment without increasing the risk of a top-up tax (Ferreira Liotti et al. 2022).

Notional interest deduction

In our analysis, the measure that results in the sharpest decline in EATRs after the tax rate reductions presented is the introduction of a generous notional interest deduction. This measure aims at creating an investment-promoting environment as it shields the marginal return of the investment from taxation. By allowing an additional allowance to be deducted from the tax base that reflects the cost of equity financing, a notional interest deduction addresses the debt-equity bias that arises from the distinct tax treatment of debt and equity (Devereux and Freeman 1991). Thus, it helps to achieve two primary objectives: enhancing the investment environment for domestic corporations and attracting foreign direct investments (Konings et al. 2022).

In the context of our study, one of the major benefits of notional interest deduction regimes lies in their neutrality regarding marginal investment decisions, as these regimes ultimately result in the taxation of economic rents only (De Mooij and Devereux 2011, van Campenhout and van Caneghem 2013). Furthermore, the notional interest deduction remains neutral for various asset classes, such as tangibles or intangibles, as the deduction is applied in principle and is only linked to equity (Konings et al. 2022). With respect to the widespread debt equity bias, a notional interest deduction decreases the cost of equity and contributes to a more equal treatment of debt and equity.[33] The IMF (2016) emphasises that removing the debt bias (from external borrowing) helps to ensure macroeconomic stability. Empirical studies corroborate this positive impact of a notional interest deduction on reducing debt levels of firms (Hebous and Ruf 2017, Romaniuk and Malik 2021).

Yet, the empirical evidence on investment effects of notional interest deductions is mixed. While Hebous and Ruf (2017) do not find significant effects on production investment after the implementation of the notional interest deduction in Belgium, Konings et al. (2022) show positive effects on employment and investment. Domestic Belgian firms experienced an increase in their after-tax return on investment due to the notional interest deduction (Konings et al. 2022).

However, the deduction of the cost of equity financing increases the complexity of the calculation of the tax base as well as the risk of cross-border tax planning (Hebous and Ruf

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[33] Due to the interest deductibility, a debt financed investment results in a lower tax burden in comparison to an equity financed one.

2017). Furthermore, the tax benefit might be quite sensitive to the overall interest environment. From a government perspective, a notional interest deduction regime could be a quite costly measure. Finke et al. (2014) derive a revenue loss of up to 18 percent from a microsimulation model for Germany. According to their simulations this could be financed by an increase of the corporate profit tax rate by six percentage points to compensate for the narrowing of the tax base. The costs of a notional interest deduction regime could be capped, if one limits the benefit only to new equity which is brought into the company.

As illustrated in Section 3.1, a notional interest deduction reduces the effective tax burden significantly. Although the effect size depends on the notional interest rate and the amount of a firm's equity, such a regime makes the application of a top-up tax more likely. As the notional interest can be deducted from the tax base continuously and is not available under financial accounting rules, it results in a permanent difference between both sets of rules. Therefore, in contrast to an accelerated depreciation scheme, a notional interest deduction is not covered by deferred taxes and decreases the effective tax rate by all means. In sum, the effectiveness of such a regime is likely to be reduced by the application of the global minimum tax if it results in an effective tax burden below 15 percent (Gschossmann et al. 2023).

R&D tax incentives and tax credits for investment and production

As our analysis in Section 3.1 shows, R&D tax incentives, as well as tax credits for production and investment, are an important tax instrument to enhance the tax attractiveness of countries in the competition for (R&D) investment. These tax instruments are used by legislators to provide targeted incentives to encourage investment in specific industries or innovative markets (Hymel 2006). In particular, for investment activities where the benefits are highly uncertain and public spill overs are larger than private ones, the optimal level of investment is not undertaken by the private sector (e.g. R&D, green transition, digitalisation). However, higher R&D investment increases economic growth as measured by GDP (Akcali and Sismanoglu 2015). In addition, persistent R&D performers seem to survive crises better than their competitors (Lome et al. 2016), suggesting that R&D investment acts as a form of insurance against future economic downturns.

