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Oxford, September 2023 *Jessica Martina Müller*

Für meine Großmutter Rosa Müller
15.01.1928 – 08.02.1978

Im Herzen bin ich Rosa.

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A	depreciation allowances
$E_{overall}$	total of R&D expenditures
$E_{qualified}$	share of own, qualifying R&D expenditures
$EATR$	effective average tax rate
F	net present value of financing expenses
F^D	net present value of debt financing expenses
F^{NID}	net present value of notional interest deduction financing expenses
F^{RE}	net present value of retained earnings financing expenses
δ	economic depreciation
i	inflation rate
i_{NID}	notional interest rate
$I_{overall}$	total amount of IP related income
$I_{qualified}$	share of qualifying IP related income
NPV	net present value
p	pre-tax rate of return
π	inflation rate
φ_0	initial expense of an investment (t=0)
φ_{IP}	share of qualifying IP income
r	real interest rate
R^*	net present value before taxes
R^t	net present value after taxes
T	tax liability
τ	(corporate) income tax rate
τ_{IP}	corporate income tax rate under IP box regime
$\tau_{IP\ nexus}$	corporate income tax rate under IP box regime with nexus

List of Abbreviations

a.A.	anderer Ansicht
Abs.	Absatz (paragraph)
ACE	allowance for corporate equity
AR	augmented reality
Art.	Article
AT	Austria
BE	Belgium
BEFIT	directive on ‘Business in Europe: Framework for Income Taxation’
BEPS	base erosion and profit shifting
BFH	Bundesfinanzgericht (German Fiscal Court)
BG	Bulgaria
BGB	Bürgerliches Gesetzbuch (German Civil Code)
BGBl.	Bundesgesetzblatt (German Federal Gazette)
BMF	Bundesministerium der Finanzen (German Federal Ministry of Finance)
bspw.	beispielsweise (for example)
CCCTB	common consolidated corporate tax base
CCTB	common corporate tax base
CH	Switzerland
CIT	corporate income tax
CoC	cost of capital
CY	Cyprus
CZ	Czech Republic
DAC	directive on administrative cooperation in direct taxation
DE	Germany
DEBRA	directive on a debt-equity bias reduction allowance
DK	Denmark
DLT	distributed ledger technology
e.g.	exempli gratia (for example)
EATR(s)	effective average tax rate(s)
EBITDA	earnings before interest, taxes, depreciation, and amortisation
ECJ	European Court of Justice
ed.	edition
eds.	editors
EIOPA	European Insurance and Occupational Pensions Authority
ES	Spain
EStG	Einkommensteuergesetz (German Income Tax Code)
EStH	Einkommensteuer-Hinweise (German Official Income Tax Notes)
et al.	et alii (and others)
et seq.	et sequens/sequentia (the following item/s)
ETR(s)	Effective tax rate(s)

EU	European Union
EU-10	refers to states that joined the EU in 2004
EU-15	refers to states that joined the EU before 2004
EUR	Euro
EY	Ernst & Young
FG	Finanzgericht (Fiscal Court)
FI	Finland
FIFO	first in, first out
FR	France
GR	Greece
HGB	Handelsgesetzbuch (German Commerical Code)
HR	Croatia
Hs.	Halbsatz (half sentence)
HU	Hungary
HUF	Forint
i.e.	id est (that is)
i.S.d.	im Sinne des (within the meaning of)
IBFD	International Bureau of Fiscal Documentation
IE	Ireland
IFRS	International Financial Reporting Standards
IIR	income inclusion rule
Inv.	investment
IP	intellectual property
IT	Italy
LIFO	last in, first out
LT	Lithuania
LU	Luxembourg
MiCA	markets in crypto-assets
Mio.	million (Millionen)
MNE(s)	multinational enterprise(s)
MT	Malta
NFT(s)	non-fungible token
NL	The Netherlands
no.	number, marginal number
NPV	net present value
Nr.	Nummer (number)
OECD	Organisation for Economic Co-operation and Development
OJ	Official Journal of the EU
para.	paragraph
PE	permanent establishment
PL	Poland
PLN	Złoty

pp.	percentage points/pages
PStTG	Plattformen-Steuertransparenzgesetz (German Platform Tax Transparency Act)
PT	Portugal
QDMTT	qualified domestic minimum top-up tax
R&D	research and development
RO	Romania
S.	Satz, Seite (sentence, page)
SE	Sweden
SI	Slovenia
SK	Slovakia
SME(s)	small and medium-sized enterprises
TEU	Treaty on the European Union
TFEU	Treaty on the Functioning of the European Union
UK	United Kingdom
US GAAP	United States Generally Accepted Accounting Principles
USD	United States dollar
UTPR	undertaxed profits rule
vgl.	vergleiche (see)
VR	virtual reality
z.B.	zum Beispiel (for example)
ZEW	Center for European Economic Research

1 Preface

A highly globalised economy requires coordination of national tax systems to prevent legal uncertainties, double taxation or tax evasion opportunities.[1] Without coordination, gaps and frictions in cross-border transactions are caused through the interaction of heterogeneous tax systems. On the one hand, this potentially harm the multinational activities of companies due to higher administrative burdens.[2] On the other hand, this allows multinational companies to benefit from the international tax arbitrage reducing the companies effective tax levels, which is favoured by interstate tax competition for the location of companies.[3] The European Union (EU) aims at fair and effective taxation[4] but has no mandate for harmonising direct taxes[5]. Even tough the EU Member States are sovereign, their tax legislation is limited by superior EU law, especially the Fundamental Rights and Fundamental Freedoms. Regarding direct taxes, the EU's institutions supervise the national legislation and enforce directives as minimum standards to ensure the functioning of the internal market and preventing discrimination.[6] Still, the EU has not been able to solve the distortions and challenges caused by differing tax systems of the EU Member States.

Another major trend of the last decades, the digitalisation, challenges the existing tax systems as digitalised businesses are internationally mobile through highly flexible immaterial assets.[7] Under the existing systems, companies are taxed where the mobile activities are located, which does not always coincide with the place of value creation. This misalignment between the place of taxation and the place of value creation probably threatens fair and effective taxation.[8] Especially recent digital developments, e.g., the metaverse, challenge the existing tax systems as cross-border transactions take place in a virtual world without physical presence. However, EU Member States also try to benefit from digital businesses by attracting them through special tax

[1] European Commission et al. 2020, 43 et seq.
[2] OECD 2013, 9.
[3] Endres and Spengel 2015, 391 et seq. For empirical evidence, see, e.g., Barrios et al. 2012; Dharmapala 2014.
[4] European Commission 2020a.
[5] The provisions regarding the mandate for harmonising indirect taxes are laid down in Article 110-113 Treaty on the Functioning of the European Union (TFEU).
[6] European Commission 2001.
[7] OECD 2015a, 16; Olbert and Spengel 2017.
[8] European Commission 2017; European Commission 2018.

incentives, like intellectual property (IP) boxes.[9] However, it is also known that some of these tax incentives are misused by companies for harmful tax practices.[10]

Overall, the globalisation and digitalisation of the business world carry the risk of base erosion and profit shifting (BEPS) through companies.[11] In light of the current debate on fair and effective taxation, the fight against BEPS is a top priority for the EU,[12] resulting in the enactment of harmonised legal minimum standards through directives on direct tax matters[13]. For the political and academic debate, it is relevant to understand how past EU interventions have affected and how future policy initiatives and technological developments will affect the EU Member States.

This dissertation aims to enrich the ongoing debate among academics, policymakers, and practitioners by answering the following three research questions:

1. How does harmonisation efforts in terms of anti-discrimination and anti-tax avoidance measures in the EU affect the effective tax levels of the EU Member States?
2. What are the effects of the EU's recent tax policy proposals on the location attractiveness and scale of investments of the EU Member States, and how do the proposals interact in terms of effective tax levels?
3. What are the general functioning and the tax implications of new digital business models in the metaverse, and are the current tax systems capable of achieving fair and effective taxation?

This dissertation addresses these questions in four distinct main chapters that are based on four individually written research papers, which are joint work of multiple authors. These research papers have been prepared for submission for publication in academic journals. Three out of four have already been successfully published. Table 1 displays each included research paper, acknowledges the respective co-authors, describes the current publication status as well as my own key contributions.

Chapter 2 is based on the paper "IP box regimes and multinational enterprises: Does nexus pay off?", co-authored with Daniela Steinbrenner and Christoph Spengel, and focuses on the first research question of this dissertation. We analyse the impact of an anti-tax avoidance measure, i.e., the OECD's modified nexus approach (the nexus) as a minimum standard for the IP

[9] On the conflict between the states' self-interest and the international consensus on fair and effective taxation, see e.g., Devereux and Vella 2014.
[10] OECD 2015b; Heckemeyer and Overesch 2017, 965 et seq.
[11] OECD 2013, 7 et seq.; Maciejewski 2023, 61 et seq. For an overview on literature on tax planning of multinationals, see Heckemeyer and Overesch 2017.
[12] European Commission 2015, 2.
[13] European Commission et al. 2020, 21 et seq.

box regimes in the EU setting. IP box regimes are output-oriented research and development (R&D) tax incentives. Throughout the last decades, they have been heavily criticised for enabling income shifting without enhancing real R&D activities in the IP box state through the unlimited application of special tax rates on IP-related corporate income. Hence, the nexus requires a certain level of domestic R&D activities (so-called substance requirement), to benefit from the low tax rate. Therefore, this chapter provides an extensive qualitative analysis of the selected IP box tax regimes. Moreover, we add a simulation study, where we calculate the effective tax levels to determine the impact of the nexus on IP box-related tax planning and the location attractiveness of the states. Even though we find that the nexus prevents an excessive reduction of the effective average tax burden, a considerable decrease is still possible. Furthermore, accounting for shifts in IP tax planning due to higher substance requirements, we find that the combination of out- and input-oriented tax incentives could still result in an excessive reduction of the effective tax levels, i.e., negative values in more than 60% of the IP box states, resulting in an increasing location attractiveness of these states.

Chapter 3 is based on the paper "The distorting effects of imputation systems on tax competition in the EU", co-authored with Leonie Fischer and Christoph Spengel, and also focuses on the first research question of this dissertation. We assess the effects of certain anti-discrimination actions, i.e., abolishing discriminating imputation systems in certain EU Member States. The imputation systems intend to avoid double taxation of dividend payments; however, the enforced systems included discriminatory treatment depending on the source country of the dividend payment. Hence, in this chapter, we assess the economic effects of the shift in corporate tax systems by a simulation study focusing on the location attractiveness for capital investments and tax competition. For the five EU Member States that abolished the imputation systems in favour of shareholder relief systems between 1999 and 2019, we find that the abolishment eroded the domestic investment bias for investors by converging the effective tax level spread between domestic and foreign investments, which could potentially increase the tax competition in the EU. Moreover, the previous tax advantage for domestic investments from the shareholders' perspective reversed, leading to a higher location attractiveness of foreign investment. Overall, we observe substantial economic impacts resulting from the transition from the imputation systems to the shareholder relief systems.

Chapter 4 is based on the paper "The EU's new era of fair company taxation: The impact of DEBRA and Pillar 2 on the EU Member States' effective tax levels", co-authored with Emilia Gschossmann, Jost H. Heckemeyer, Christoph Spengel, Julia Spix, and Sophia Wickel. This chapter addresses the second research question by assessing the directive on Pillar 2, the

proposed directive on a debt-equity bias reduction allowance (DEBRA) and a common corporate tax base under the proposed directive on Business in Europe: Framework for Income Taxation (BEFIT). The political objectives of the (proposed) directives differ, however, they are all built on the harmonisation efforts of the EU. Under DEBRA, the different tax treatment of debt and equity financing for companies shall be removed by introducing an EU-wide harmonised notional allowance on equity and limitation on interest deduction. Pillar 2 imposes an effective minimum tax rate of 15% for large corporations to prevent aggressive tax planning. Moreover, we consider the proposals on a common corporate tax base under BEFIT. Our simulation study confirms our theoretical hypotheses that DEBRA[14] substantially reduces the effective tax levels resulting in a higher scale of investment and location attractiveness compared to the status quo in the EU Member States. In contrast, our assessment of Pillar 2 confirms the politically intended increase in effective average tax rates. As a simultaneous application of the (proposed) directives is highly probable in practice, we find, that the effects of Pillar 2 dominate these of DEBRA. To diminish the influence of tax base effects, we include the common tax base rules under BEFIT, whereas all results hold.

Chapter 5 is based on the paper "Unternehmen im Metaverse – Eine steuerrechtliche Einordnung", co-authored with Paul F. Farwick and Christoph Spengel. In this chapter, we focus on answering the third research question of this dissertation by analysing the corporate tax implications for business models in the metaverse. Due to the novelty of this topic, we have been the first providing a conceptual framework for understanding the metaverse and analysing various business models through practical case studies. As a digital platform that merges real and virtual world, the metaverse provides fundamentally new ways of value creation for businesses. The core components throughout most business models are non-fungible tokens (NFTs), and cryptocurrencies. Hence, we qualitatively assess the business models in terms of general implications under German tax law and the specific considerations regarding the treatment of NFTs, cryptocurrencies, and potential tax reporting obligations. We show that the recent tax systems are not able to achieve fair and effective taxation of metaverse business models through a high legal uncertainty. In particular, the questionable tax accounting of NFTs and classifying cryptocurrencies as intangible assets instead of a means of payment are highly demanding. Overall, these challenges not only potentially harm the business activity in the metaverse but could result in fiscal revenue losses for states.

Chapter 6 concludes with a summary of the main findings of this dissertation.

[14] For an equity-financed company.

Table 1: Overview of papers, co-authors, and contribution

Chapter	Paper	Co-authors	Publication status	Own key contribution
2	IP box regimes and multinational enterprises: Does nexus pay off?	Christoph Spengel Daniela Steinbrenner	Published in: World Tax Journal Ranking: C	– Research question – Literature survey – Introduction and positioning of the paper – Description of the functioning of IP box systems and the nexus – Collecting information on countries' IP box regimes – Implementation of the nexus approach in the Devereux/Griffith methodology and calculation of the effective average tax rates – Conclusion
3	The distorting effects of imputation systems on tax competition in the EU	Leonie Fischer Christoph Spengel	Published in: Intertax Ranking: C	– Research question – Literature survey – Introduction and positioning of the paper – Collection of information on EU Member States' corporate tax systems and the taxation of dividends at the shareholder level (1999-2019) – Implementation in the Devereux/Griffith methodology and calculation of the effective average tax rates and cost of capital – Interpretation of the results – Conclusion
4	The EU's new era of fair company taxation: The impact of DEBRA and Pillar 2 on the EU Member States' effective tax levels	Emilia Gschossmann Jost H. Heckemeyer Christoph Spengel Julia Spix Sophia Wickel	Prepared for submission	– Research question – Introduction and positioning of the paper – Literature survey – Data collection and implementation of Pillar 2 in the Devereux/Griffith methodology – Calculation of the effective average tax rates and cost of capital – Interpretation of results (Pillar 2, BEFIT, interaction) – Conclusion
5	Unternehmen im Metaverse – Eine steuerrechtliche Einordnung	Paul F. Farwick Christoph Spengel	Published in: Steuer und Wirtschaft Ranking: B	– Research question – Introduction and positioning of the paper – Literature survey – Qualitative analysis and description of metaverse business models – Analysis and description of tax implications – Conclusion

Notes: Ranking based on VHB-Jourqual.

2 IP box regimes and multinational enterprises: Does nexus pay off?

Co-Authors: Christoph Spengel, and Daniela Steinbrenner[15]

Abstract: Over the last decades, the Organisation for Economic Co-operation and Development (OECD) and the European Union (EU) aimed at regulations that prevent aggressive intellectual property (IP) tax planning of multinational enterprises (MNEs). These regulations are designed to mitigate the international 'race to the bottom' in effective tax rates. Contemporaneously, EU Member States enacted favourable tax systems for corporate research and development (R&D) activities to increase their location attractiveness. Especially, the output-oriented R&D tax incentives, namely IP box regimes, gained attention from a tax fraud perspective as well as popularity by national governments to generate public revenues. In this article, we qualitatively and quantitatively examine the European IP boxes. Thereby, we analyse their impact on IP tax planning and location attractiveness considering the OECD's modified nexus approach ('the nexus'). Our results demonstrate that even after introducing the nexus, a considerable reduction in effective average tax burdens is possible. Nonetheless, in line with the policy intention, the nexus effectively prevents excessive reductions of MNEs' tax burden. Moreover, we account for changes in IP tax planning and observe implicit subsidies for the combination of out- and input-oriented tax incentives. Thus, these combinations reduce MNEs' tax liabilities and finally, increase the location attractiveness in the post-nexus era.

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[15] This chapter is based on the article published in the World Tax Journal, see Müller, Spengel, and Steinbrenner 2022.

2.1 Introduction

Innovations are a crucial driver of countries' economic growth and social welfare.[16] During the last decades, R&D activities for innovative IP became increasingly important for companies and the overall economy.[17] The COVID crisis highlighted the value of innovations, as the speed of development for new vaccine patents as well as for new technologies intensely increased.[18] Thus, IP, as one primary fruit of innovation, impacts most industries and generates vast amounts of corporate income, especially of MNEs relying on a cross-country knowledge network.[19]

IP is characteristically tremendously agile: No significant physical presence on site is necessary to carry out relevant R&D activities or to serve the markets with final goods and services. In fact, MNEs can internally relocate IP in a time- and cost-efficient manner.[20] While companies are flexible in choosing their geographic location,[21] governments want to attract these corporate taxpayers to increase fiscal income by providing targeted tax incentives.[22] For instance, 13 EU Member States and the UK offer a preferential tax treatment of income accruing from certain intangibles in 2021. Besides an increasing adoption of those IP boxes within the EU, we observe a growing number in non-EU-countries (e.g., Canada, Israel, Serbia, Switzerland, and Turkey). The IP boxes are characterised by significantly lower effective tax rate for specific types of IP-related income compared to the general corporate income tax rate in the respective countries.

Contrary, the high flexibility of IP and MNEs has also negative consequences. One drawback is the increase in base erosion and profit shifting (BEPS) opportunities. To limit these harmful tax strategies regarding IP boxes, the OECD established the modified nexus approach (henceforth: 'the nexus'). The nexus was introduced in 2016 and set certain boundaries to the overall generosity of IP boxes by linking the grant of incentives to a certain degree of substantial local activities.[23] As a minimum standard, the nexus requires theoretically relatively homogenous IP box characteristics (e.g., qualifying assets, treatment of expenses) compared to the previously heterogeneous regimes in terms of scope and overall generosity across countries.