Investment incentives reduce the cost of investment, i.e. they allow companies to invest more at the same cost and thus have a positive impact on the risk-return profile of the investment. Empirical evidence shows that if input-based R&D tax incentives are sufficiently generous, they do increase R&D investment (Hall and Van Reenen 2000, Appelt et al. 2016, Guceri and Liu 2019, OECD 2020). This increase in investment and employment leads to more output

(Lerche 2022) and, consequently, higher tax revenues for governments. Yet, increases in R&D investments may also be due to the relocation of R&D activities and not an overall increase in R&D activity, i.e. R&D tax regimes have competitive effects (Knoll et al. 2021). In contrast, there is only limited evidence on the encouraging effect of output-based R&D tax incentives on innovation activity within a country (Alstadsæter et al. 2018, Gaessler et al. 2021).

The advantages for increasing investment activity by generous incentives (e.g. a broad scope of the tax base, refundability in case of losses) represent at the same time the more costly aspects of this measure. However, similar to accelerated depreciation schemes, they are highly targeted and only applicable to certain categories of expenditure (Thomson 2017). Thus, they still provide a clear link to pre-specified investment activity and are less costly than a general tax rate cut. In order to limit government expenditure, it is feasible to cap investment allowances beyond specific thresholds to ensure that incentives are only available to small or particularly sustainable firms (Hanappi et al. 2023, Clark and Sichel 1993).

One major limitation are the administrative and compliance costs caused by the complex and highly specific nature of these tax incentives (Hanappi et al. 2023). In addition, the delay in investment response, i.e. a time lag between carrying out the investment and receiving the tax benefit, could limit the effectiveness of tax incentives in promoting investment and innovation (Clark and Sichel 1993, Lome et al. 2016). Finally, as these incentives are exclusively granted to the initially intended companies (Lerche 2022), separate incentives need to be developed and implemented for each asset or industry in which investments shall be encouraged, constituting an additional administrative burden for policy makers.

Depending on their design, R&D incentives can lower a firm's effective tax burden significantly (see Section 3.1, Figure 7), potentially even below 15 percent. However, due to the jurisdictional blending approach in the context of the global minimum tax, i.e. the aggregation of all group entities in a country, lower-taxed income (e.g. due to R&D credits, patent box regimes) can be compensated with higher-taxed income (Ferreira Liotti et al. 2022, Perez-Navarro 2023). Therefore, the impact of the global minimum on R&D tax incentives is limited.

4 Conclusion

For many years, countries have used tax incentives to create an attractive environment for corporate investment. However, against the background of currently tight government budgets in many countries, the scope for tax reforms remains limited. Thus, a sustainable tax policy requires a careful balancing between tax revenues and policy goals. This article examines past

developments in the EU Member States' location attractiveness in terms of corporate investment as well as current tax reform options for improving it.

We measure the relative tax attractiveness of locations in terms of the EATR. Over the last 20 years, we find marked differences in the attractiveness of investment location among the countries examined, especially within the EU. On average, all EU Member States followed the trend of declining effective tax burdens. However, the high-tax EU countries in particular have not been able to improve their relative attractiveness. Our analysis also indicates that EATRs have not fallen consistently over the last 20 years, but have alternated between periods of falling and more stagnant EATRs. In addition, we show that, alongside reductions in statutory corporate tax rates, tax base measures have become more important instruments for enhancing the attractiveness of an investment location.

Our more detailed assessment of recent tax policies highlights that tax rate cuts strongly reduce the EATR. The same holds true for the introduction of a notional interest deduction regime as put forward by the EU commission. In contrast, accelerated depreciation schemes have only a minor effect on the EATR and might therefore be less relevant for the location choice. However, they can have a strong impact on the EMTR and thus on the volume of investments. In addition to these general policy actions, R&D tax incentives are a widely used measure to attract mobile activities. Depending on the specific design, these targeted tax incentives can reduce the effective tax burden significantly.

A concluding discussion of the reform options' investment effects, costs and their interaction with the global minimum tax puts the figures into context. While there is no clear empirical evidence that notional interest deductions stimulate corporate investment, the literature has shown positive effects of corporate tax rate cuts, accelerated depreciations and input-based R&D incentives on investment activity. However, as countries might be budget-constraint, the scope for tax rate cuts as well as for other tax incentives is limited. All measures have in common that they lead to lower tax revenues in the short run. Yet, tax rate cuts and notional interest deductions are particularly costly since they apply to all taxpayers independent of their investment behaviour. In contrast, targeted measures such as accelerated depreciations, R&D incentives and reduced tax rates exclusively for certain qualified investment types have a clear focus on increasing investment activity while simultaneously preventing free-riding. In the context of the global minimum tax, accelerated depreciations remain the most viable option for stimulating corporate investment. Moreover, R&D incentives can still be used as a targeted measure without triggering a top-up tax as long as a firm can compensate lower-taxed income

with higher-taxed income from other activities. In sum, it should be noted, however, that the global minimum tax applies exclusively to large multinationals, while small and medium-sized enterprises can benefit from all tax incentives without limitations.

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Appendix

Appendix A: The Devereux/Griffith methodology of analysing effective tax burdens

The Devereux/Griffith methodology allows the computation of effective tax burdens on marginal investments that only yield a minimum required return (relevant measure: cost of capital, effective marginal tax rate) and on highly profitable investments with a pre-tax rate of return of 20 percent (relevant measure: effective average tax rate). The Devereux/Griffith methodology builds on the work of Jorgenson (1963), Hall and Jorgenson (1967) and King and Fullerton (1984) and assumes that firms invest in capital as long as marginal returns cover marginal costs.

The cost of capital (CoC) and the effective marginal tax rate (EMTR) indicate the impact of taxation on marginal investments, i.e. investments that yield a rate of return on the initially invested capital that is sufficient to compete with an alternative investment. This minimum rate of return before taxes required by a shareholder is called the cost of capital. As an alternative investment, we assume a financial asset that yields the market interest rate, assumed to be 5 percent. Thus in the absence of taxes, the cost of capital equals the real market interest rate. If taxation raises the cost of capital above the real market interest rate, the marginal corporate investment is discriminated and theoretically, taxation influences the optimal level of investment activity. The EMTR represents the relative tax-induced wedge between the minimum required pre-tax rate of return and the real market interest rate. Thus, the lower the EMTR is at the corporate level, the lower the required pre-tax rate of return necessary to yield – after taxes – at least the market interest rate, and the more investments will be undertaken, i.e. optimal investment levels will be higher.

The effective average tax rate (EATR) indicates the effective tax burden on an infra-marginal investment in an economic sense, i.e. a highly profitable investment. In our study, we assume that the investment yields a standardized pre-tax rate of return on investment of 20 percent. In particular, the EATR measures the change in the net present value (NPV) of a highly profitable investment caused by taxation. The international comparison of the tax burden on highly profitable investments is most important in terms of the **choice of investment location** (Devereux and Griffith 2003, Spengel 2003). When choosing from a set of mutually exclusive investments with an identical pre-tax real rate of return, a company will favour the alternative

with the highest post-tax net present value, where the EATR is lowest.[34] In the context of highly profitable investments, the corporate income tax rate is the main driver of effective tax burdens (i.e. EATR). In contrast, for marginal investments (i.e. CoC and EMTR), the relevance of tax base elements is the main source of variation.

Our calculations of the effective tax burden based on the Devereux/Griffith methodology assume a hypothetical domestic incremental investment by a corporation in the manufacturing sector. The incremental investment comprises investments in buildings, machinery, intangibles, financial investments and inventory. Each of the five assets is accorded equal weight, that is, it represents 20 percent of capital employed. Furthermore, we assume that the company finances its investment by new share issue (10 percent), retained earnings (55 percent) and a loan (35 percent). Figure A1 shows the structure of the baseline model. To calculate the effective average tax burden, the model considers country-specific information on the type of the tax system, applicable profit and non-profit taxes (e.g. corporate income tax, real estate tax, etc.), and tax base and tax rate regulations. The computation of income reflects the depreciation or amortization rules for each of the five assets in the model. Any applicable capital taxes, such as property taxes or charges on other assets held, are also factored into the calculations. By contrast, the tax charged on the parent company's shareholders is ignored due to lack of relevant information.