In this article, we evaluate qualitatively if the nexus and its national implementations are effective in aligning IP box regimes with the objective of fostering domestic R&D activities on one side and in restricting artificial profit shifting on the other. Thereby, we explicitly set the focus

[16] Hasan and Tucci 2010.
[17] Karkinsky and Riedel 2012.
[18] Wagner et al. 2022, 2 et seq.
[19] Singh 2008; Berry 2014, 869 et seq.
[20] Markusen 1995; Baumann et al. 2020, 468 et seq.
[21] Huang, Krull, and Ziedonis 2020, 2523 et seq.
[22] For the location decision of patents under tax considerations, see Karkinsky and Riedel 2012, 177 et seq.
[23] OECD 2015b.

on the main tax parameters of IP box regimes. Thus, our paper does not consider, e.g., the impact on transfer pricing effects that can be associated with the nexus. Moreover, the qualitative analysis will be transferred into quantitative values on behalf of the Devereux/Griffith methodology. In this analysis, we examine the tax treatment of domestically operating business models in the legal form of a corporation under the regular tax system. Next, we compare the absolute and relative advantageousness in the pre- and post-nexus era of IP box regimes in Europe for a fictitious R&D project. Thus, our article contributes to the existing research on IP boxes by providing a qualitative and quantitative overview of the changes in European IP box characteristics before and after the nexus enactment.[24]

Our main results show that the nexus effectively prevents negative effective tax burdens, i.e., an implicit subsidy, which indicates that aggressive tax planning concerns are reduced. However, by incorporating input-oriented R&D tax subsidies along with IP box regimes into the analysis, we reveal that the nexus is likely to accelerate a race to the bottom. This creates incentives to extend the benefits of internationally recognised input-oriented tax incentives as we could observe highly negative effective average tax rates (EATRs). Even though the nexus increases the harmonization of specific IP box characteristics, there is still a high leeway in designing possible simultaneously applicable R&D incentives or general notional deductions.

This article is organised as follows: In Section 2.2, we highlight changes in the tax planning on behalf of IP since the implementation of the nexus. Section 2.3 introduces the nexus and provides a qualitative overview of existing IP boxes as R&D tax incentives in Europe. Afterward, in Section 2.4, we give a brief overview of the methodology and describe the model implementation of IP box regimes. We then present our main results and discuss them in Section 2.5. Based on our effective tax rate indicators, we evaluate the impact of the IP box regimes and, in particular, consider the impact of the nexus based on different scenarios. Moreover, different nexus quotients are implemented in our sensitivity analysis. In addition, in Section 2.6 we examine the effect of a possible combination of out- and input-oriented R&D tax incentives. Section 2.7 concludes.

2.2 Evolution of IP tax planning during the last decade

In a globalised world, multinationals face severe pressure of competition but also heterogeneous tax environments across the states. This heterogeneity allows them to exploit international differences in tax rates and tax bases, aiming to reduce the group's overall tax burden given a

[24] A detailed overview of the heterogeneous design of IP boxes in the pre-nexus period is provided by Evers 2015.

certain level of profitability.[25] In this context, IP is an especially well-suited instrument to establish tax-efficient structures due to its missing clear geographical connection as well as a missing arm's length price for transfer pricing. It is well known that MNEs exploit these features primarily to maximise their tax benefits. In fact, they disentangle the location of IP ownership from the place of the underlying R&D activity in the pre-nexus era at comparatively low (non-tax) cost.[26] To do so, they transfer the IP to a permanent establishment (PE) or subsidiary located in a low-tax country without simultaneously relocating the R&D activity.[27] This allows them to maintain their R&D activities in a high-tax country with a good innovation infrastructure or generous input-oriented R&D tax incentives. The latter ensures that the (additional) deduction of R&D expenses reduces the domestic tax liability in the development phase. A subsequent minimization of an MNE's global tax burden is enabled by tax benefits associated with the relocation to a low-tax country in the exploitation phase. The relocation can lead to a bundling of IP assets in an IP holding company that grants licenses to affiliated intra-group companies.[28] In this way, royalties reduce the tax bases of the licensees located in countries with higher corporate tax rates, while the licensor faces low tax rates on its royalty income.

Moreover, as innovation classifies as one key driver of economic growth and firm value, many states provide a diverse selection of beneficial tax rules for IP. MNEs could exploit these existing input-oriented (e.g., R&D tax credits, enhanced deductions) or output-oriented R&D tax incentives (e.g., IP boxes)[29] in the majority of OECD countries. Unsurprisingly, higher R&D activities are associated with more tax planning.[30] The increasing introduction of preferential tax rates (i.e., IP boxes) raised public attention as a tool for international tax planning merely used by MNEs during the last decade.[31] These lower tax rates on IP income enable high-tax countries to compete with classical tax havens. In fact, this intensifies the international tax competition on IP asset locations and the risk of domestic tax base erosion. The initial idea behind IP box regimes is twofold: to prevent domestic IP assets from being transferred abroad and to attract innovative companies to increase national R&D activities that positively impact a country's overall economy.[32]

[25] Endres and Spengel 2015. Other studies find evidence that tax rate differential between subsidiaries impacts the locations of R&D activities, see, e.g., Hines 1994; Bloom and Van Reenen 2002.
[26] Griffith, Miller, and O'Connell 2014, 12 et seq.; Böhm et al. 2015.
[27] Eynatten 2008, 502; Ernst and Spengel 2011; Griffith, Miller, and O'Connell 2014, 12 et seq.; Böhm et al. 2015, 25; Alstadsæter et al. 2018; Koethenbuerger, Liberini, and Stimmelmayr 2019; Baumann et al. 2020, 468 et seq.; Chen et al. 2023.
[28] Maine and Nguyen 2017, 2 et seq.
[29] Some authors refer to the synonym income-based, see, e.g., Lester and Warda 2018.
[30] Gao, Yang, and Zhang 2016.
[31] Heckemeyer and Overesch 2017, 965 et seq.
[32] Klemm 2010; Böhm et al. 2015, 2.

Various studies show that a reduction in the corporate tax rate can, in principle, lead to an increase in patent registrations. However, this effect occurs mainly in countries with already implemented R&D tax incentives and thus, created sensitivity among stakeholders.[33] Recent empirical work confirms that pre-nexus IP boxes mainly attract cross-border transfers of high-value patents.[34] Yet, they did not stimulate additional domestic R&D activity.[35] The use of other profit-shifting channels by MNEs to shift regularly taxed income out of an IP box country further indicates that the patent location is driven mainly by taxes.[36]

To avoid the emerging tension between harmful IP-based tax planning, i.e., profit-shifting, and the accepted increase of primary R&D activities by supportive instruments, the OECD developed within Action 5 of the BEPS project the modified nexus-approach.[37] To put it simply, the nexus aims to address mismatches between the location where profits are booked and where profits are generated. It restricts the scope of application to trade intangibles, i.e., patents and functionally equivalent IP assets,[38] and approximates economic substance, i.e., R&D activity, by R&D expenditure.[39] Therefore, a taxpayer benefits from IP only to the extent that the taxpayer incurred qualifying R&D expenditure that gave rise to the IP income.[40] R&D expenditure act as a proxy for substantial activities because IP regimes are typically designed to encourage R&D activities and foster growth and employment. In line with this argumentation, the restriction to trade intangibles ensures that only IP assets that result in positive (R&D) spillovers benefit from the preferential tax rate.

The introduction of the nexus represents one of the most significant turning points in IP tax planning, as it subjects global IP holding practices to closer scrutiny. The more rigorous substance requirement excludes various types of IP assets (e.g., purely acquired patents without any further development) from the scope of qualifying income of IP boxes. Additionally, it limits intangible asset mobility as the cross-border separation of R&D activity and IP location

[33] Dischinger and Riedel 2011, 700 et seq.
[34] Alstadsæter et al. 2018; Schwab and Todtenhaupt 2021.
[35] The Belgium IP box does not significantly increase patenting activity (applications), see Bornemann et al. 2023. *Alstadsæter et al.* do not find an indication of inducing innovative local activities, see Alstadsæter et al. 2018.
[36] Ismer and Piotrowski 2015; Koethenbuerger, Liberini, and Stimmelmayr 2019.
[37] Pinkernell 2014; OECD 2015b.
[38] The functional equivalency is proven by legal protection and, if relevant, by a patent-like approval and registration process. Exclusive rights for using IP, legal remedies against infringement, trade secret law, and contractual and criminal protections against the use or unauthorised disclosure of information linked to the IP belong to legal protection, OECD 2015b, 25 et seq.
[39] Schwarz Martínez 2017, 178; Traversa and Flamini 2018, 107 et seq.
[40] OECD 2015b, 9.

reduces or even prohibits IP box tax benefits.[41] Therefore, taxpayers who wish to benefit from IP regimes should incur actual expenditure on such activities in the respective location.

However, the nexus ensures that MNEs engage in domestic R&D activities and reinforces the importance of input-oriented R&D tax incentives for qualifying R&D expenditures. This changes international IP tax planning significantly, as the separation of R&D activities and the exploitation of IP no longer necessarily leads to the most tax-efficient outcome, at least within the EU. Instead, MNEs favour the centralization of R&D activities and IP, especially within a legal system that offers both generous out- and input-oriented R&D tax incentives. This development also increases the risk of relocating real research activities, especially for new R&D investment location decisions. The exit taxation regarding the offshore shifting of activities or companies can be an essential obstacle in reducing the corporate tax burden for existing structures. Contrary to the buying or licensing approach, when bundling of R&D activity and IP in one country is not possible, cost-sharing agreements offer a more tax-efficient design choice in the nexus era.

In summary, in the post-nexus era, the national legislators must provide a set of tax incentives that reduce the group's overall tax liability to increase the attractiveness of their locations in tax competition. However, as the nexus requires MNEs to shift tax bases and underlying R&D activity to achieve the IP box incentive, a distortion of international location choices is possible.[42] Thus, this group-wide tax planning in favour of the states that provide the whole bundle of tax incentives will not reduce the intensity of international tax competition. Therefore, in the following, we examine the quantitative impact of post-nexus tax incentives on this race to the bottom in the tax burden in the context of location attractiveness.

2.3 Qualitative overview of existing European IP box characteristics

In our analysis[43], we cover all existing IP box regimes within the EU as of 2021. Further, we include the IP boxes introduced in Switzerland (Zurich) and the UK. All of these national IP box regimes have to be in line with the nexus, which is mandatory as of 30 June 2016. Further, the grandfathering rules for IP assets brought into IP box regimes which existed before the

[41] Schwab & Todtenhaupt found empirical evidence that a cross-border effect for nexus IP boxes is on average close to zero and significant negative for low-tech manufacturing firms, see Schwab and Todtenhaupt 2021.
[42] Schwab and Todtenhaupt 2021.
[43] The information on relevant national tax parameters presented in this study is mainly based on the following sources: IBFD 2023; *BE:* Heyvaert 2018; *CH:* Uebelhart and Bellwald 2019; Züricher Steuerbuch 2020; Balmer-Etienne and IPrime 2021; *CY:* EY 2020; *FR:* Council of the European Union 2019a; *HU:* Deloitte 2021; *IE:* Revenue Irish Tax and Customs 2022, 47; *IT:* Gallo 2018; *LT:* Council of the European Union 2019b; *LU:* Council of the European Union 2018a; *MT:* Council of the European Union 2019d; KPMG 2019; *PL:* Council of the European Union 2019c; *PT:* Martins 2018; *SK:* Council of the European Union 2018b; *UK:* TWP Accounting 2019; HM Revenue & Customs 2023.

nexus introduction ended in 2021. Still, we observe heterogeneous definitions of specific design characteristics, which could influence the tax planning incentives.

The most salient feature of IP box regimes is their preferential tax rate on IP income. As of 2021, the effective IP box rates range from 1.75% in Malta to 13.95% in Italy. This results in a significant percentage point (pp.) decrease in the statutory tax rate applicable to IP income (e.g., of up to 33.25 pp. in MT). The covered IP box regimes apply different **relief techniques** to achieve lower effective tax burdens (see Table 2). In most countries, we observe a partial exemption of the qualifying IP income, i.e., a reduction of the tax base by either a total (pro-rata) exemption of qualifying income or a lump-sum deduction of business expenses.[44] Therefore, adjustments to the IP box tax rate occur not only when the share of tax-exempt income changes but also when the corporate tax rate changes. Whereas in the earlier periods, in most countries, the share of exempt or deducted income constituted up to 80%[45], nowadays half of the countries only exempt up to 50% of the qualifying IP income. Still, the majority of countries reduce their IP box tax rate in comparison to 2015, which is driven mainly by a decrease in the regular corporate income tax rate. In our sample, only in Malta and the Netherlands MNEs face a higher effective tax rate on IP income in 2021 compared to 2015. Besides the Netherlands, the regimes in France, Lithuania, and Poland explicitly stipulate a preferential tax rate for IP income.

In addition to the amount of the partial exemption or the level of the preferential tax rate, it is decisive how tax surcharges and local taxes are dealt with. The treatment of these surcharges varies substantially from a total exemption (i.e., of the business and innovation tax in HU), a partial consideration (i.e., at the cantonal level in CH) to a total consideration (i.e., ES, FR, IT, LU, PT)[46].

Within Europe, only Hungary and Slovakia apply a general limitation of the IP box benefit. Specifically, Hungary limits the amount of the deduction to 50% of the taxpayer's pre-tax profit. Slovakia limits the tax benefit to periods in which depreciation write-offs from capitalised costs on patents are reported as tax-deductible expenses.

In addition to the preferential tax rate, the generosity of the existing IP box regimes is also determined by the specific design of the tax base, which is strongly affected by nexus. The most relevant feature is the nexus ratio. It comprises first, the scope of qualifying IP, second, the type

[44] Graetz and Doud 2013, 36.
[45] Evers 2015, 53.
[46] The local business tax in Spain represents a particular case as it is a non-income tax on business capital. Due to its nature as a business tax on capital, the tax base is not dependent on the profit situation of an MNE. Following existing literature, we do not consider it in the evaluation of the IP box regime. For more details on the Spanish local business tax, see Spengel et al. 2020.

of eligible income, and third, how attributable current and historical expenses are treated. These features taken together determine the overall generosity of existing IP box regimes.

As mentioned previously, the nexus requires a certain degree of the taxpayer's substantial activity in the IP box jurisdiction. This is to ensure that the purpose of the IP box to encourage additional (domestic) R&D activities is achieved by limiting the application of the beneficial tax treatment to taxpayers participating in R&D activities. Therefore, the nexus applies a preferential IP box tax rate to certain IP-related income ($I_{overall}$) in proportion to the nexus ratio. The nexus ratio is the share of own qualifying R&D expenditures ($E_{qualified}$) in overall R&D expenditures ($E_{overall}$).[47] Finally, the share of income that may receive the IP box treatment is calculated by the following formula:

$$I_{qualified} = \frac{\min\left(1.3 \times E_{qualified}, E_{overall}\right)}{E_{overall}} \times I_{overall}$$

The characteristics of the various parameters are sovereignly determined by the national jurisdiction within the limitations set by the OECD. In general, expenditures are regarded as qualified if they are directly linked to the IP asset and only incurred for actual R&D purposes by the eligible taxpayer. Building costs and other non-separable capital costs lack in the establishment of a direct relationship between a particular IP asset and those expenditures. Moreover, a 30% uplift of expenses is permitted and is also implemented by all countries considered to increase the amount of qualifying expenditures up to overall expenditures. This uplift intends to address the unreasonable discrimination of taxpayers who predominantly generate non-qualifying expenditure, i.e., outsource R&D activities, but who are still responsible for a large part of the value creation (including costs and innovation risk).[48]

The overall expenditures include expenditures that would have been qualified if they had been incurred directly by the taxpayer itself. Thus, non-qualifying expenditures are not included, even if they were undertaken by the taxpayer. In addition, acquisition costs and expenses for contract research carried out by related parties are also considered as overall expenses.[49]

The parameter overall income depends on the national legal definition of income, including the mandatory application of transfer pricing rules. Regarding the scope of **qualifying IP** assets, all observed IP box regimes follow the OECD guidelines and restrict the eligibility to trade intangibles, which should provide higher positive spillover effects due to real R&D activity.[50]

[47] OECD 2015b, 24 et seq.
[48] OECD 2015b, 25 et seq.
[49] OECD 2015b, 25 et seq.
[50] Arginelli 2015, 31.

All IP box regimes include software protected by copyright in addition to patents, except Switzerland and the UK. However, in both countries, it is possible to include patents that relate to computer-implemented inventions (so-called 'software patents'). These software patents cover computer-technical controls but also software-based systems such as robotics, artificial intelligence, cryptography, and cyber-physical systems. Moreover, some IP box regimes apply to a broader scope of IP assets which could include utility models, designs and models, plant breeders' rights, orphan drug designation as well as secret formulas and processes.[51] Besides self-created eligible IP assets, the observed regimes still comprise acquired IP assets given further development.

Qualified types of income, i.e., income that is subject to the preferential treatment of the IP box, are income from the transfer of use of licenses (royalties), income from the sale of the qualified IP, as well as from the internal exploitation or use of qualified IP. The consideration of the latter category shall prevent an unequal treatment of companies that internally use qualified IP. Thereby, it must be distinct if the income is generated by sales revenue from products or services that contain qualified assets (i.e., embedded income) or if the income results from fictitious licensing.[52] Fictitious licenses refer to income that is linked to the use of qualified IP for the operation of the company's own business process (e.g., production of finished products, execution of services) and would have to be paid if the qualified IP is owned by a third party.[53] The majority of countries make use of the broad range of qualifying types of income, which is suitable to achieve a tax incentive that is not sector- or industry-specific and thus avoids distortions of competition.[54] Still, France, Lithuania, Portugal, and Spain exclude IP income from internal exploitation or use. In this subset of countries, the patent box creates a significant distortion of competition among industries that rely heavily on internal use rather than generating profits through a licensing model.[55] With regard to capital gains, we observe various treatments, ranging from total exemption in Cyprus and Hungary to no inclusion of capital gains in Ireland. In Belgium and Italy, taxpayers need to fulfil a reinvestment condition to benefit from the preferential treatment. Italian beneficiaries have to reinvest at least 90% of the proceeds, within the following two tax years, in R&D activities of other qualifying IPs. In Belgium, the reinvestment period of five years is slightly more generous, however; capital gains only qualify if the underlying IP is a fixed asset and is held for more than 24 months.

[51] For an overview of the qualifying IP assets and IP income, see Appendix 1.
[52] The implementation of embedded income requires an additional method to distinguish income related and unrelated to IP (e.g., BEPS conform transfer pricing principles), see OECD 2015b, 29.
[53] Evers 2015, 64 et seq.; Schwarz Martínez 2017, 255 et seq.
[54] Spengel 2016, 417.
[55] Spengel 2016, 417.

For determining the tax base of IP box regimes, the **treatment of current expenses** (i.e., depreciation allowances incurred on the use of capitalised IP, administrative expenses, improvement expenses, and financing expenses) related to qualifying income differed substantially in the past.[56] IP boxes either allow the deduction of current expenses against regular taxed income (gross approach) or restrict it to preferentially taxed income (net approach). The tax-deductibility of current expenses shields income from taxation, i.e., a tax shield whose value is determined by the applicable tax rate. A deduction of current expenses from the profit subject to regular taxation leads to an asymmetrical treatment and thereby enables tax arbitrage. Therefore, the net approach prescribes to ensure that the tax benefit is proportionate to the expenses and income incurred. Further, companies have to allocate the income and respective expenses on each qualified IP asset separately.[57] In line with this requirement, all IP boxes considered apply the net approach for calculating the IP box base.