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[34] The EATR is computed as the difference of the NPV before and after taxes (R* – R) divided by the discounted pre-tax rate of return p. Hence, the EATR equals the EMTR if the pre-tax rate of return (p) is identical to the cost of capital (~p). Further, the EATR approaches the statutory tax rate τ if profits increase (i.e. an increasing pre-tax rate of return).

Figure A1: Devereux/Griffith model structure for manufacturing companies (baseline scenario)
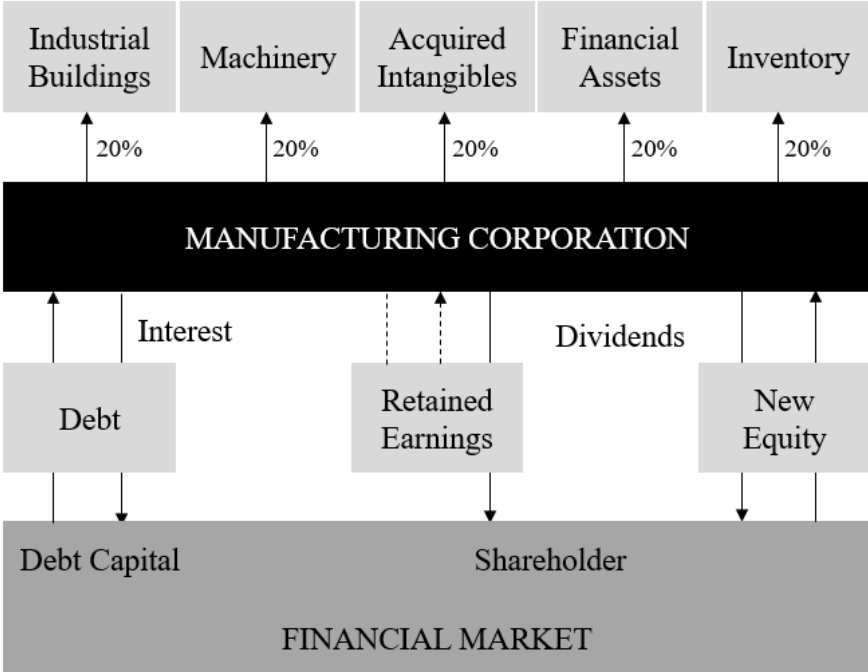
Source: Authors' contribution.

To quantify the impact of existing R&D tax incentive regimes, we have to adapt the baseline scenario of the manufacturing company. While we rely on an acquired intangible in the baseline scenario, we assume for the R&D scenario that the corporation develops the intangible itself. Thus, we are able to incorporate the different R&D tax incentives on personnel and capital expenditures as well as existing patent boxes for self-developed intangibles in the computation of the EATR. In doing so, we follow Spengel et al. (2022) and assume that company incurs not only current expenses (e.g. wages for R&D staff and materials) but also expenditures in R&D infrastructure (e.g. buildings and machinery) for the in-house development of a patent. In line with Cabral et al. (2021), we assume that the R&D expenditure is composed of 90 percent current expenses and 10 percent capital expenditure, with an even split assumed for investments in buildings (five percent) and machinery (five percent). Figure A2 shows the structure of the R&D scenario.