Closely related to the overall determination of the tax base of IP boxes is the **treatment of resulting losses** based on the applicable net approach as well as the per-IP asset allocation of expenses and income. In order to ensure a proportionate treatment, IP boxes must be designed in such a way that it is not possible to offset initial and current losses against income taxed at the regular tax rate. However, the alignment of these initial R&D expenses is more complex since these costs have been incurred in the past and will have been deducted from the regular tax base before the MNE applies for the IP box.

Although we observe international variations in the treatment of **current losses,** all regimes ensure that there is no asymmetrical treatment of these losses and beneficial income. The majority of countries allow to set off initial losses against ordinary income. To do so, there are three options: either a reduced value method (e.g., IE, IT, CY[58], MT, SK), a benefit recovery method (e.g., FR, LU, MT, NL, PT), or even a combination of both approaches (e.g., ES). Under the reduced value method, the taxpayer is not allowed to deduct the part of expenses that is proportional to the share of exempt qualifying IP income. The basic idea is to entirely avoid tax losses arising from IP box regimes. On the other hand, the benefit recovery method grants an initial offset at the regular corporate income tax rate, whereby subsequent profits have to be taxed regularly up to the amount of the initial loss offset. In Spain, the respective treatment depends on the timing of losses: If losses occur after the preferential treatment of income, the

[56] For an overview of designs of IP boxes before the modified nexus approach, see Evers 2015, 53.
[57] If a per-IP asset allocation of expenses and income is not possible, MNEs are allowed to apply a product-based approach, i.e., product families, see OECD 2015b, 32.
[58] In line with the exemption of 80% of qualifying profits, only 20% of resulting losses can be surrendered to other group companies or be carried forward to subsequent years.

reduced value method applies up to an amount equal to the previously exempted income. Excess (initial) losses can be set off against the regular corporate tax rate with a subsequent recapture by applying the benefit recovery method. In contrast, the separate loss method only allows to set off IP losses against qualifying IP income (e.g., BE[59], PL, LT, CH, and the UK). Thus, IP losses cannot be used against ordinary income, even if there is no IP income against which to use the losses. This option usually provides an (un-)limited loss carryforward. Both approaches are in principle suited to ensure a proportional treatment of losses and income. Assuming that MNEs earn enough profits from other sources of income to use the direct loss offset, the separate loss method is less favourable from a taxpayer's perspective, taking into account the time value of money. Offsetting the losses against regular taxed income results in an immediate offset of the losses and thus interest and liquidity benefits compared to the separate loss method. This advantage increases with the time lag between initial development costs and subsequently arising profits.

In addition, the treatment of **historical expenses** (i.e., **initial losses**) incurred in connection with the qualified asset must also be considered since these expenses reduced the tax base of the regular taxed profit as immediate expenses before the intangible asset has been created. These expenses have to be added to the regularly taxed profit and subsequently subtracted from the IP box tax base in the year in which the IP box benefit is claimed to avoid tax arbitrage.[60] The recapture can take place in the form of capitalization or by means of the benefit recovery method. In the case of capitalization, the historical R&D expenses are fully added to the regular tax base and depreciated over the asset's useful lifetime (e.g., CY, HU, and SK)[61]. This mandatory periodical depreciation delays the tax deduction of R&D expenses and makes them less valuable from the taxpayer's perspective when considering the time value of money. Alternatively, IP box regimes that rely on the benefit recovery method apply the IP box tax rate only to the amount of income that exceeds the initial R&D expenditure. The remaining income is subject to the regular corporate tax rate.[62] In line with the treatment of current losses, the majority of IP box regimes relies on the benefit recovery method, which is more beneficial to the

[59] Any unused portion of the Belgium IP box deduction that is carried forward to a subsequent tax year will be added to a basket of tax attributes that are being carried forward (the Basket). In any subsequent tax year, no more than 70% of the taxpayer's taxable income exceeding 1 Mio. EUR will be eligible for set-off against the aggregate tax attributes in the Basket that are being carried forward.
[60] Ernst et al. 2016, 26; Spengel 2016, 418 et seq.
[61] In Cyprus, the taxpayer may elect not to claim tax depreciation or only claim part of it in a certain taxable period. Unused tax depreciation can be carried forward and claimed as additional tax depreciation during the remaining useful life of the IP asset. This provides greater flexibility given the impact on the amount of notional interest deduction (limited to 80% of taxable income before notional interest deduction) and a limited loss carryforward of five years.
[62] Felder 2013, 83 et seq.; Evers 2015, 72 et seq.

taxpayer due to the initial set off against the ordinary income (e.g., ES[63], FR, IE, IT, LU, MT[64], NL, PT[65], and the UK). In addition, Belgium and Switzerland offer the option to choose between the two methods depending on the advantageousness in the respective situation (BE: seven years, CH: five years). Poland and Lithuania follow the separate loss method also for historical R&D expenditures. Thereby, these costs are treated as initial losses which have to be allocated against subsequent qualifying IP income.[66] The UK still pursues the streaming approach.

In general, the implemented national IP boxes are accessible for resident entities that are subject to the national corporate income tax, as well as branches and PEs of non-resident entities which are subject to non-resident corporate income tax. Some countries, e.g., Italy, only grant the benefit to non-resident entities if the home country has a double tax treaty in force with Italy and allows an effective exchange of information.

Moreover, the IP box regimes generally distinguish between economic and legal ownership.[67] The Belgian IP box has a broad scope of interpretation as it considers the legal and economic ownership as well as exclusive rights holders as permissible. The Maltese box requires the legal ownership of the qualifying IP or an exclusive right. Furthermore, the Dutch IP box restricts access to the IP box regime to technical innovations that are developed under an approved R&D project that qualifies for a WBSO certificate.[68] The economic ownership is sufficient in Italy as well as in Cyprus and Poland.[69] The minimum ownership requirements are the licensing right in the UK and the temporary use of rights in Portugal[70]. For the Irish IP box, the location of the owner does not influence the availability of the beneficiary tax treatment.[71]

[63] In Spain, expenses incurred in the creation of the assigned asset that have not been previously incorporated into the value of the aforementioned asset have to be deducted. Thus, we interpret this as an option to capitalize, which is not mandatory, see Article 12 (3)(c) Ley del Impuesto sobre Socieadades.
[64] Article 6 (b)(ii) Legal Notice 208 of 2019.
[65] Article 50a (7) Código do Imposto sobre o Rendimento das Pessoas.
[66] *PL:* IP losses are always kept separate from the ordinary income even if there is no IP income against which to use the losses. However, a loss carryforward of five years is possible. *LT:* In the report prepared by the Council of the European Union, the separate loss method is mentioned in case of losses. However, no further information is given on an initial recapture of historical expenses.
[67] The economic owner can actually control, dispose and exploit the asset without being the legal owner (e.g., through purchase contracts) so that the ownership is assumed for tax purposes.
[68] De Nies and Oosterhoff 2016, 531.
[69] In Italy, the box refers to ownership as the right to economically exploit the qualifying IP asset.
[70] Article 50a Código do Imposto sobre o Rendimento das Pessoas.
[71] Revenue Irish Tax and Customs 2022, 17.

Table 2: IP box regimes in place in the EU and selected other countries (2021)

State	Year	Relief technique		Rate (%)		Tax base		
				CIT	IP	Expenses	Losses	Recapture
BE	2016	Notional Deduction	85	25	3.75	Net	Separate loss	Option
CY	2016	Partial Exemption	80	12.5	2.5	Net	Reduced value	Capitalization
FR	2019	Preferential Tax Rate	.	33	11.7	Net	Separate loss	Benefit recovery
HU	2016	Partial Exemption	50	9	4.5	Net	N/A due to cap	Capitalization
IE	2016	Partial Exemption	50	12.5	6.25	Net	Reduced value	Benefit recovery
IT	2015	Partial Exemption	50	27.7	12.975	Net	Benefit recovery	Benefit recovery
LT	2018	Preferential Tax Rate	.	15	5.0	Net	Separate loss	Separate loss
LU	2018	Partial Exemption	80	24.94	4.99	Net	Benefit recovery	Benefit recovery
MT	2019	Partial Exemption	95	35	1.75	Net	Reduced value/benefit recovery	Benefit recovery
NL	2017	Preferential Tax Rate	.	25	9.0	Net	Benefit recovery	Benefit recovery
PL	2019	Preferential Tax Rate	.	19	5.0	Net	Separate loss	Separate loss
PT	2016	Partial Exemption	50	21	10.5	Net	Benefit recovery	Benefit recovery
SK	2018	Partial Exemption	50	21	10.5	Net	Reduced value	Capitalization
ES	2018	Partial Exemption	60	25	10	Net	Reduced value/benefit recovery	Benefit recovery
CH	2020	Partial Exemption	90	21.1 [a]	9.18 [a]	Net	Separate loss	Option
UK	2016	Notional Deduction	~47	19	10	Net	Separate loss	Streaming

Notes: The table shows the key characteristics of the IP box regimes effective in the EU, CH, and UK as of 2021. The column year refers to the year of implementation of the nexus. The column rate depicts the main effective rates for corporations under the regular tax system and the IP box regime. The column CIT (=corporate income tax rate) includes the statutory CIT rate, surcharges levied on top of the CIT rate, and other (local) income taxes. The column IP depicts the effective IP box tax rate. If no separate IP box rate is given, the effective IP box rate is the product of the main rate and the share of exempt income. In the column recapture, the variant option allows to deduct immediately or to spread the recapture over seven periods (BE) or five periods (CH). Concerning CH (indicated by '[a]') the tax rates of the canton Zurich are applied. For a federal tax rate of 8.5%, a cantonal tax rate of 7%, and a municipal multiplier of 129.01 as well as the mutual deductibility of federal and state tax, the effective IP box rate is as follows 9.18% (=0.085+0.07*229.01/100*(1-0.9))/(1+(0.085+0.07*229.01/100*(1-0.9)))).
Source: Own research and illustration.

2.4 Location attractiveness for IP investments

2.4.1 Methodology

To analyse the location attractiveness for stylised corporate investments in IP box regimes pre and post the nexus implementation, we rely on the (prospective) effective tax burden methodology put forward by *Devereux & Griffith*[72]. The methodology allows for a better evaluation of the tax environment as it goes beyond statutory corporate tax rates by accounting for several tax parameters (tax rate, tax incentives, etc.) and measures their impact on corporate investments in terms of after-tax returns. So, it is suitable to comprehensively point out the type and the extent of tax distortions[73], and measure the influence of tax parameters on the tax attractiveness of locations.

The approach is based on the neoclassical investment theory and relies on a discrete, hypothetical investment decision of an (at least) marginal investment of a profit-maximising company. It distinguishes between marginal investments that reach a return equal to their cost of capital (CoC) and investments with an assumed positive pre-tax return measured by the indicator effective average tax rate (EATR). The CoC shows the impact of taxation on the scale of investments and a country's relative attractiveness for investment extensions compared to alternative investment locations.[74] In contrast, the EATR is the relevant measure if companies have to decide on the geographical allocation of economic returns in the course of investment location decisions, which are the focus of our analysis.[75]

For the modelling, we follow *Evers et al.* and rely on a hypothetical corporate R&D investment (only current investment costs[76]), which results in a self-developed patent.[77] Further, in line with previous literature, we acknowledge that the value of R&D expenditures accrues over several periods.[78] Moreover, we assume that the company generates sufficient other income to

[72] Devereux and Griffith 1999, 33 et seq.; Devereux and Griffith 2003, 112 et seq.; Evers, Miller, and Spengel 2015.
[73] Lammersen 2005, 10 et seq.
[74] CoC defines the minimum real pre-tax return required by an investor compared to a given real post-tax return on alternative investment (i.e., financial investment).
[75] Devereux and Griffith 1998; Devereux and Griffith 2003, 337. The EATR measures the change in the net present value (NPV) of a highly profitable investment caused by taxation. Thereby, we assume that the company earns firm-specific and largely mobile economic rents, expressed by a positive NPV of the investment. Since economic rents are only available to a limited extent, a company chooses the project with the highest NPV after taxes among two or more mutually exclusive projects, see Devereux and Griffith 1999, 13 et seq.
[76] Current expenses generally account for the largest share of R&D expenditures, see Cameron 1996, 216; Leitner et al. 2011, 14 et seq.
[77] Evers, Miller, and Spengel 2015. A consideration of personal tax characteristics of different shareholders regularly does not provide theoretical insights for profitable and discrete corporate investments, see Devereux and Pearson 1995, 1660.
[78] See Hall and Van Reenen 2000, 451; McKenzie 2008.

immediately benefit in whole from any tax deduction.[79] Our analysis builds on well-established studies[80] for the economic parameters in the Devereux/Griffith methodology. Most importantly, we assume a pre-tax return of the IP investment of 20%.[81]

Based on our qualitative analysis of the changes in IP tax planning in Section 2.3, we focus in our baseline scenario on a domestic company that develops and exploits the IP asset in the same jurisdiction. The introduction of the nexus increases the tax location attractiveness of countries in the combined beneficial tax treatment of R&D expenses (i.e., tax-deductibility) and the treatment of IP income (i.e., preferential tax rates, partial exemption). As the effective tax burden measures are given for different types of financing (i.e., equity and debt), the model also allows a differentiated analysis of the impact of taxes with regard to these factors.[82]

2.4.2 Implementation of the nexus

We incorporate the nexus and its implications in the Devereux/Griffith methodology via the variable IP box tax rate ($\tau_{IP\ nexus}$).[83] The previous literature on the modelling of IP boxes assumed that all IP income is classified as tax-beneficial income.[84] We remove this assumption in the following since we account for the nexus in the calculation of the EATR. Due to the associated application of the substance requirement, the reduced IP box tax rate τ_{IP} can no longer generally replace the regular corporate income tax rate in the model. Accordingly, we determine a modified IP box tax rate ($\tau_{IP\ nexus}$, where $\tau_{IP\ nexus} \leq \tau_{IP}$).

Thus, we have to compute a modified IP box tax rate, which accounts for the nexus ratio. To do so, we first determine the overall tax burden of a multinational company exploiting a patent investment. This overall tax burden comprises the share of tax-privileged income, subject to the IP box tax rate, as well as a possible residual of non-tax-privileged income, subject to the regular corporate income tax rate. This residual can arise due to partial non-compliance with the substance requirement, i.e., that the qualified R&D expenditure does not correspond to the total R&D expenditure ($E_{qualified} \neq E_{overall}$), e.g., due to outsourcing R&D activities to related companies. We resolve the calculation of the overall tax burden according to the implicit

[79] The assumption of no tax exhaustion is most appropriate in large mature companies that generate income from other investment projects. If, in contrast, the taxpayer is tax exhausted, the tax benefit associated with tax allowances is delayed. Thus, the NPV of tax allowances is lower, and thereby, the effective tax rates are higher as under the case of no-tax exhaustion, see Devereux, Griffith, and Klemm 2002.
[80] We follow the annual report on effective tax levels in the EU prepared by Spengel et al. 2020, no. 45 at B-1.
[81] This is in line with previous studies, see Devereux, Griffith, and Klemm 2002. For the other applied parameters, see Appendix 2.
[82] Devereux and Griffith 1999, 11 et seq.; Devereux and Griffith 2003, 110.
[83] A detailed overview of the technical details of the Devereux/Griffith methodology and especially the implementation of nexus-compliant IP box regimes can be found in the Appendix 3.
[84] Evers, Miller, and Spengel 2015; Pfeiffer and Spengel 2017.

effective tax rate in order to determine the modified IP box tax rate under the nexus.[85] Besides the direct effect of the reduced tax rate on IP income, the generosity of an IP box depends on the treatment of expenses. Within our sample, all countries allow current R&D expenses incurred in the creation of a self-developed intangible asset to be expensed immediately when they are incurred. Further, we observe that all current IP box regimes apply the net income approach in line with the nexus. Thus, the value of the tax allowance of current expenses is determined by the preferential IP box tax rate. For mandatory capitalization, we make the simplifying assumption that immediate deduction and subsequent capitalization occur in the same period. Therefore, the IP box rate is decisive for the NPV of the periodical depreciation allowances. With respect to financing costs, i.e., (notional) interest expenses, the net income approach mandates that the tax shield is determined by the IP box tax rate.[86]

As the majority of countries do not require the initial capitalization of development costs, a recapture mechanism of previous R&D expenditure is necessary to ensure the equal treatment of income and expenses. Otherwise, the asymmetrical treatment of income and current expenses results in a tax shield based on the regular taxed profit being greater than the tax burden of the income based on the modified IP box tax rate, so that $EATR \leq 0$. As stated in Section 2.3, all countries have either an initial capitalization or a recapture mechanism in place. For the capitalization mechanism, we follow the procedure of an initial capitalization with subsequent periodical depreciation. If not stated otherwise in the national tax law, we assume a depreciation period of five years. However, if countries rely on the threshold approach, i.e., taxing IP income up to the development expenses at the general corporate income tax rate, the preferential IP box rate does not necessarily apply immediately when IP income is earned. As already stated by *Evers et al.*[87], this version of the recapture cannot be precisely modelled in the two-period framework of the Devereux/Griffith methodology.[88] Following their approach, we assume that the tax allowances are best approximated in the model by the IP box rate.[89] We acknowledge that this simplification does not account for the interest effects arising from the initial higher depreciation values and their lack of compensation when setting the threshold. Thus, we depict the benefit recovery method as slightly less advantageous than it would be for both the EATR and the CoC. In the latter case, the CoC would tend to be reported slightly below 5% due to the

[85] For a detailed calculation of the formula, see Appendix 4.
[86] Evers 2015, 103.
[87] Evers, Miller, and Spengel 2015.
[88] The two-period model according to Devereux/Griffith is unsuitable for modelling the threshold mechanism, since the income from IP does not exceed the current R&D expenses on the basis of the standard data set until the fourth period. This results from the comparison of revenues and R&D expenditures, which are assumed to be constant over time. The time effects are taken into account by discounting and generating the first payback in t_1.
[89] Evers 2015, 102.

resulting more favourable treatment compared to the alternative investment, i.e., interest effect. However, this deviation depends strongly on the respective interest rate level, which is why our results are a good approximation due to the current low-interest-rate environment.

2.5 Effective tax rates under IP box regimes

To illustrate the impact of the nexus on the effective tax burden of firms in IP box countries, we focus our analysis on a domestic firm that develops and exploits the IP asset in the same jurisdiction. In doing so, we do not only reflect the current incentive for firms to choose R&D locations that are fiscally attractive from the combined perspective of IP development and exploitation. Furthermore, this focus allows us to compare our results with the previous literature reflecting pre-nexus tax competition.

The first set of estimates in Table 3, presents the CoC and the EATR for both extremes in which the MNE either bears all qualifying costs or none at all. The latter represents our baseline scenario in which the domestic company generates revenue by licensing out a patent for which it has not incurred qualifying expenses to be eligible for the IP box. In this scenario, we assume that the company has fully outsourced the development of the patent to an affiliated company via contract R&D, which allows for immediate expensing of these costs as they are incurred.[90] Since the company does not incur any qualifying development costs, it is also not eligible for a potential uplift under the nexus ratio. This comparison of both extremes allows us to quantify the maximum tax benefit that a multinational could receive on a (self-developed) patent investment based on existing IP box regimes. Further, we use the results of *Evers et al.*[91] to quantify the changes in the effective tax burden in the pre- and post-nexus era. In 2014 there was no definition of qualifying expenses. Thus, we refer to the treatment under the regular tax system to approximate our baseline scenario for 2014.

[90] R&D contracting arrangements are defined as the R&D activities performed by one party (the contractor) on behalf of, i.e., at risk and for the account of another party (the client). Thus, the client bears the risk for the contract research by performing, directing, and controlling the R&D activity. This requires adequate resources, including sufficiently trained staff, to effectively lead and control the R&D work. Whereas the contractor receives remuneration, usually determined on a cost-plus basis, in return for its services, the client acquires legal and economic ownership of the intangible asset resulting from the R&D activity. For practical examples, see OECD 2017. Alternatively, the acquisition of a patent would be conceivable. However, under our model, this is disadvantageous for the company from a tax point of view, as the acquisition results in capitalization and associated periodic depreciation, see Appendix 5 and Appendix 6.

[91] Evers, Miller, and Spengel 2015, 513.

Table 3: Effective tax levels of self-developed patent pre- and post-nexus

	IP box tax rate		CoC			EATR		
Country	2021	Δ 2014	2021	Δ baseline	Δ 2014	2021	Δ baseline	Δ 2014
BE	3.75	-3.05	5.00	0.00	6.88	2.81	-15.94	29.76
CY	2.50	0.00	4.96	0.64	0.14	1.66	-4.75	-0.68
FR	11.70	-5.06	5.00	0.00	4.56	8.25	-13.46	14.66
HU	4.50	-5.00	5.17	0.17	2.31	4.21	-2.54	6.75
IE	6.25	-6.25 [a]	5.00	0.00	0.00 [a]	4.69	-4.69	-4.69 [a]
IT	12.98	-18.31 [a]	4.85	0.15	0.93 [a]	9.79	-9.97	-9.97 [a]
LT	5.00	-10.00 [a]	5.00	0.00	0.00 [a]	3.75	-7.50	-7.50 [a]
LU	4.99	-0.85	5.00	0.00	-0.23	3.74	-14.96	-1.73
MT	1.75	1.75	4.89	2.10	0.00	0.77	-18.31	0.77
NL	9.00	4.00	5.00	0.00	0.00	6.75	-12.00	3.00
PL	5.00	-14.00 [a]	4.88	0.35	-0.12 [a]	3.17	-9.19	-11.08 [a]
PT	10.50	-4.50	3.92	1.08	0.35	7.26	-8.96	2.09
SK	10.00	-12.00 [a]	5.43	0.43	0.43 [a]	9.82	-5.93	-6.68 [a]
ES	10.50	-1.50	5.00	0.00	3.47	7.50	-11.25	10.45
CH	9.18	-11.97 [a]	5.18	0.00	0.00 [a]	7.70	-7.80	-8.87 [a]
UK	10.00	0.00	5.00	0.00	0.00	7.50	-6.75	0.00

Notes: The table represents the comparison of several key indicators of the IP box regimes over time and within time across different scenarios. The Δ 2014 shows the change in pp. for the indicators from the pre-nexus era (year 2014) to the post-nexus era (year 2021), where the underlying scenario assumes a fully self-developed patent. The Δ baseline quantifies the maximum available tax benefit of the applicable IP box regime in comparison to our baseline scenario in the year 2021. The baseline scenario refers to the application of the post-nexus IP box regimes for a patent under fully outsourced R&D activities. Results marked with '[a]' indicate that these countries had not enacted an IP box in 2014. Therefore, the values refer to the taxation of IP income under the regular tax system in 2014 compared to the results under the IP box regime in 2021.
Source: Own calculation and illustration.

2.5.1 Marginal investment

We first present our results on the CoC in Table 3, which demonstrate the effect of taxation on a marginal investment, i.e., an incremental corporate investment that just yields a rate of return on the initially invested capital that is sufficient to compete with an alternative investment. If the after-tax CoC is 5% and thus equal to the assumed real market interest rate of our alternative financial market investment, taxation has no influence on the corporate investment decision. Whereas a CoC below the real market interest rate indicates that taxation favours the respective corporate investment in a patent more than the alternative financial investment, which we assume as a benchmark.

To quantify the maximum impact of an IP box on the effective tax burden of a patent investment, we consider the scenario, in which all qualifying expenses are borne by the company itself. Compared to the baseline scenario of contract R&D (Δ baseline), the results show that the application of the IP box does not further reduce the CoC. The immediate deduction of R&D

expenses under the regular tax system already results in marginal investments being unaffected by taxation as it shields the marginal return from taxation.[92] Thus, we observe for the majority of countries analysed a CoC of 5%, meaning that the MNE is indifferent between the corporate and the financial market investment.[93] The constant CoC for both cases is driven by the nexus, which prescribes a symmetrical treatment of current as well as historical expenses and costs. Therefore, companies can no longer reduce their tax base by deducting current as well as historical R&D expenses from the regular taxed corporate income tax base while the corresponding income is taxed at the favourable tax rate, as was common in the past. In 2014, the mismatch of R&D expenses and IP income even resulted in a negative cost of capital of -1.88% in the Belgium IP box regime.[94] Thus, it is not surprising that countries applying an asymmetrical treatment of income and expenses in 2014 face significant increases in the CoC in comparison to 2021.

On the contrary, the application of an IP box can be even detrimental to the company as IP-boxes can be associated with higher capital costs than under the regular tax system. This makes an investment in a fully self-developed patent relatively less attractive, both compared to the alternative financial market investment as well as contract R&D. This is mainly due to two reasons: While the increase in the Hungarian (+0.17 pp.) and Slovakian CoC (+0.43 pp.) is wholly driven by the mandatory capitalization to recapture historical R&D expenses, the Cypriot increase in the CoC (+0.64 pp.) is a combination of the mandatory capitalization and a reduced value of the notional interest deduction. Due to the mandated net approach, MNEs have to allocate all financial expenses to beneficiary income. Thus, the value of the NID is determined by the effective IP box rate and this reduction increases the capital costs (IT, MT, PL, PT). Therefore, the CoC increases e.g., in Malta from 2.79%[95] in the baseline scenario to 4.89% if we consider the full applicability of the IP box regime. In Switzerland the high CoC is driven by the Swiss wealth taxation on immovable assets, including self-developed patents, which raises the CoC above the market interest rate, i.e., 5.18%. Thus, it exerts a negative influence on the optimal level of investment activity. For marginal investments, IP boxes are not a suitable tax instrument to provide additional incentives to expand existing research activities, as they do

[92] The comparison to the alternative option of acquisition illustrates that the immediate deductibility of contract R&D expenses for tax purposes already represents subsidization of R&D that does not exist in the first case. The capitalization leads to delayed recognition of expenses in the context of periodical allowances. Therefore, we observe CoC above the 5% benchmark in the majority of countries considered, ranging from 5.29% in Poland to 6.51% in France. Only in Cyprus, Malta and Portugal are the existing NID high enough to compensate for the disadvantage of deferred depreciation. For further details, see Appendix 5.
[93] For a detailed overview on the level of the observed cost of capital, see Appendix 5.
[94] For more details on the effective tax burden of IP boxes as of 2014, see Evers, Miller, and Spengel 2015.
[95] Please refer to Appendix 5.

not lead to any further reduction in the cost of capital. Instead, they reduce the tax benefits of other incentives, e.g., NID. This finding is robust to the type of financing of the investment.[96]

2.5.2 Profitable investment

In the following, we expand our analysis to the EATR in Table 3 as it is an essential indicator of the attractiveness of investment locations in an international comparison.

The application of the IP box significantly reduces the effective tax burden of profitable investment projects relative to the EATRs in the baseline scenarios. Already in these, we observe a significant reduction in the tax burden due to the immediate deductibility of R&D expenditures. In this scenario, the average effective tax burden is 15.21%, and we already observe three countries with EATRs below 10% (i.e., CY, HU, and IE). Among our comparison countries, only French MNEs face an EATR above 20% on their self-developed patent investment.[97] As the immediate deductibility of R&D expenses does not distort the corporate tax base, the relative location attractiveness of countries is strongly correlated to the statutory tax rate. Thus, the effect of the low statutory IP box rates is accelerated.

In contrast to previous literature, we do not observe negative EATRs (i.e., BE, ES, FR, HU in 2014) due to the mandatory net approach, which does not allow for an asymmetrical treatment of R&D expenses and IP income. Thus, MNEs cannot use these regimes to shelter (non-) IP income from taxation. Nonetheless, the IP box regimes offer a significant potential to reduce the EATR. In Malta, corporations can reduce their EATR in the baseline scenario by 18.31 pp. on behalf of the IP box regime, resulting in the smallest EATR in our sample and thus the most attractive location, at 0.77%. This vast reduction in EATR with more than 10 pp. can also be observed in several other countries (BE, ES, FR, LU, NL), which are all characterised by a high statutory corporate tax rate. This induces an accelerated leverage effect of the tax relief through the IP box regime.

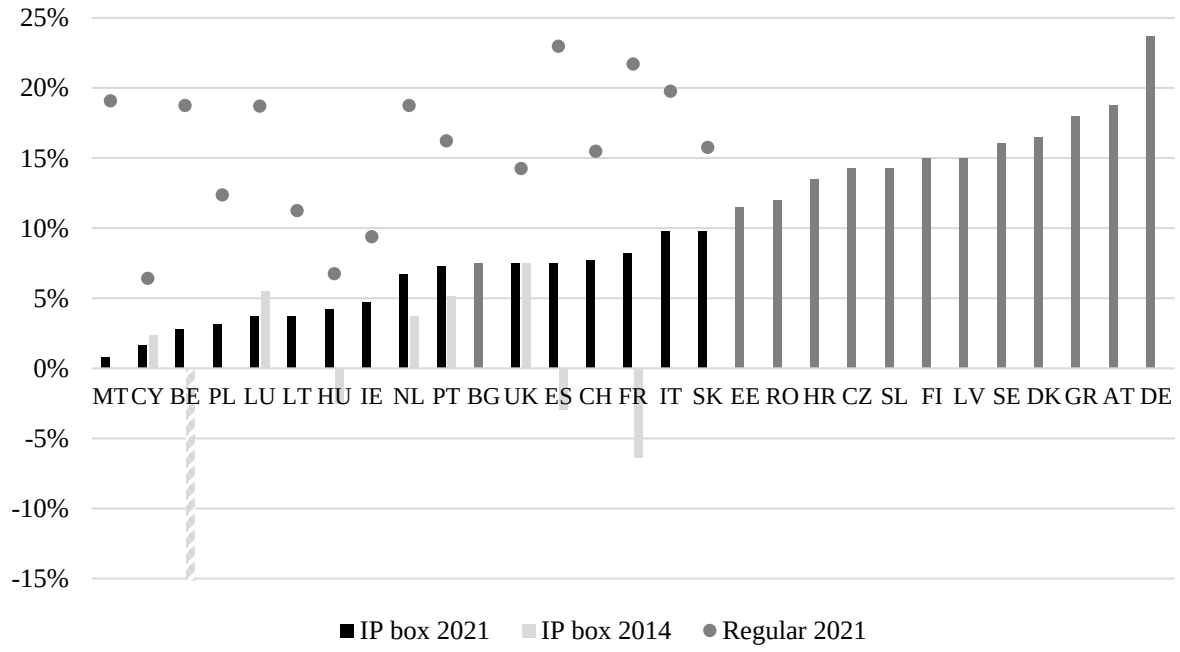
In summary, we observe for eight countries EATRs below 5% (i.e., BE, CY, HU, IE, LU, LT, MT, PL), thus providing a very generous tax environment for in-house IP investments. At the same time, the effective tax burden in the larger economies in our comparison group is still

[96] Due to the deductibility of interest payments from the corporate tax base, we observe a lower level of CoC in the case of debt financing of up to 1.5 pp. on average, depending on the scenario, see Appendix 10. Analogous to disregarding shareholder taxation, we do not consider the taxation of interest payments at the hand of the lender.
[97] The immediate deductibility leads to a significant reduction in EATRs (-1.43 pp. in BE to up to -5.36 pp. in FR) compared to capitalization and subsequent periodic depreciation of R&D expenses. Still, our results show a wide dispersion of effective tax levels across countries for our baseline scenario of contract R&D, with a total spread of more than 15 pp. Cyprus provides the most attractive location (6.41%), while France is the least attractive (21.71%). For more details on the EATR for our baseline results, see Appendix 6.

comparatively moderate to high (IT: 9.79%, FR: 8.25%). With the exception of Italy and Slovakia, all other countries in our comparison group have more than halved their effective tax burden for a patent investment. Thus, it comes as no surprise that these two countries represent the least attractive investment location. However, they are closely followed by France, for which even a reduction of more than 10 pp. is not enough to compete with the most attractive investment locations.

To put our results in a broader perspective, Figure 1 compares EATRs for a self-developed patent to the remaining EU Member States. IP box countries lead the country ranking. This is mainly because IP box regimes offer lower statutory tax rates than the regular tax rates in the other countries. However, this is not always the case. For example, the IP box rate in France (11.7%), Italy (~12.98%), Portugal and Slovakia (both 10.5%) are higher than the regular tax rate in Bulgaria (10%), being the only tax competitive EU country without IP box regime.[98] Further, the comparison to 2014 highlights the increase in EATRs for most IP countries, except Cyprus and Luxemburg, after the implementation of the nexus approach.

Figure 1: Ranking of EATRs for sample states (2021)



Notes: The figure represents the scenario of an equity-financed investment in a self-developed patent with variation in the share of qualifying expenses according to the IP box regime. The black bars depict the EATR for 100% qualifying expenses, i.e., application of the IP box regime in 2021. The light grey bars show the EATR for the application of the IP box regime in 2014. In Belgium the EATR amounts to -26.95%. The dark grey bars and dots depict the regular corporate tax burden for a patent without qualifying expenses in 2021. Bulgarian serves as a benchmark in the following, as it has the lowest EATR without an IP box in place.
Source: Own calculation and illustration.

[98] For an overview on the effective IP box rates, see Table 2.

For IP box countries, the dots in Figure 1 show the EATR under the regular tax system. The implementation of the IP box significantly improves its location attractiveness. In all countries, the IP box regimes reduce the EATR below the EU-27 average EATR at 15.29%. Further, it shows that the majority of IP box countries, which would qualify under the regular tax system as moderate to high tax countries, are as competitive as classical low tax countries in the EU, i.e., Eastern EU Member States as well as the Scandinavian countries.

In summary, our results demonstrate that IP boxes substantially reduce effective tax rates. In addition, we show that the mandatory alignment of the treatment of expenses and income does not result in negative effective tax burdens and thus subsidization of R&D investment. Further, it leads to the fact that the effective IP box tax rate (i.e., the amount of exempt IP income) becomes the decisive factor for determining the effective average tax burden. Our results apply strictly to the case of licensing income from the exploitation of patents. Nonetheless, to a large degree, they will equally apply to a broader scope than patents, e.g., software. In calculating the precise, effective tax burden, there would only be minor differences arising, e.g., from different assumed economic depreciation rates. Further, we show that these results are not driven by the assumption on the type of financing.[99]

2.5.3 Sensitivity analysis with respect to nexus ratio

Besides the alignment of the tax treatment of R&D expenses and IP income, the implementation of a strict nexus requirement – the nexus ratio – significantly impacts the effective IP box tax rate. We, therefore, examine this possible key driver of our result within a sensitivity analysis. If a company incurs less than 100% of the qualifying R&D expenses, it faces a proportional reduction in preferentially treated IP income, thereby increasing its effective IP box tax rate by the proportion of regular taxed income. To partially mitigate this impact, as well as to not put certain groups of corporations at an extraordinary disadvantage, corporations qualify for an uplift of up to 30% on their qualifying expenses. Thus, they only have to incur 76.92% of qualifying expenses themselves to fully benefit from the IP box.[100]

Figure 2 displays the evolution of the country's EATRs by varying the nexus ratio. To better illustrate the relative location attractiveness of countries from a tax perspective, we refer to the Bulgarian EATR for an in-house patent investment (= 7.5%) as a benchmark. Whereas none of the IP box countries could compete with the Bulgarian EATR if domestic MNEs do not incur

[99] For further details, see Appendix 9 and Appendix 10.
[100] A detailed derivation of the modified IP box tax rate is given in Appendix 4.

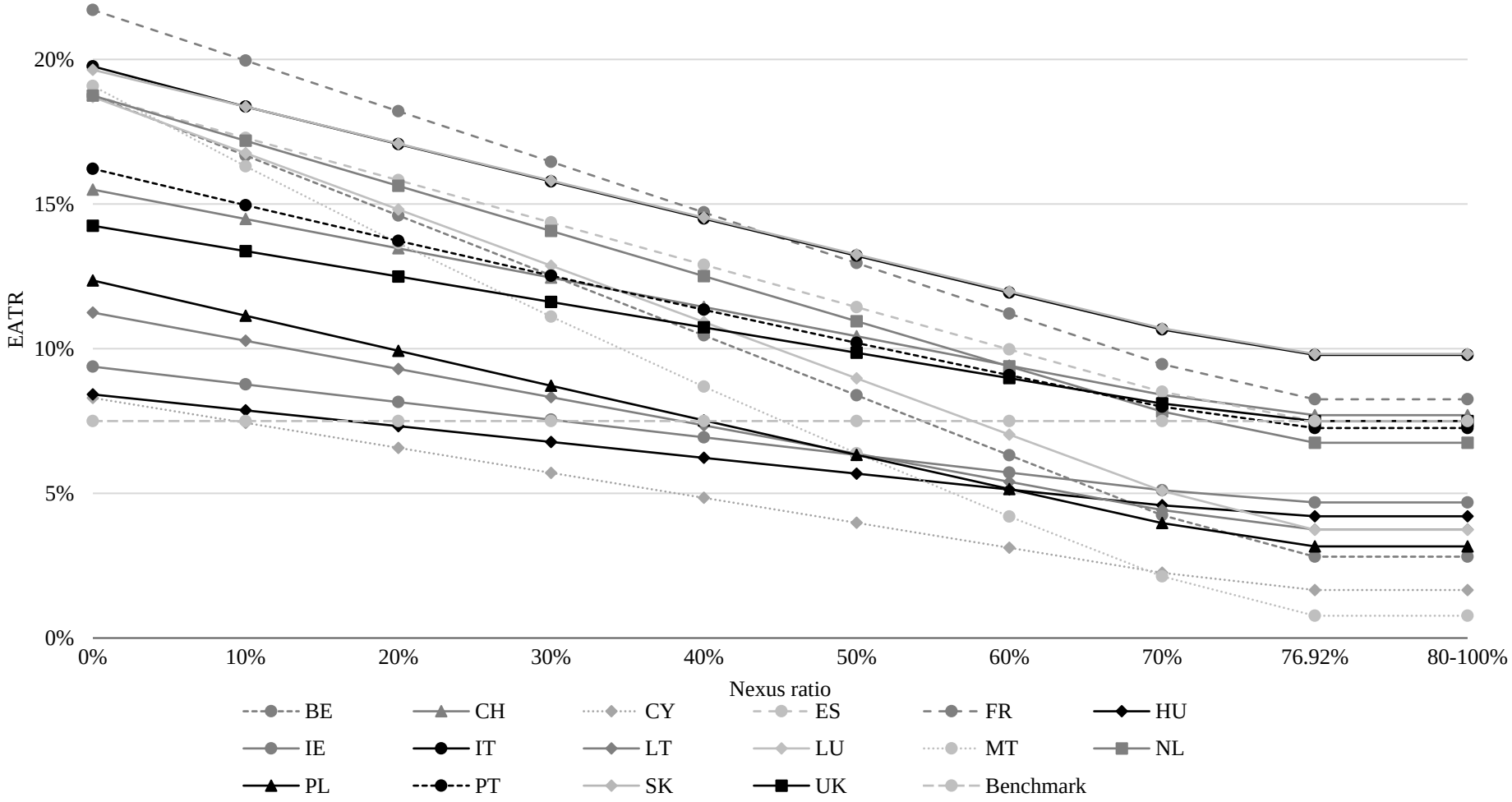
qualifying expenses (nexus ratio of 0), we observe only four countries (i.e., CH, FR, IT, SK) with an EATR above our benchmark if the MNEs can make use of the full tax benefit.