Figure A2: Adjustment of the baseline scenario to a R&D scenario
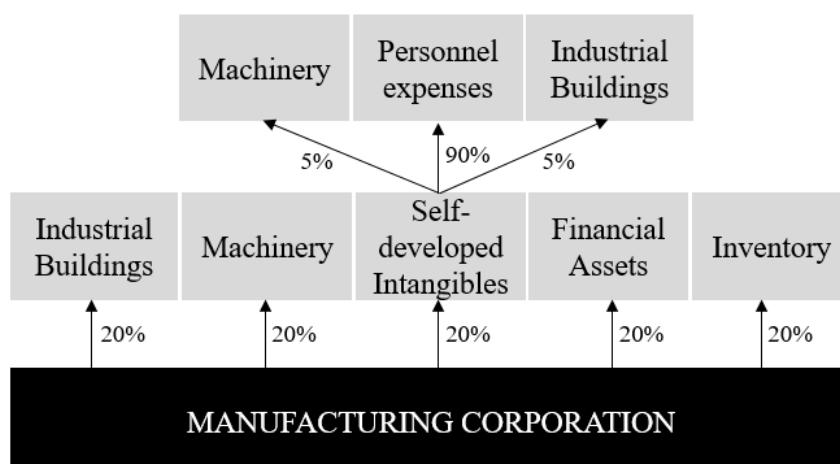
Table A1 shows the economic assumptions which meet international standards behind it. All economic parameters are held constant across all investments to isolate the effect of different international tax regimes irrespective of their location.
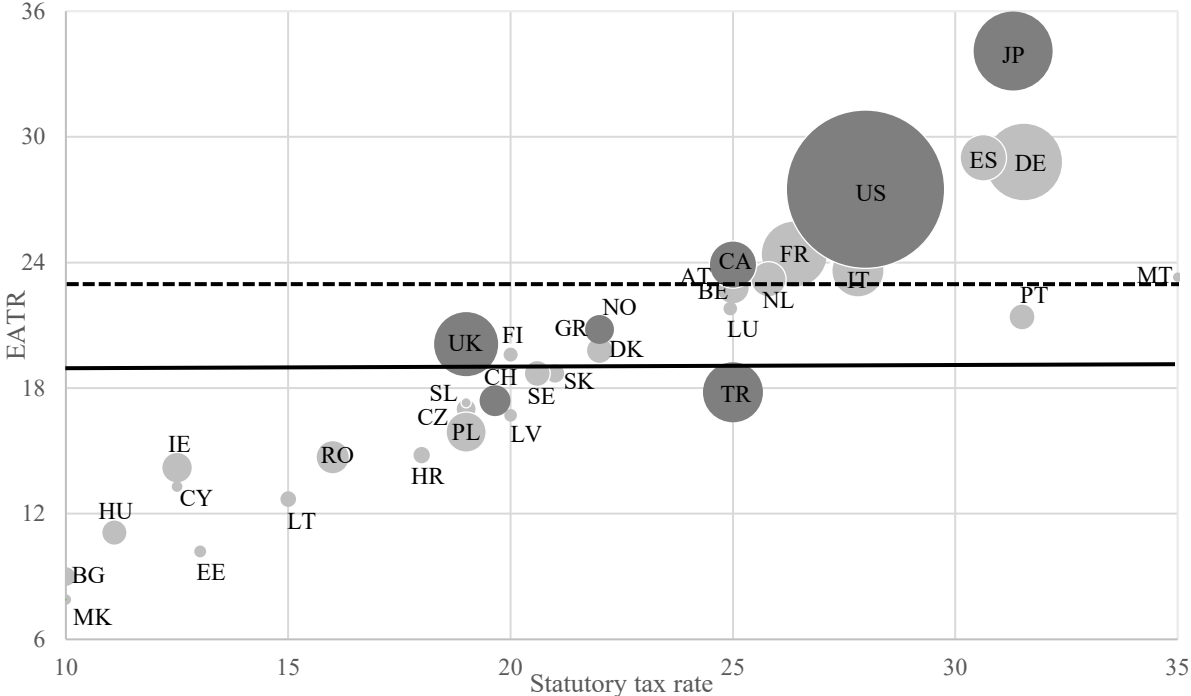
Table A1: Summary of the key assumptions and weightings

| Legal form	corporation	corporation
Scenario	manufacturing	R&D
Assets (weights)	industrial buildings (20%), **intangibles – acquired patent** (20%), machinery (20%), financial assets (20%), inventory (20%)	industrial buildings (20%), **intangibles – self-developed patent** (20%), machinery (20%), financial assets (20%), inventory (20%)
		self-developed patent consists of current expenditure (90%), buildings (5%) and machinery (5%)
Financing (weights)	retained earnings (55%), new equity (10%), debt (35%)	retained earnings (55%), new equity (10%), debt (35%)
True economic depreciation	degressive	degressive
	industrial building 3.10%	industrial building 3.10%
	intangibles 15.35%	intangibles 15.35%
	machinery 17.50%	machinery 17.50%
Real capital market interest rate	5%	5%
Pre-tax real rate of return for EATR calculation	20%	20%
Inflation rate	2%	2%