For all other countries, we observe a broad range of the minimum required share of qualifying expenses to reach the target EATR of 7.5%. MNEs investing in Cyprus only need to reach a nexus ratio of 9.27%, as Cyprus levies a quite competitive EATR in a scenario without qualifying expenses, while competitors investing in the Netherlands and Portugal require a share of qualifying expenditures of more than 70% to be equally attractive (i.e., NL: 72.12%, PT: 73.32%). However, for several countries, a share of less than 50% of qualifying expenses has to be incurred by MNEs to approach an effective tax burden of less than 7.5% (CY: 9.27%, HU: 16.81%, IE: 30.82%, LT: 38.46%, PL: 40.43%, MT: 46.70%).[101]

Due to the high sensitivity of the EATR to the nexus ratio, the relative location attractiveness between the countries considered may also change significantly. Whereas Malta is the most attractive location if one considers the full benefit of the IP box, it requires a share of more than 70% on qualifying R&D expenses to take over the top position from Cyprus. In case a Maltese MNE incurs less than half of the qualifying expenses itself, Malta is less attractive as a location for equity-financed patents than Poland, Lithuania, Ireland, Hungary, and Cyprus. A similar pattern emerges for Belgium, which ranks initially third, but again needs a nexus ratio of around 70% to be more competitive than the Eastern EU Member States and Ireland. The reason is the comparatively high regular corporate income tax rate, which is applicable to the proportion of IP income that does not qualify for the preferential tax rate. Taking into account that not all MNEs incur 100% of the qualifying expenses, a higher share of tax-exempt IP income is thus required to compensate for the high corporate income tax rate (e.g., MT: 90%). Thus, the position of a country relative to other IP box countries in terms of their effective tax burden is determined by the generosity of the implemented incentives themselves and the share of qualifying expenses but also by the level of taxation under regular income tax rules.

[101] For a more detailed overview of the sensitivity of our EATRs to the assumed nexus ratio, see Appendix 8.

Figure 2: Sensitivity of EATRs on nexus ratio (2021)



Notes: The figure depicts the EATR for an equity-financed investment in a self-developed patent by varying the nexus ratio. Our benchmark at 7.5% is based on the Bulgarian EATR for a self-developed patent, being the most tax-competitive EU Member State without an IP box regime. Further, we assume that all IP box countries opted for the IP box regime irrespective of the amount of qualifying income. **Source:** Own calculation and illustration.

2.6 Additional consideration of input-oriented R&D tax incentives

As shown in the previous subsection, the nexus requires substantial R&D activity in the IP box state if MNEs are to enjoy the full benefit of the preferential regime. Thus, MNEs in these countries may also benefit from any existing input-oriented R&D tax incentives there. These incentives include, e.g., R&D tax credits, accelerated depreciation, or super deductions, which are linked to R&D expenses and can reduce the costs of R&D activities significantly. Furthermore, these tax incentives can be considered as a tool for continually reducing the group's overall tax burden. Hence, countries could further increase their location's attractiveness for MNEs by providing both types of incentives. Therefore, we compare the effective tax burden of IP box regimes with R&D tax incentives as well as the possible combinations of those tax incentives in our selected IP box states.

We restrict our analysis to R&D tax incentives that are available to large firms, current expenses, and deducted from the corporate tax liability. Thus, we do not consider reductions in payroll taxes or social security contributions. Based on our selection criteria, we observe an input-oriented R&D tax incentive in all countries considered, except Cyprus and Luxembourg. In particular, five countries offer a super deduction in addition to the immediate deduction for R&D expenses (i.e., CH, HU, LT, PL, SK), while eight countries have enacted an additional tax credit (i.e., BE, ES, FR, IE, IT, MT, PT, UK). In our analysis, we exclude the Dutch R&D tax credit as it is used to reduce the labour tax burden instead of the corporate income tax rate.[102]

In Table 4 we provide a comparison of the effective tax measures of the baseline scenario on a fully self-developed patent with and without input-based R&D tax incentives. Consistent with the net approach according to the nexus, we allocate additional deductions of R&D expenses (i.e., super deductions) to preferentially taxed income. Thus, the super deductions cannot be used to reduce the regular tax burden of the MNE. As R&D tax credits are, per definition, independent of the applicable corporate income tax rate, the net approach is not decisive.

2.6.1 Marginal investment

In the case of marginal investments, tax base regulations, like input-oriented R&D tax incentives, are key drivers of the effective tax burden and have a significant impact on its key indicator, the CoC. Thus, we find that input-oriented tax incentives reduce the CoC to a greater extent in the context of a marginal investment compared to IP boxes. While the CoC ranges in case of an IP box from 3.92% in Portugal to 5.43% in Slovakia, in the case of input-oriented

[102] For a detailed overview of the considered input-oriented R&D tax incentives, please refer to Appendix 7.

R&D tax incentives an expanded bandwidth of the results from -5.82% in Slovakia to 5.01% in Belgium is given. Further, we observe negative CoC for the offered tax credit in France, Ireland, Italy, Malta, and Portugal, as well as for the super deduction offered in Lithuania and Slovakia.

In all countries, the combination of out- and input-oriented R&D tax incentives results in constant or even higher CoC relative to the separated consideration. The reasons for the reduction in the CoC are twofold: First, regardless of the applicable input-oriented R&D tax incentive, the CoC increase as the value of the tax shield of the initial deduction of R&D expenses is reduced. This is due to the fact that the value of depreciation is determined by the lower applicable IP box tax rate. In Cyprus, Hungary, and Slovakia, this effect is amplified by mandatory capitalization. Second, by the application of the net principle, the value of the super deductions in Hungary, Lithuania, Poland, Slovakia, and Switzerland depends on the lower IP box rate, in line with the treatment of the initial deduction.

2.6.2 Profitable investment

Secondly, as depicted in Table 4, the application of (input-oriented) R&D tax incentives results in a significant reduction of the EATR as opposed to the regular tax system and, in general, also with respect to the application of IP box regimes.[103] Moreover, we observe negative EATRs in eight countries which imply that an investment's post-tax NPV is higher than its pre-tax NPV, or respectively, a subsidy for the investment is offered. Regarding the interaction of the two leverages of the tax relief, our results show that with an increase in profitability of the investment, tax base adjustments are less decisive (respectively, the more critical is the applicable tax rate). R&D tax incentives offer a more significant potential to reduce the effective tax burden of an investment in a self-developed patent, which is in line with the goal to decrease the costs of conducting R&D. This creates an incentive for MNEs to accrue sufficient other income in the (input-oriented) R&D tax incentive country to fully make use of the tax benefits. Thus, there is an incentive to co-locate R&D activities and the exploitation of the resulting IP asset, as well as other kinds of activities that are taxed at the regular tax rate. The negative EATRs indicate that companies may be able to shelter non-R&D income from taxation by investing in R&D in half of our comparison countries.

[103] In CY, LU, and NL, no R&D tax incentives are modelled.

Table 4: Effective tax levels for self-developed patent under IP box regimes and R&D tax incentives (2021)

	BE	CY	FR	HU	IE	IT	LT	LU	MT	NL	PL	PT	SK	ES	CH	UK	ø
Statutory																	
CIT	25.00	12.50	33.00	9.00	12.50	27.70	15.00	24.94	35.00	25.00	19.00	21.00	21.00	25.00	19.70	19.00	21.52
CoC																	
IP box	5.00	4.96	5.00	5.17	5.00	4.85	5.00	5.00	4.89	5.00	4.88	3.92	5.43	5.00	5.16	5.00	4.95
R&D tax incentive	5.01	4.32	-3.59	2.99	-0.81	-0.19	-2.18	5.00	-2.89	5.00	0.13	-5.22	-5.82	-1.78	3.09	2.35	0.34
both incentives	4.43	4.96	-1.86	4.39	-0.43	0.62	2.86	5.00	-0.26	5.00	3.81	-3.51	0.23	-0.65	4.94	2.62	2.01
EATR																	
IP box	2.81	1.66	8.25	4.21	4.69	9.79	3.75	3.74	0.77	6.75	3.17	7.26	9.82	12.56	7.60	7.50	5.90
R&D tax incentive	18.77	6.41	-8.82	-2.41	-16.06	2.13	-19.28	18.70	0.59	18.75	-5.46	-11.39	-26.99	-6.69	7.11	3.54	-1.07
both incentives	0.09	1.66	-22.27	0.46	-20.75	-8.39	-6.43	3.74	-24.53	6.75	-1.89	-24.05	-13.49	-17.94	6.61	-3.21	-7.73

Notes: The table depicts the effective tax burden for a marginal investment (CoC) and a profitable investment (EATR) under the IP box regimes, input-oriented R&D tax incentives and the combination of both for an equity-financed investment in a fully self-developed patent in 2021. All numbers displayed are in %. We assume the mandatory net approach of the post-nexus IP box regimes also for the input-oriented R&D tax incentives and the combined application of both kind of incentives. In CY, LU, and NL, the R&D scenario captures the baseline scenario without any R&D tax incentive. We do not consider the Dutch R&D incentive as it is applicable against payroll taxation instead of CIT.

Source: Own calculation and illustration.

2.7 Concluding remarks

In this article, we examine in qualitative and quantitative terms the IP boxes in Europe in light of the changes through the nexus. Concerning the qualitative evaluation, we show that the nexus has been merely successful in aligning IP box characteristics. Predominantly, the nexus enforces the net approach and reduces the scope of beneficially treated IP assets that are not considered as predominant tax evasion vehicles. Undoubtedly, the key characteristics of IP box regimes that have been used for aggressive tax planning are theoretically abolished. However, the states still have leeway with regard to the design of IP box regimes and, thus, the extent of tax benefits. For instance, the definition of embedded royalties as qualifying expenses is one major difference that impacts the scope of application. The non-recognition of embedded royalties can lead, in fact, to discrimination of specific industries that only use royalties within the internal production process (e.g., automobile) rather than as final product or service. Furthermore, the IP box designs widely differ in the treatment of losses. Our results show that these differences impact the effective tax burden as following: loss treatment approaches that limit the set off to the reduced tax IP income (e.g., separate loss approach) lead to a smaller tax reduction effect compared to unlimited offsetting against the corporate tax burden.

Regarding the quantitative research, we contribute to the Devereux/Griffith methodology by incorporating the nexus. Our results demonstrate that even after the introduction of the nexus, a considerable reduction in the EATR is possible. Nonetheless, we find that the nexus effectively prevents excessive reductions of MNEs' tax burden. This is in accordance with the policy intention of preventing BEPS concerns. Our results indicate this by decreasing, non-negative CoC and EATR in the post-nexus IP box regimes compared to the countries' regular taxation. The impact of the IP boxes on the effective tax burden is mainly driven by the share of tax-exempt income.

Moreover, our sensitivity analysis indicates that the location attractiveness ranking of IP box regimes in terms of effective tax burdens is highly influenced by the nexus ratio. The position within the ranking is determined by the generosity of the implemented incentives, the share of qualified expenses, and the level of the regular corporate income taxation. Moreover, we include two further aspects in our calculation. First, we examine existing tax instruments such as the NID, which should eliminate the debt-equity bias and fits R&D intensive investments, predominantly financed by equity. Second, we allow for the combination with other national input-oriented R&D tax incentives. Even though the IP tax planning changed during the last decades, the combined out- and input-oriented tax incentives can be seen as attractive measures for

reducing MNEs' tax liabilities and, thus, increasing the location attractiveness. Our results undermine this statement as negative EATRs are given in the scenario of a combination of incentives in 10 out of 16 states. It is also interesting, that especially IP boxes combined with R&D tax credits are suited to reduce the overall effective tax burden of MNEs for a self-developed patent. Thus, the parallel application of the IP box decreases the beneficial effect in the case of the first group of tax incentives.

The results of our analysis apparently demonstrate that IP boxes are still a decisive factor of a country's location attractiveness under tax considerations for MNEs. Through the nexus this effect no longer occurs at the cost of aggressive subsidies. However, the rapid development of the digital economy leads to new service and production technologies like artificial intelligence. These new technologies will not only impact the location-related organization of MNEs but also the scope of application of IP box regimes. Thus, policymakers should carefully monitor new technologies in order to maintain fairness in international tax planning, especially in the context of IP box regimes.

3 The distorting effects of imputation systems on tax competition in the EU

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Abstract: The design of corporate income tax systems and thus the taxation of (cross-border) dividends are encompassed within the sovereignty of the Member States of the European Union (EU). However, these rules are restricted by the EU regulatory framework and the case law of the European Court of Justice (ECJ) which prohibit discrimination of foreign- against domestic-sourced dividends. Therefore, five EU Member States abolished their discriminatory imputation systems in favour of shareholder relief systems between 1999 and 2019, which had not only legal but also economic implications. In this simulation study, we assess how and to what extent the abolishment of discriminatory imputation systems in the EU Member States affected a country's tax location attractiveness for capital investments and tax competition. The analysis is based on the cost of capital (CoC) and effective average tax rates (EATR) using the Devereux/Griffith methodology. Overall, under the discriminatory imputation systems, we find lower CoC and EATR for investments located in the shareholder's residence country compared to foreign investment alternatives. The advantageousness is, on average, reversed after the switch to the shareholder relief systems and places additional tax competition pressure on the affected Member States.

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[104] This chapter is based on the article published in Intertax, see Fischer, Müller, and Spengel 2023.

3.1 Introduction

Increasing globalization has reduced trade barriers and enhanced capital mobility.[105] Hence, corporations and their shareholders decide where to locate their investments in a globally integrated marketplace. Consequently, these entities are not necessarily residents of the same country, therefore, to avoid possible distortions caused by taxation, corporate and personal income taxation should be integrated.[106] Within the European Union (EU), corporate tax systems are not harmonised and are thus shaped by the tax regulations of each Member State. However, national tax regulations must comply with superior EU law.[107] In addition, the case law of the European Court of Justice (ECJ) impacts Member States' national tax regulations. In particular, the Member States' corporate tax systems shall not discriminate dividends received from foreign investments against those that are domestic-sourced in order to avoid restrictions on the fundamental freedoms, especially the free movement of capital. In terms of integration, this requires equal tax treatment of dividend payments irrespective of their source country.[108] In the past, the increase in cross-border transactions placed pressure on the Member States that applied an imputation system as the underlying credit was restricted to domestic-sourced dividends. Consequently, these systems were considered incompatible with the free movement of capital due to the discrimination of foreign against domestic investments; this was later confirmed by the ECJ jurisprudence. Thus, Member States shifted from discriminatory imputation systems to shareholder relief systems to comply with internal market regulations. This switch in corporate tax systems not only affected the overall tax burden of domestic and foreign investments but also tax competition as the abolishment of the discriminatory imputation systems removed the self-created domestic investment bias.

The changes in the national tax policy contributed to an alignment of corporate tax systems across EU Member States even though no legal harmonization mandate exists. In addition, the changes could have affected the increasing tax competition between Member States. Especially economically meaningful ones like Germany or France made relevant changes to their corporate tax systems that could have affected the tax environment for capital investments in the EU. Overall, the harmonization and anti-discrimination intention of the EU interacted with tax competition between the Member States. The tax competition between the states is still an important obstacle for fair taxation in the policy debate 20 years later. Thus, the analysis in this

[105] Avi-Yonah 2000, 1575.
[106] McLure 1975, 257; Warren 1981, 719 et seq.
[107] See, e.g., ECJ C-319/02 2004, para. 19.
[108] Referred to also as interpersonal and intercountry equity; see Musgrave and Musgrave 1972; McLure 1980, 151.

contribution evidences the evolution of current tax-policy trends in terms of increasing tax competition and ongoing harmonization initiatives in the EU. The development of corporate tax systems in the context of EU legislation and ECJ case law has been subject to numerous legal studies focusing exclusively on the normative-juridical perspective.[109] An ample amount of empirical literature addresses the effect of imputation systems in various forms (especially including non-EU countries) on different aspects such as foreign portfolio investments[110], firm value[111], tax avoidance[112], dividend policy[113], stock prices[114], or corporate capital investments[115]. However, this study focuses on the implications of changes in corporate tax systems in combination with the ECJ's related rulings on the scale and location of investments as well as on tax competition.

In contrast to the literature mentioned previously, the evidence for the former is comparatively scarce. For example, *Evers & Spengel*[116] discuss the cross-border taxation of dividends in the case of individual portfolio investors for the year 2012. They find that juridical double taxation, the discriminatory crediting of withholding taxes in the shareholder's residence country, and the negative cash-flow effects of the imposition of withholding taxes can hinder shareholders from investing abroad. To overcome these obstacles for a more effective functioning of the internal market, they propose abolishing withholding taxes for dividend payments to individual shareholders and introducing an automatic exchange of information regarding the dividend payments that were mentioned. Another study conducted by *Maier & Schanz*[117] includes economic tax measures in the examination of corporate tax systems. They show the convergence of the taxation of domestic dividends and capital gains in 14 EU Member States over 25 years for corporate and individual shareholders. *Schanz & Theßeling*[118] measure the effects on different shareholders of a transition from the full imputation to the shareholder relief system under two German tax reforms (2001, 2009). They find a change in the dividend payout policy of firms listed on the Frankfurt stock exchange due to the reduced advantageousness of dividends compared to capital gains after the respective reforms. In addition, the interdisciplinary literature assessing the economic impact of ECJ case law is also limited. The studies by *Bräutigam et*

[109] See, among many others, Van den Temple 1970; Englisch 2005; Denys 2007; Englisch 2010.
[110] Desai and Dharmapala 2011; Amiram and Frank 2016; Chang, Chen, and Chen 2017.
[111] Prevost, Rao, and Wagster 2002.
[112] Wilkinson, Cahan, and Jones 2001.
[113] Pattenden and Twite 2008; Chen and Gupta 2011; Amiram and Frank 2016.
[114] Chang, Chen, and Chen 2017.
[115] Jugurnath, Stewart, and Brooks 2008.
[116] Evers and Spengel 2012.
[117] Maier and Schanz 2016.
[118] Schanz and Theßeling 2012.

al.[119], *de la Feria & Fuest*[120], or *Spengel et al.*[121] focus on ECJ jurisprudence concerning tax regulations at the corporate level, like controlled foreign company rules or final losses, but do not cover the ECJ's case law on discriminatory corporate tax systems such as imputation systems.

The impact of corporate tax systems, i.e., a switch from a (discriminatory) imputation system to a shareholder relief system on the functioning of the internal market, has mainly been evaluated in the legal literature. Hence, none of the studies mentioned above analyse the implications of such a transition and its effects on investment location decisions and tax competition in a systematic manner. Thus, this paper contributes to the interdisciplinary literature by addressing the research question on how and to what extent the abolishment of discriminatory imputation systems in the EU Member States affected a country's tax location attractiveness for capital investments and tax competition in the EU.

In addition, this study is enriched by the explicit inclusion of shareholder taxation as a determinant that can impact investment decisions.[122] It might be less decisive for investment decisions if corporate and shareholder taxation is only loosely integrated. For example, in the case of shareholder relief systems, the tax burden at the shareholder level is in addition to the corporate tax burden irrespective of the shareholder's residence. Thus, as the after-tax ranking of investment alternatives at the corporate level is less influenced by shareholder taxation, its consideration would not change the decision-making.[123] In contrast, adhering to the same logical argumentation, shareholder taxation can impact investment decisions if an imputation system applies that limits the application of the imputation credit to domestically taxed profits, and the majority of shareholders are individuals with unlimited tax liability.[124] As this study focuses on this, it is essential to include the taxation of individual shareholders in order to provide a comprehensive analysis.

[119] Bräutigam, Spengel, and Streif 2017.
[120] De La Feria and Fuest 2016.
[121] Fischer, Spengel, and Stutzenberger 2020.
[122] The study by Spengel et al. provides an overview of effective tax measures (EATR, EMTR, CoC) from 1998 to 2021 without further analysis on specific research questions. In section C, they include the shareholder level in their calculations but only for a domestic investment. In contrast, to analyse how and to what extent the abolishment of discriminatory imputation systems in the EU Member States affected a country's tax location attractiveness for capital investments and tax competition in the EU, we must compare and evaluate a domestic against a foreign investment. Thus, the analysis of this paper clearly exceeds the scope of the cited study. See Spengel et al. 2020.
[123] Spengel 2003, 84.
[124] Fuest and Huber 2000, 353; Spengel 2003, 84; for cross-border cooperation, see Herzig 1996, 196 et seq. Shareholder taxation can also impact the CoC if an imputation system applies, and the shareholders are mostly individuals with unlimited tax liability. See, e.g., Devereux and Freeman 1995, 86 et seq. For a detailed discussion of the decision relevance of personal taxes, see Spengel 2003, 81 et seq.

The first step will briefly analyse the corporate tax systems under the fundamental principles of the EU regulatory framework. The second step will evaluate the impact of discriminatory imputation systems and their abolishment on investment conditions for an individual, qualified[125] shareholder in the internal market. Hereby, the focus is on the EU Member States that applied a discriminatory imputation system between 1999 and 2019[126], specifically, Finland, France, Germany, Italy, and Spain. To quantify the effects, we build on the approach of *Devereux & Griffith* and analyse the tax burdens of marginal and highly profitable investments by calculating the cost of capital (CoC) and effective average tax rates (EATR). The CoC and the EATR are both relevant measures for identifying tax-induced distortions in the context of location choices. To do so, a stylised scenario is considered: An individual, qualified shareholder undertakes an investment in a domestic corporation. The corporation decides whether to invest the additional capital in a domestic (domestic investment) or foreign (foreign investment) subsidiary. For the foreign investment, there is a distinction made between an investment in the EU-15 Member States or the EU-10 Member States.[127]

Overall, under the discriminatory imputation systems, higher CoC and EATR are ascertained for the foreign compared to the domestic investment due to the denial of the imputation credit for foreign-sourced dividends. Regarding the CoC, this suggests a positive implication on the scale of investment for subsidiaries located in the shareholder's residence country. The lower EATR of the domestic compared to foreign investment clearly signals a higher tax location attractiveness for profitable investments in the shareholder's residence country. Some governments and tax experts expected such corporate tax systems to be incompatible with the fundamental freedoms; this was confirmed by ECJ rulings. Thus, the respective Member States finally abolished discriminatory imputation systems and switched to shareholder relief systems. This switch also implied the abolishment of the self-induced domestic investment bias. Consequently, the spread in the CoC between the domestic and foreign investments converged, and the advantageousness was reversed. This also holds for the EATR. Thus, individual qualified shareholders face a lower EATR if a domestic corporation invests additional shareholder capital abroad. This effect is primarily driven by the tax rate differential between the five selected EU Member States and the respective EU-15/ EU-10 Member States. Thus, it potentially increases tax competition within in the EU.

[125] We assume that shareholding requirements according to EU Member States' national tax law such as a specific holding period or a certain percentage of shareholding are fulfilled.
[126] The observation period begins with the availability of the comprehensive IBFD Tax Handbooks in 1999.
[127] The EU-15 refers to states that joined the EU before 2004 whereas the EU-10 refers to states that joined in 2004. As Bulgaria, Romania (both 2007), and Croatia (2013) joined the EU in later years, they are not considered for the quantitative analysis of this study.

The remainder of this paper proceeds as follows. Section 3.2 elaborates on the relevant fundamental regulatory principles of the EU's internal market and the different types of corporate tax systems. Section 3.3 provides a brief overview of the methodology used to measure the CoC and the EATR as well as the related underlying assumptions. Subsequently, the main characteristics of the corporate tax systems implemented in Finland, France, Germany, Italy, and Spain between 1999 and 2019 are explained. In Section 3.4 the results on the related tax effects of discriminatory imputation systems and their abolishment on a country's tax location attractiveness for capital investments and tax competition are discussed. Section 3.5 concludes.

3.2 Assessment of corporate tax systems under the fundamental principles of the EU regulatory framework

The ongoing globalization has increased cross-border transactions as companies and investors are able to locate their investments in a global rather than a domestic marketplace.[128] Studies have shown that – besides several non-tax factors[129] – taxation affects the investment location decision of firms.[130] Due to non-harmonised tax regulations across countries, firms and investors can benefit from differentials in the corporate tax systems. As these can be directly influenced by a government, they can be considered as an instrument that enhances a country's tax location attractiveness for investments.[131] The increase of the relative attractiveness of a location by setting tax parameters, marks the focus of tax competition between countries.[132] However, in an integrated market like the EU, governments have to ensure that their national tax regulations are in accordance with superior EU law that constitutes the legal framework of the EU.[133] The EU envisages the establishment of an internal market (Article 3 (3) TEU)[134], an area in which any discrimination and obstacle to the free movement of goods, persons, services, and capital shall be eliminated (Article 26 TEU)[135]. Regarding corporate tax systems, the free movement of capital is important as the systems' underlying dividend payments result directly from prior capital investments.[136] The free movement of capital prohibits any restriction on cross-border capital movements within the EU or involving a third country. This exists if a Member

[128] Schanz, Dinkel, and Keller 2017, 252.
[129] For an overview of the location decision determinants of foreign affiliates, see, e.g., Fontagne and Mayer 2005
[130] For a review of different tax regulations that affect the investment location decision of firms, see, e.g., Hanlon and Heitzman 2010, 147 et seq.; Jacob 2022, 12 et seq.
[131] For an overview of the evolution of tax base regulations and tax rates in EU Member States between 1999 and 2017, see Bräutigam, Spengel, and Stutzenberger 2019.
[132] For a detailed discussion of the definition of tax competition, see Bräutigam et al. 2018, 3 et seq.
[133] ECJ C-446/04 2006, para. 35; ECJ C-379/05 2007, para. 35 referring to other case law.
[134] Jacobs 1999, 264.
[135] Especially the removal of tax obstacles to establish and maintain the functioning of the internal market has priority; see European Commission 2001, 8.
[136] ECJ C-315/02 2004, para. 21 et seq.

State's national tax law treats foreign-sourced dividends less favourably than those that are purely domestic.[137]

The realization of an internal market can be achieved through positive integration, i.e., the implementation of harmonised regulations across the Member States[138], and negative integration, i.e., the removal of competitive distortions enforced through the jurisprudence of the ECJ[139]. Concerning corporate tax systems, the EU Member States are sovereign under the subsidiary principle as the EU's mandate for harmonization is limited to indirect tax matters (Article 113 TFEU). However, in the past, the EU Commission undertook several efforts to harmonise corporate tax systems and contribute to a better functioning of the internal market through positive integration. The removal of tax obstacles in the internal market gained significant importance, especially in times of ongoing globalization leading to an increase in cross-border transactions.[140] In 1975, the EU Commission published a draft council directive on the harmonization of corporate tax systems which was opposed by Luxembourg and the Netherlands.[141] The first success of harmonization initiatives concerning dividend taxation was made in 1990 with the adoption of the parent-subsidiary directive.[142] However, it affects dividend payments to corporate rather than individual shareholders. Further initiatives that covered dividend payments to individual shareholders, like the Ruding Report in 1992 or the communication on 'Dividend taxation of individuals in the Internal Market' in 2003, did not result in harmonising corporate tax systems across the EU Member States.[143]

Thus, the EU Member States had and still have different corporate tax systems in place that can be classified by the level of integration of corporate into personal income taxation.[144] The relief mechanism either applies at the shareholder or corporate level. In the following, the focus is on the first option as it is in accordance with the unilateral rules in most EU Member States and at the forefront of the analysis in this contribution.[145] Thus, three main categories are generally distinguished.

[137] The ECJ referred to these restrictive features of national tax systems as treating cross-border investments "less attractive" than domestic investments; see, e.g., ECJ C-334/02 2004, para. 24. Two landmark decisions on the double tax relief systems are the first case of Avoir Fiscal in 1986 (ECJ C-270/83 1986), and Manninen in the early 2000s (ECJ C-319/02 2004).
[138] Blauberger 2009, 1033; Craig and De Búrca 2015, 608.
[139] Scharpf 1998, 157; Schmidt 2008, 301.
[140] Ruding et al. 1992, 22.
[141] Tenore 2010, 74.
[142] Tenore 2010, 74.
[143] Maier and Schanz 2016, 914.
[144] McLure 1980, 140 et seq.; Jacobs 1999, 265 with further references.
[145] Thus, we exclude the double tax relief systems of the United Kingdom and Ireland as they are not applicable at the shareholder level. For the EU Member States included in this study's sample, see Appendix 11.

First, under the classical system, no integration of corporate into personal income taxation exists which results in full economic double taxation of dividends. Therefore, the overall tax burden is commonly determined by the tax burden at the corporate and shareholder levels. In a cross-border setting, the classical system is advantageous due to its simplicity and a more effective functioning of the internal market as it achieves equal treatment of domestic- and foreign-sourced dividends without increasing complexity for the tax administration.[146] However, the double taxation caused by this corporate tax system could limit the capital formation of companies.[147]

Second, double taxation-reducing systems partially integrate corporate into personal income taxation by applying a tax concession at the shareholder level. The tax concession can take the form of a partial imputation or a shareholder relief.[148] The former is characterised by crediting a share of corporate taxes obtained from dividends (<100%) against the shareholder's personal income tax liability. The tax burden at the corporate level is therefore only partially final. Under the shareholder relief systems that are currently applied by the majority of the EU Member States[149], dividend income is either subject to a reduced (flat) tax rate or partially exempt from the tax base at the shareholder level. The taxation at the corporate level is final and non-refundable. Concerning cross-border activities in the internal market, the shareholder relief system – compared to the (partial) imputation system – offers less complexity as the determination of the relief mechanism at the shareholder level is independent of the corporate taxes paid abroad. Still, to avoid a discriminatory effect of the shareholder relief system, its scope must be equally applicable to domestic- and foreign-sourced dividends.[150]

Third, double taxation-avoiding systems, specifically the dividend exemption or full imputation system, completely align the two levels of taxation and achieve full integration of the corporate

[146] Harris 1996, 60 et seq.
[147] Lodin 1998, 230.
[148] The dual income tax system – mainly applied by Scandinavian countries – qualifies as a mixed system. It legally separates all income into the two categories of capital and labour income. Capital income is generally tax-exempt up to a predefined return rate. The income exceeding this rate is regularly subject to a reduced flat tax rate or a proportional tax rate whereas labour income is fully subject to a progressive tax rate (see, e.g., Lammersen 2005, 216 et seq.). Thus, only abnormal investment returns are subject to economic double taxation. For a detailed description of the system, see, for instance, Korkeamaki, Liljeblom, and Pasternack 2010, 574 et seq.
[149] See Appendix 11.
[150] Otherwise, the ECJ established with its case law that the difference in treatment based on the source of dividends within the shareholder relief system infringes the free movement of capital; see ECJ C-315/02 2004, para. 21 et seq. A justification based on the coherence of the national tax system (see ECJ C-204/90 1992, para. 14 et seq.; ECJ C-300/90 1992, para. 28) fails since the tax relief mechanism at the shareholder level – in contrast to the imputation system – is not dependent on the taxation of the distributing company; see ECJ C-315/02 2004, para. 34 et seq. referring to ECJ C-55/98 1999, para. 24; ECJ C-436/00 2002, para. 52. Moreover, the justification by the possibility of a lower tax liability of the distributing company in another state does not hold; see ECJ C-315/02 2004, para. 49. Additionally, higher tax administrative burdens or obstacles to control the foreign tax liability does not serve as sufficient justification; see ECJ C-315/02 2004, para. 44 et seq.

into personal income taxation. Under the dividend exemption system, dividends are exempt from taxation at the shareholder level. Thus, taxation at the corporate level is decisive for the overall tax burden. In contrast, the full imputation system allows shareholders to credit corporate taxes obtained from dividends against their personal income tax liability. Thus, the economic double taxation is eliminated if taxes paid at the corporate level can be wholly offset against the personal income tax liability.[151] In this case, the tax burden at the shareholder level determines the overall tax burden on dividends.

In a cross-border setting, domestic- and foreign-sourced dividends are only burdened with corporate taxes if the dividend exemption system applies.[152] Thus, from a shareholder perspective, countries with tax regulations resulting in low corporate tax burdens are particularly attractive for the location of investments. In contrast, applying full imputation systems to cross-border investments caused problems. For the determination and application of the imputation credit, the tax authority in the shareholder's residence country needs information on the amount of corporate taxes levied abroad and their effective payment.[153] This information was difficult to obtain and consequently increased complexity[154] before the EU Member States agreed on the directive on administrative cooperation on tax matters in 2011[155]. In addition, the creditability of foreign corporate taxes in the shareholder's residence country would imply a refund of corporate taxes that the residence state would never collect, i.e., which could cause a potential loss in fiscal revenues.[156] Therefore, in the past, most EU Member States restricted the imputation credit to domestic-sourced dividends which resulted in full economic double taxation of foreign-sourced dividends such as that under a classical system. Hence, if a domestic shareholder receives domestic- and foreign-sourced dividends, the latter bears a higher overall tax burden.[157] In the late 1990s, the literature and some governments that had a full imputation system in place, e.g., Germany, expected the difference in treatment to be incompatible with EU law and changed their corporate tax system accordingly.[158] Other countries maintained their regulations until there was an ECJ decision . The ECJ declared the difference in treatment as a prohibited discrimination of cross-border against domestic investments. Therefore, it was an infringement of the free movement of capital that cannot be justified by the risk of fiscal tax revenue losses[159]

[151] Harris 1996, 119.
[152] Jacobs 1999, 268.
[153] Van den Temple 1970, 30; Harris 1996, 136.
[154] Van den Temple 1970, 30; Harris 1996, 107; Englisch 2005, 200; Harris 2010.
[155] Council Directive 2011/16/EU 2011, 1 et seq.
[156] E.g., the rationale for the US negative stance was based on this, see US Treasury 1992, 16.
[157] Ruding et al. 1992, 34.
[158] Jacobs 1999, 275; German Parliament 2000, 95.
[159] See ECJ C-319/02 2004, para. 49; ECJ C-292/04 2007, para. 30.

or increasing difficulties in determining the tax credit[160]. Instead of expanding the scope of the imputation system to foreign-sourced dividends under the pressure of the ECJ rulings,[161] the affected EU Member States began to abolish the imputation system in favour of other corporate tax systems, in particular shareholder relief systems. Consequently, not only the taxation of foreign- but also domestic-sourced dividends has changed. However, the extent of the change in the overall tax burden of both investment alternatives and the implication on tax competition from the perspective of the affected countries are largely unknown and will be assessed in the following.

3.3 Economic implications of discriminatory imputation systems

3.3.1 Methodology and underlying assumptions

The abolishment of imputation systems within the EU not only has legal but also economic implications for shareholders and the investment decisions of corporations. To analyse the location attractiveness for capital investments under the discriminatory imputation systems and after their abolishment, we rely on the methodology of *Devereux & Griffith*[162]. It goes beyond statutory tax rates as it incorporates country-specific information on the type of the tax system, applicable profit and non-profit taxes, tax bases, and tax rates at the company and shareholder levels.[163] It measures the impact of these tax parameters on corporate investments in terms of after-tax returns. Thus, it allows analysing the influence of taxation on a country's location attractiveness for investments from an investor's perspective and to demonstrate the type and the extent of tax distortions caused under these imputation systems and after their abolishment.[164] Apart from country-specific information (e.g., type of tax system, tax bases/rates on company and shareholder levels) that is based on *Spengel et al.*[165] and our own additional research, the model relies on certain economic assumptions depicted in Table 5.

The Devereux/Griffith methodology builds on the neoclassical investment theory and considers a hypothetical incremental investment by a corporation in the manufacturing sector.[166] The investment takes place in one period and generates a return in the next period. Further, it is based on the assumption that firms undertake the hypothetical incremental investment as long as its marginal return covers its marginal costs. The model distinguishes between marginal and highly

[160] See ECJ C-334/02 2004, para. 29; ECJ C-319/02 2004, para. 54.
[161] Lupo 2000.
[162] For a detailed description of the model framework, see Spengel 2003, 68 et seq.; Spengel, Heckemeyer, et al. 2018, 171 et seq.
[163] As indicated by the annual update on effective tax levels in the EU; see Spengel et al. 2020.
[164] Lammersen 2005, 10 et seq.
[165] Spengel et al. 2020.
[166] Evers, Miller, and Spengel 2015, 510; Pfeiffer and Spengel 2017, 21.

profitable investments. Marginal investments just yield a return equal to their CoC, i.e., the minimum pre-tax real rate of return required by an investor given a post-tax real rate of return on an alternative financial investment.[167] Hence, it shows the impact of taxation on the scale of investments. In contrast, highly profitable investments with a pre-tax rate of return above the market interest rate are measured by the indicator EATR.[168] The EATR measure is especially relevant regarding the decisions on the geographical allocation of economic returns in the course of investment location decisions.[169] For a comprehensive analysis of the effects of discriminatory imputation systems and their abolishment on tax competition in the EU, we consider both indicators as they differ with regard to their main drivers. While the CoC is primarily driven by income tax base regulations and non-income taxes, the income tax rate can be considered the main driver of the EATR as the latter approaches the statutory tax rate if profits increase.[170]

Table 5: Economic assumptions

Assumptions on types of taxes and tax bases			
Company level	Corporate income tax including surcharges, local business taxes, non-profit taxes		
Investor level	Personal income tax, surcharges		
Tax base	Depreciation, inventory valuation, deductibility of interest expenses		
Types of assets	Intangibles, buildings, machinery, financial assets, inventory (20% each)		
Assumptions on depreciation, inflation, interest rate and pre-tax rate of return			
Economic depreciation period	Intangibles	Buildings	Machinery
	15.35%	3.10%	17.50%
Inflation rate (π)		2%	
Real interest rate (r)		5%	
Nominal interest rate (i)		7.1%	
Pre-tax rate of return (p)		20%	

Notes: The table displays the economic assumptions for the parameters used in the Devereux/Griffith methodology.
Source: Own illustration based on Spengel 2003, 88.