Appendix B: Figures

Figure B1: Relationship of EATRs and statutory tax rates to GDP

Notes: The figure displays the relationship of statutory and effective average tax rates (in percent) to GDP. The size of the bubbles indicates the size of the economy measured by GDP and the colour EU27 (light grey) and third countries (dark). The black (dashed) line represents the unweighted (GDP-weighted) average EATR in the EU27. *Source:* Authors' contribution.

Figure B2: EATRs with R&D incentives under status quo and reform options (in percent)
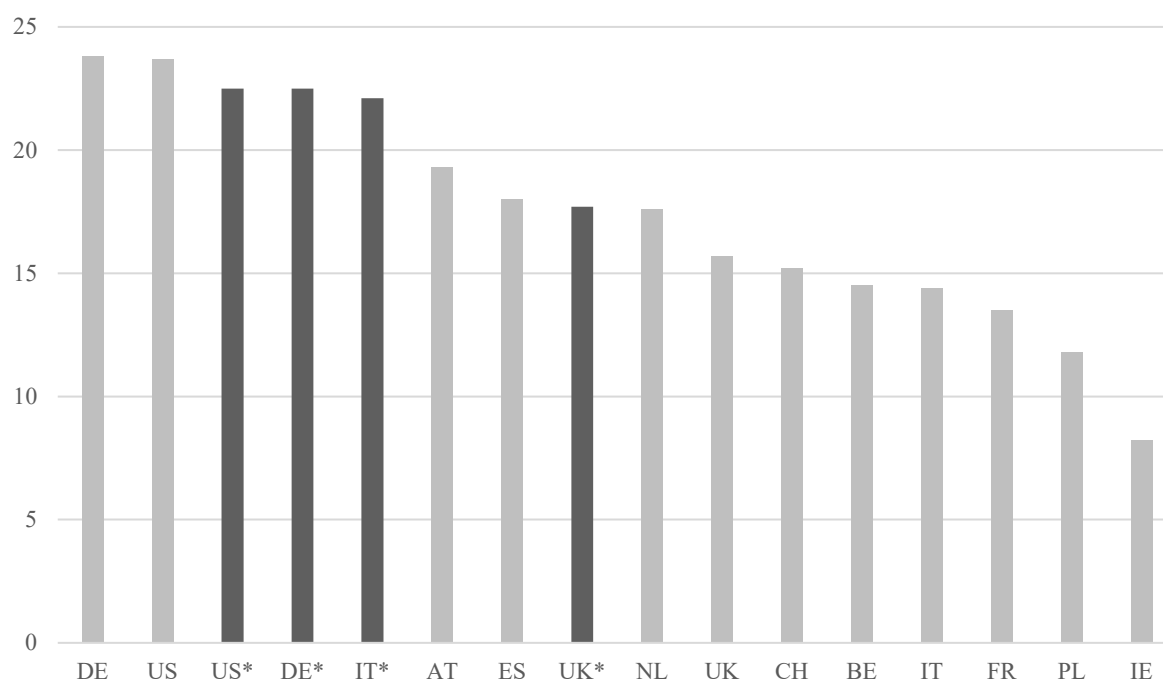
Notes: The figure displays the EATRs taking into account R&D incentives in place in 2022 (in percent). The EATRs of countries marked with an asterisk (dark coloured bars) incorporate the reform options discussed in Section 3.1. In case of the US, the dark coloured bar represents the pre-reform status and the light coloured bar the status quo.
Source: Authors' contribution.

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