To evaluate the distortions created by a switch from a discriminatory imputation to a shareholder relief system between 1999 and 2019 and its effects on tax competition, we compare the CoC and EATR of a domestic and foreign investment relying on the following stylised scenario (see Figure 3). An individual, qualified shareholder undertakes an investment in a domestic

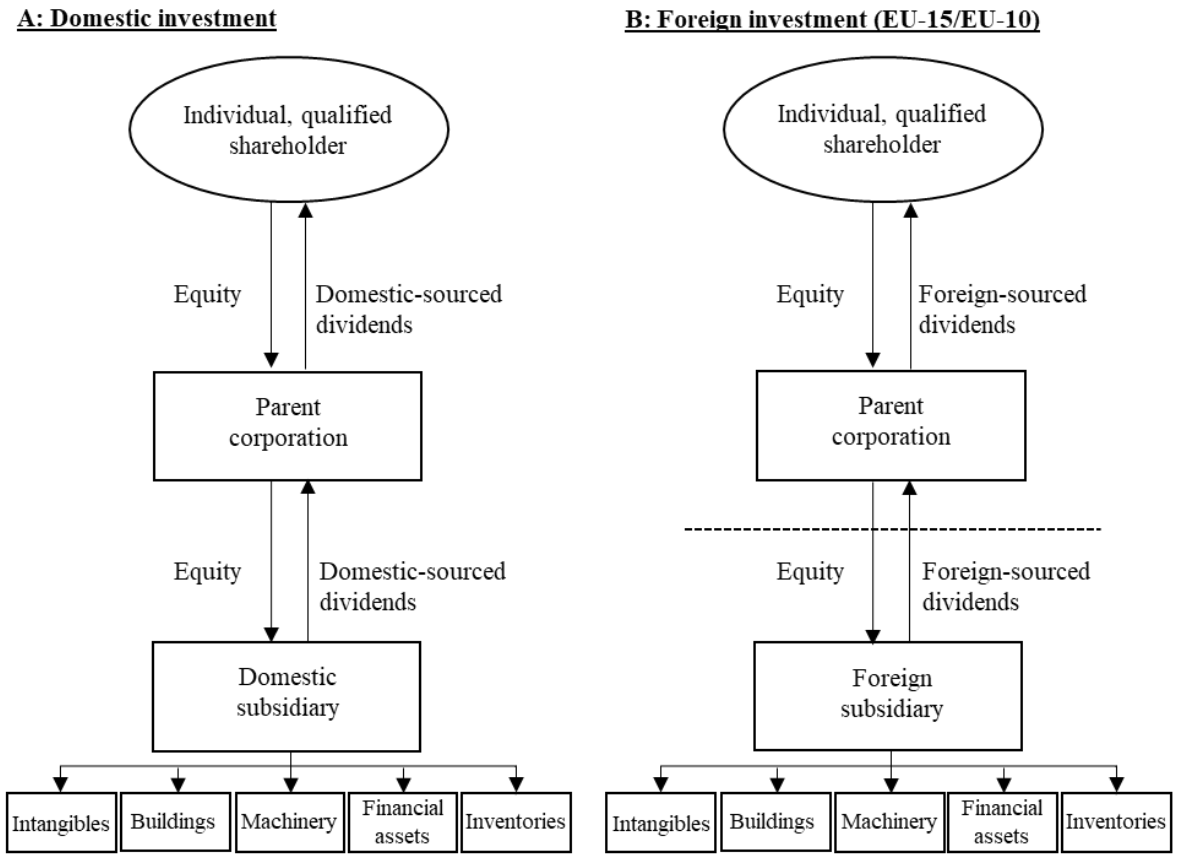
[167] Devereux and Griffith 1999, 2.
[168] The Devereux/Griffith methodology assumes a real market interest rate of 5%. The pre-tax rate of return of a profitable investment is set at 20%. For further economic assumptions of the Devereux/Griffith model, see Spengel 2003, 88.
[169] Devereux and Griffith 1998; Devereux and Griffith 2003. The EATR measures the change in the net present value (NPV) of a highly profitable investment caused by taxation. Thereby, it is assumed that the company earns firm-specific and largely mobile economic rents that are expressed by a positive NPV of the investment. Since economic rents are only available to a limited extent, a company chooses the project with the highest NPV after taxes among two or more mutually exclusive projects; see Devereux and Griffith 1999, 3 et seq.
[170] E.g., Spengel, Nicolay, et al. 2018, 66. For the derivations, see Devereux and Griffith 1999, 21 et seq.

corporation. The corporation subsequently decides whether to invest the additional capital in a domestic (domestic investment) or foreign (foreign investment) subsidiary. The option of an investment split is excluded. The subsidiary owns five different assets: Intangibles, buildings, machinery, financial assets, and inventory (20% each). In addition, we assume equity investments at the shareholder and corporate levels to isolate the tax distortion effects caused by the potential double taxation of economic returns in the form of dividend payments.[171] As the foreign investment, the unweighted average effective tax burden/CoC of the EU Member States is considered excluding the shareholder's residence state in the respective year. Previous work has identified significant tax base and especially tax rate differentials between the 'old' and 'new' Member States.[172] For example, Member States that joined the EU in 2004 (EU-10 Member States) show, on average, a remarkably lower statutory corporate income tax rate compared to Member States that joined the EU before 2004 (EU-15 Member States).[173] To account for such tax differentials that can impact the EATR and CoC, we differentiate between a foreign investment in the EU-15 and the EU-10 Member States.[174]

Concerning the individual, qualified shareholder, the applicability of the top personal income tax rate is assumed as it is more likely that high net-worth individuals undertake (qualified) equity investments in corporations.[175] Since the model assumes an incremental investment, tax allowances for small amounts of dividend income provided by Member State's national tax rules are already exhausted and hence disregarded for the CoC and EATR calculations. If a country's national tax regulations provide different options for the taxation of dividend income from qualified shareholding, e.g., a flat tax rate or partially reduced tax base with ordinary tax rates, the option is considered to result in a lower tax burden.

[171] Due to the parent-subsidiary directive, it is assumed that, in the case of cross-border investments, source countries do not levy any withholding taxes on dividend payments. In addition, we neglect non-deductible expenses/add-backs in the residence country as they are only of smaller magnitudes. Thus, under the given assumptions, the CoC/EATR spreads between the domestic and foreign investments should be interpreted as a lower bound in the imputation systems period and as an upper bound in the post-imputation systems period.
[172] E.g., Bräutigam, Spengel, and Stutzenberger 2019.
[173] Bräutigam, Spengel, and Stutzenberger 2019, 544.
[174] For a similar approach, see Bräutigam, Spengel, and Stutzenberger 2019, 539. As Bulgaria, Romania (both 2007), and Croatia (2013) joined the EU in later years, they are not considered for the calculation of the foreign investment's EATR/CoC.
[175] For a similar approach with regard to portfolio investors, see Maier and Schanz 2016, 917 et seq.

Figure 3: Structure of considered domestic and foreign investments



Notes: The figure displays the two considered investment alternatives of an individual, qualified shareholder. This shareholder undertakes an equity investment in a domestic corporation which then decides to pass the additional capital on as new equity to a domestic (domestic investment) or a foreign (foreign investment) subsidiary. The latter owns five different assets: Intangibles, buildings, machinery, financial assets, and inventory (20% each). The foreign subsidiary is either located in the EU-15 or EU-10 Member States. The option of an investment split is excluded.
Source: Own illustration.

3.3.2 Qualitative analysis of corporate tax systems

Before displaying and analysing the calculation results, a brief overview is provided of the evolution of corporate tax systems of the EU Member States that had a discriminatory imputation system in place within this study's observation period. Thus, the focus is on Finland, France, Germany, Italy, and Spain, and the main changes to their corporate tax systems are displayed in Table 6. The overview does not provide all of the details of the respective systems but instead focuses on the relevant parameters for this study's model calculations.[176]

[176] Information on the EU Member States' tax laws is derived from our own research in the annual European tax handbooks published by the International Bureau of Fiscal Documentation (IBFD) and the IBFD's online tax research platform, see IBFD 2023.

Table 6: Major changes in corporate tax systems in sample states (1999-2019)

States	Year 1999	Year 2019	Year(s) of change
DE	IM[c]	SR[a/b, c, d]	2001, 2009
ES	IM[c]	SR[a, c, d]	2007
FI	IM[c]	SR/DIT[b, c, d]	2005
FR	IM[c]	SR[b, c, d]	2005, 2009, 2013
IT	IM[c]	SR[a, c, d]	2004, 2018

Notes: The table shows the EU Member States that abolished their discriminatory imputation system between 1999 and 2019. The year(s) of change correspond to the elimination of the imputation system and following major changes in the type of the corporate tax system. Following this study's modelling, we assume an individual shareholder who is subject to the maximum tax rate and has a qualified shareholding in a corporation. The abbreviations are as follows: DIT = Dual income tax system; IM = Imputation system; SR = Shareholder relief system. To further explain the systems, the following indices are used: [a] Reduced flat tax rate; [b] partial exemption; [c] applicable to domestic-sourced dividends, [d] and applicable to foreign-sourced dividends. Multiple indices can co-exist.
Source: Own illustration.

Within the observation period, Germany was the first country that abolished the imputation system[177] through a major tax reform in 2001. Before that date, individual shareholders were able to credit 3/7, i.e., 42.86% of the dividends received against their personal income tax liability to set off the corporate income tax on dividends – but only in the case of domestic-sourced dividends. The imputation credit was not eligible for foreign-sourced dividends. After abolishing the discriminatory imputation system, Germany introduced a shareholder relief system with a partial exemption of 50% from personal income taxation equally applicable to domestic- and foreign-sourced dividends. To counteract the partial double taxation under the shareholder relief system, the statutory corporate income tax rate was reduced from 40% in 2000 to 25% in 2001. The second major change in the German corporate tax system with a switch from the partial exemption to a flat tax rate of 25% on capital income, i.e., dividends, interest, and capital gains, was implemented in 2009. Simultaneously, the statutory corporate income tax rate has been decreased to 15%.[178]

The application of the Italian imputation system expired at the end of 2003. From 1999 to 2002 (2003), individual shareholders were eligible for an imputation credit equal to 58.73% (51.51%) of dividends received from Italian companies to set off the corporate taxes paid. The imputation credit was denied for foreign-sourced dividends. From 2004 to 2017, domestic- and foreign-sourced dividends distributed to a substantial shareholder have been partially exempted from personal income taxation. The exemption varied from 60% in 2004 to 41.86% in 2017. In

[177] In general, the German imputation system can be classified as a full imputation system if the focus is only on corporate and personal income taxes. However, the missing integration of the local business tax leads only to a partial imputation for the German trade tax.
[178] In addition, individual, qualified shareholders can – under certain conditions – opt for a partial exemption of dividend income instead of the application of the reduced flat tax rate. In this case, only 60% of the dividends are taxed under the shareholder's personal progressive income tax rate. The partial exemption method is mandatory for dividends classified as business income.

contrast to Germany, the switch from the discriminatory imputation system to the shareholder relief system in Italy did not result in a significant change in the statutory corporate income tax rate. Since 2018, Italy has applied a flat tax rate of 26% on domestic- and foreign-sourced dividends.

Finland abolished its discriminatory imputation system by the end of 2004. The imputation credit amounted to 7/18, i.e., 38.88% in 1999 and 29/71, i.e., 40.85% from 2000 to 2004 of the net domestic dividends, which was equal to the tax paid by the distributing corporation[179]. Since 2005, domestic- and foreign-sourced dividends have received equal tax treatment. However, the applicable corporate tax system distinguishes between dividends distributed from quoted and non-quoted companies. Until 2011, 30% of dividends received from quoted companies were tax-exempt while the remaining 70% were taxed at 28% as capital income at the shareholder level. Since 2012, progressive income tax rates have applied to the capital income already mentioned, and the exemption was reduced to 15% as of 2014. The latter has also been accompanied by a reduction in the statutory corporate income tax rate from 24.5% in 2013 to 20% in 2014. Dividends distributed by non-quoted companies are tax-exempt up to a predefined rate of return. Dividends exceeding the predefined return rate are taxed at progressive rates.

Until its abolishment by the end of 2004, the French imputation system provided a credit (*avoir fiscal*) of 50% on the declared tax payments of the shareholder, i.e., gross domestic dividends and *avoir fiscal* – however, only for domestic-sourced dividends. After eliminating the discriminatory imputation system, France introduced a shareholder relief system with a partial exemption of domestic- and foreign-sourced dividend income from personal income taxation. This system was applied from 2005 to 2008 and reintroduced in 2013. The tax exemption ranged from 50% in 2005 to 60% from 2006 to 2008. Since 2013, 40% of the received dividends have been tax exempt. Between 2009 and 2012, dividend income at the shareholder level was taxed at a reduced flat tax rate of 18% (plus social contribution). The changes previously discussed in corporate tax systems only led to adjustments in dividend taxation at the level of an individual shareholder, but we do not observe related, significant changes in the statutory corporate income tax rate.

Finally, Spain claimed a retreat from the discriminatory imputation system by the end of 2005. Under the regime, domestic dividends before withholding tax have been included in the shareholders' taxable income and grossed up the amount by 40%. Afterward, a credit of 40% on the

[179] A compensatory tax ensured that the distributing corporation paid at least an amount of tax equal to the imputation credit granted to the shareholders and allowed for a carryforward of exceeding tax payments. For a detailed explanation, see Hintsanen and Pettersson 2005, 131 et seq.

shareholder's personal income tax liability was provided. Spain switched from a discriminatory imputation system to a shareholder relief system with a reduced flat tax rate for domestic- and foreign-sourced dividend income at the shareholder level. As of 2010, further tax brackets were included in the tax schedule. None of the changes mentioned previously in corporate tax systems and thus in dividend taxation resulted in a related, significant change in the statutory corporate income tax rate.

Taken together, Finland, France, Germany, Italy, and Spain applied discriminatory imputation systems within our observation period. While Germany abolished its imputation system in 2000, Spain still applied it until the end of 2005. At least since the peak of the ECJ jurisprudence with regard to imputation systems in the early 2000s, it is legally unambiguous that these systems discriminated foreign against domestic investments and thus infringed the functioning of the internal market in times of ongoing globalization.[180] Instead of expanding the imputation credit to foreign-sourced dividends, all countries concerned switched to shareholder relief systems that equally apply to domestic- and foreign-sourced dividends, however, with different relief mechanisms. France, Germany, and Italy first applied a partial exemption method that was replaced in later years by a reduced flat tax rate. While the latter is still in place in Germany and Italy, France reintroduced the partial exemption method. In the post-imputation system period, Finland switched only once to a shareholder relief system with a partial tax exemption for dividends received from quoted companies and a dual income tax system for dividends received from non-quoted companies. Spain is the only country that switched directly to a shareholder relief system with a flat tax rate after abolishing the discriminatory imputation system. The retreat from the discriminatory imputation systems abolished unequal treatment and restrictions against foreign investments according to the ECJ case law and the EU legal framework. Thus, juridical compliance with the internal market is achieved. However, the implications and, in particular, the extent of tax-induced distortions under the imputation system and after their abolishment on the scale and location of investments for the affected EU Member States remains unclear.

[180] The peak of the ECJ case law that was reached in the mid-2000s that concerned both natural persons and legal entities as shareholders accelerated this trend in the EU Member States' legislation. No clear demarcation in the interpretation of possible discrimination based on the type of shareholder exists, see Lang 2008, 69 et seq. referring to ECJ C-446/04 2006, para. 215. For a detailed overview, see Lang 2008, 69 et seq; Englisch 2010, 199 et seq.

3.4 Results

3.4.1 Implications on the scale of investment

The first step will evaluate the implications of discriminatory imputation systems and their abolishment on the scale of investment. Figure 4 graphically illustrates the results for the period 1999 to 2019.[181] The dashed (solid black (EU-15)/grey[182] (EU-10)) lines represent the CoC for a domestic (foreign) equity-financed corporate investment at the level of the individual, qualified shareholder in the respective year. Moreover, we expanded the results with the scenarios of foreign investments in the EU Member States with the highest respectively lowest CoC during the sample period as an upper respectively lower bound for the average EU-15/EU-10 results.[183]

Focusing on the CoC allows analysing the effects of taxation on a marginal investment that just yields a required rate of return that is sufficient for competing with an alternative capital market investment. The latter earns the real market interest rate that is established at 5%. Thus, if the CoC equals 5%, the investor, i.e., the individual, qualified shareholder, is indifferent between the alternative capital market investment and the equity investment in the corporation. In this case, taxation does not influence corporate investment decisions. In contrast, taxation favours the corporate investment over the alternative investment if the CoC is below the real market interest rate and vice versa.[184] In addition, the competitive effects of taxation can be assessed as the CoC indicates the long-term lower price limit. Higher (lower) CoC indicates higher (lower) prices and, thus, a worse (better) competitiveness of companies.

Under the considered imputation systems, foreign dividend payments were, in contrast to domestic dividends, not eligible for an imputation credit in the shareholder's residence country and hence effectively taxed as under a classical system (see Section 3.2). Due to this double taxation, foreign investments – compared to domestic investments – had to earn a higher pre-tax rate of return to gain a return after taxes that equals the real market interest rate. The results displayed in Figure 4 show higher CoC for the foreign compared to the domestic investment under the imputation systems in all countries considered. The spread between the CoC of a

[181] The numerical results are presented in Appendix 12.
[182] In the cross-border scenario, we assume, for the whole observation period, that the source country does not levy any withholding taxes due to the applicability of the parent-subsidiary directive. However, the latter is only legally binding for EU Member States. As EU-10 Member States joined the EU in 2004, withholding taxes might have been applicable before their EU accession. For the sake of comparability and to provide consistency, we still apply the assumption to EU-10 Member States since 1999 but depict the period from 1999 to 2003 in light grey to account for these circumstances.
[183] The results are displayed in Appendix 12.
[184] For example, a CoC of 7% indicates that the investment needs a pre-tax rate of return of 7% in order to gain a 5% return after taxes.

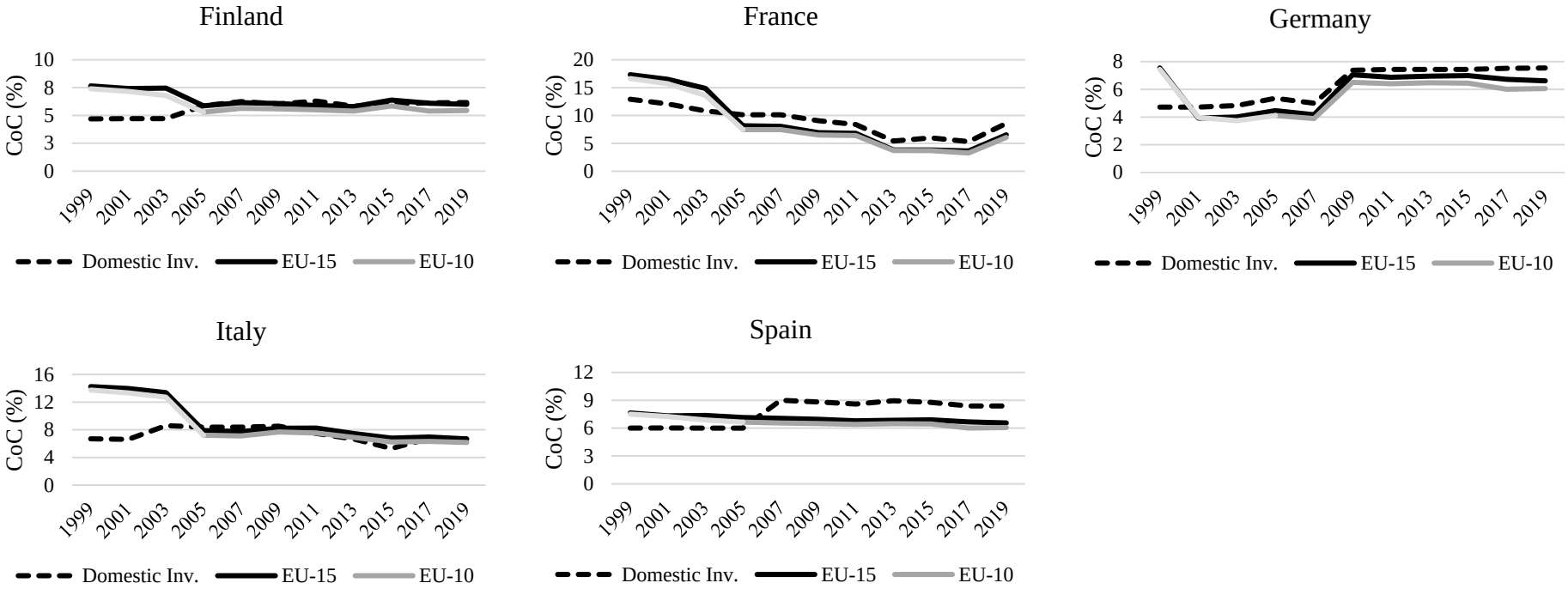
foreign investment in the EU-15 Member States and a domestic investment amounts to 3.51 percentage points (pp.) on average. For a foreign investment in the EU-10 Member States, the average spread is only slightly lower at 3.02 pp. Stated differently, a foreign investment in the EU-15 (EU-10) Member States must earn an average of 3.51 (3.02) pp. higher pre-tax rate of return to be equally attractive as the domestic investment after taxes. The implications of the significant difference between the CoC of the foreign and domestic investment are twofold. First, corporations could have a clear incentive to invest the additional shareholder capital in a domestic rather than in a foreign subsidiary. Thus, the results suggest positive implications on the scale of investment for subsidiaries located in the shareholder's residence country. Second, the spread indicates a remarkable difference with regard to the long-term lower price limit. The higher CoC of foreign investments indicate inferior competitiveness of firms located abroad as they may have had to charge higher prices compared to their counterparts located in the five EU Member States under consideration.

After the abolishment of the discriminatory imputation systems, the situation changed significantly. Under the newly introduced shareholder relief systems, the tax treatment of domestic- and foreign-sourced dividends at the shareholder level has been formally equalised and, hence, the additional tax burden on foreign-sourced dividends has been removed. As a result, the average spread between the foreign and domestic investment for the post-imputation systems period declined to -0.83 pp. for investments in the EU-15 Member States and -1.30 pp. for investments in the EU-10 Member States. Thus, on average, the advantageousness between the corporate investment alternatives is reversed. Besides differences in tax base elements and non-income taxes, the corporate income tax rates in the five selected EU Member States are marginally or significantly higher compared to the average rate of the EU-15 and the EU-10 Member States. From an investor's perspective, foreign corporate investments have become more attractive through the introduction of shareholder relief systems which could cause a decreasing scale of investment in corporations located in the five considered EU Member States. With regard to the differences in the long-term lower price limit, the convergence in the CoC of the foreign and domestic investments signals an alignment in the competitiveness with slightly better conditions for corporations located abroad.

Besides tax base regulations and non-income tax rates, differences in the taxation of dividend income as the return on the corporate investment and interest income as the return on the alternative capital market investment can drive the CoC. For example, the most significant increase in the CoC in Germany in 2009 stems from the introduction of a flat tax rate on investment income, i.e., dividends, interest, and capital gains. After abolishing the imputation system in

2001, individual qualified German shareholders could apply a 50% exemption of dividend income from taxation at progressive rates while interest income was fully taxable. Since 2009, dividend and interest income are taxed at a flat tax rate of 25%. Hence, at the shareholder level, the applicable tax rate on dividend income only slightly increased while interest income is taxed at a significantly lower flat rate. Consequently, the alternative capital market investment has become more attractive which results in a remarkable increase in the CoC of the corporate investment. In addition, we observe a kink in the CoC the case of Spain in 2005. This is driven by the abolishment of the discriminatory imputation system. As the only country in this study's sample, Spain switched directly to a shareholder relief system with a flat tax rate after abolishing the discriminatory imputation system.

Figure 4: Development of CoC in sample states at shareholder level (1999–2019)



Notes: The figure shows the development of the CoC in the selected Member States between 1999 and 2019 at two-year intervals. We assume an individual, qualified shareholder who undertakes an investment in a domestic corporation. The corporation then decides whether to invest the additional capital in a domestic (domestic investment) or foreign (foreign investment) subsidiary. The option of an investment split is excluded. Equity investments at the shareholder and corporate level are assumed to clearly identify tax distortions caused by potential double taxation of economic returns in the form of dividend payments. As the foreign investment, the unweighted CoC of the EU-15/EU-10 Member States is considered excluding the shareholder's residence state in the respective year. The dashed (solid black (EU-15)/grey (EU-10)) lines represent the CoC for a domestic (foreign) investment of an individual, qualified shareholder in the respective year. As the EU-10 Member States joined the EU as of 2004, the period from 1999 to 2003 is depicted in light grey to account for these circumstances.
Sources: Own calculation and illustration based on Spengel et al. 2020.

3.4.2 Implications on the location of a profitable investment

The second step expands the analysis to the EATR as it is an important indicator for analysing a country's tax location attractiveness for corporate investments. The results are displayed in Figure 5[185]; the dashed (solid black (EU-15)/grey (EU-10)) lines represent the EATR for a domestic (foreign) investment of an individual, qualified shareholder in the respective year. Again, the illustration of the results is expanded by including the scenarios of foreign investments in the EU Member States with the highest respectively lowest EATR during the sample period as an upper respectively lower bound for the average EU-15/EU-10 results.[186] In general, a lower EATR signals a higher tax location attractiveness for profitable investments and vice versa.

In accordance with the results of the previous section, the EATR of the foreign investment under the imputation system is significantly higher compared to a domestic investment in the shareholder's residence state. If the shareholder received foreign-sourced dividends from an investment located in the EU-15 (EU-10) Member States, the overall tax burden was, according our simulation model, on average, 15.18 (12.66) pp. higher compared to a domestic investment. Due to the denial of the imputation credit, the EATR of the foreign investment is not only determined by the personal income tax rate applicable to the domestic shareholder but also by the foreign taxes paid at the corporate level. In contrast, for the domestic investment's EATR under the imputation system, the personal income tax rate is decisive as taxes paid at the corporate level can be credited against it.

From a shareholder's perspective, the significantly lower EATR of the domestic investment clearly signals a higher tax location attractiveness for corporate investments in its residence country. To satisfy dividend claims of their domestic shareholders, corporations located in the five considered EU Member States had to generate domestic profits, which were taxed accordingly. Otherwise, dividend distributions did not entitle the individual, qualified shareholder to credit corporate taxes paid against their personal income tax liability. Thus, the discriminatory effects of the imputation systems with regard to foreign investments protected the five considered EU Member States against extensive profit shifting to low-tax countries.[187]

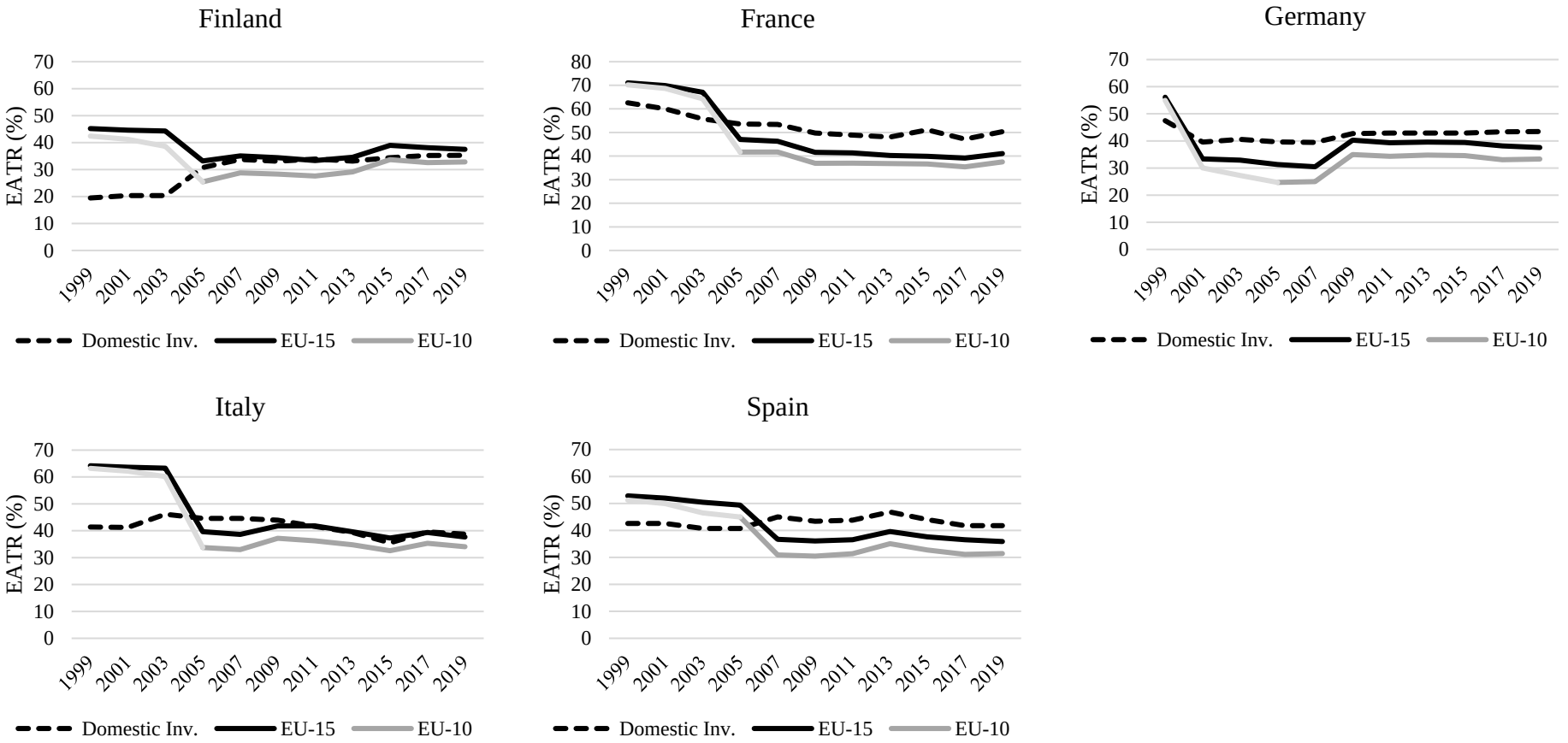
Due to the incompatibility with EU law, countries had to abolish the self-created domestic investment bias. With the introduction of shareholder relief systems, domestic- and foreign-

[185] The numerical results are presented in Appendix 13.
[186] The results are displayed in Appendix 13.
[187] Heckemeyer and Spengel 2008, 57.

sourced dividends underlie an equal tax treatment. This change also affects a country's tax location attractiveness for corporate investments. In the post-imputation systems period, the average spread between the EATR of a foreign investment in the EU-15 Member States and a domestic investment in the shareholder's residence country amounts to -4.03 pp. indicating, on average, a remarkable lower EATR of the foreign investment. With regard to an investment in the EU-10 Member States, the difference is even more pronounced at -9.02 pp.

Due to the equal tax treatment of domestic- and foreign-sourced dividends at the shareholder level, taxation at the corporate level, especially corporate income tax rates, has gained significant importance and has become the decisive factor for the EATR differences between the investment alternatives. Corporations in France, Germany, and Spain face significantly higher corporate income tax rates compared to the average rate of the EU-15 and the EU-10 Member States. In Germany, a kink in the EATR is observed for the foreign investments due to the major tax reform in 2009. The switch from a partial exemption of dividend income at the shareholder level to a flat tax rate resulted in a higher tax burden at that level. Germany counteracted the tax burden increase at the shareholder level with a 10 pp. decrease in the corporate income tax rate. These two contrary effects were nearly balanced out in the case of a domestic investment but led to an increase in EATR for foreign investments that did not benefit from the domestic corporate income tax rate cut. Nevertheless, the EATRs of the foreign investment alternatives are below the EATR of the domestic investment for the entire post-imputation systems period. This signals a clear tax advantage for locating profitable investments abroad and enhances tax competition for France, Germany, and Spain. Concerning Finland and Italy, the situation is slightly different. On average, both countries are as equally attractive as the EU-15 Member States for the location of profitable investments. However, the EATR of a foreign investment in the EU-10 Member States is lowest as the average corporate income tax rate of the EU-10 Member States is lower compared to that of Finland and Italy. Hence, after abolishing the discriminatory imputation systems, the tax location attractiveness of Finland and Italy can still compete with that of the EU-15 Member States. Still, both countries face an increase in tax competition with the EU-10 Member States.

Figure 5: Development of EATRs in sample states at shareholder level (1999–2019)



Notes: The figure shows the development of the EATRs in the selected EU Member States between 1999 and 2019 at two-year intervals. We assume an individual, qualified shareholder who undertakes an investment in a domestic corporation. The corporation then decides whether to invest the additional capital in a domestic (domestic investment) or foreign (foreign investment) subsidiary. The option of an investment split is excluded. It is assumed that equity investments at the shareholder and corporate level clearly identify tax distortions. As the foreign investment, we consider the unweighted EATR of the EU-15/EU-10 Member States excluding the shareholder's residence state in the respective year. The dashed (solid black (EU-15)/grey (EU-10)) lines represent the EATR for a domestic (foreign) investment of an individual, qualified shareholder in the respective year. As the EU-10 Member States joined the EU as of 2004, the period from 1999 to 2003 is depicted in light grey to account for these circumstances.
Sources: Own calculation and illustration based on Spengel et al. 2020.

3.5 Concluding remarks

In the last decades, cross-border investments have increased as ongoing globalization has reduced trade barriers and enhanced capital mobility. Thus, corporations and shareholders consider a global marketplace for their investment decisions. Taxation is one factor that can impact such decisions. As corporate tax systems are not harmonised across countries, corporations, and shareholders can benefit from tax differentials. To attract capital investments, governments can influence this factor to increase the country's tax location attractiveness. However, within the EU, the scope for implementing preferential tax regulations is limited by superior EU law and the ECJ's jurisprudence. At the beginning of the 2000s, this caused problems, especially regarding corporate tax systems in the form of imputation systems. As several EU Member States restricted the imputation credit to domestic-sourced dividends, economic double taxation was only removed in a purely domestic setting. The ECJ declared this discrimination against foreign investments as incompatible with EU law for which affected EU Member States switched from the imputation system to a shareholder relief system in order to comply with it. This change in corporate tax systems not only had legal but also economic implications. As the legal consequences have been extensively discussed in the literature, we focus on the implications of the discriminatory imputation systems and their abolishment on the scale and the location of investments. Thus, valuable insights are provided regarding the economic implications of ECJ case law and its effects on tax competition.

For the quantitative assessment, the focus is on the EU Member States of Finland, France, Germany, Italy, and Spain as they applied a discriminatory imputation system within this study's observation period (1999-2019). The Devereux/Griffith methodology is applied to calculate the CoC and the EATR as indicators for the effects on the scale and location of investments. Overall, significantly higher CoC and EATR are ascertained for the foreign compared to the domestic investments under the discriminatory imputation systems. This indicates positive implications on the scale of investment in the shareholder's residence country. As the CoC can also be interpreted as the long-term lower price limit, the discriminatory imputation systems could have negatively affected the competitiveness of firms located abroad. In addition, from the shareholder's perspective, the denial of the imputation credit for foreign-sourced dividends could have remarkably decreased the location attractiveness of foreign EU Member States. Thus, to satisfy the dividend claims of their domestic shareholders, corporations located in the five considered countries could have had an incentive to generate domestic profits, which were taxed

accordingly. From a country's perspective, this can be seen as a mechanism preventing domestic firms from extensive profit shifting to low-tax countries.

The switch from the discriminatory imputation systems to the shareholder relief systems removed the additional tax burden on foreign-sourced dividend income. As a result, the advantageousness of the domestic and foreign investment alternatives is, on average, reversed. The CoC indicates that, from the shareholder's perspective, foreign investments have become equally or even more attractive which could have caused negative implications on the scale of investment in the five considered EU Member States. In addition, the competitiveness between domestic and foreign corporations is aligned. This holds true in this study's setting as the average corporate tax rates of the foreign investment locations are lower than the effective tax burdens of corporations located in Finland, France, Germany, Italy, or Spain. The extent of a potential increase in tax competition for the five considered EU Member States, especially with regard to tax rate differentials, becomes visible through the EATR calculations. By introducing the shareholder relief system, the importance of corporate taxation for the overall tax burden increased as domestic- and foreign-sourced dividends receive equal tax treatment at the shareholder level. As France, Germany, and Spain are typical high-tax countries among the EU Member States, the EATR of foreign investment alternatives is lower than domestic ones in the entire post-imputation systems period. In contrast, Finland and Italy are equally attractive as the average of the EU-15 Member States for the location of corporate investments. However, Finland and Italy lost location attractiveness with regard to the EU-10 Member States as the latters' average corporate income tax rate is lowest in this study's sample.

To isolate the implications of discriminatory imputation systems on the scale and location of investments as well as tax competition in the EU, we assume equity investments at the shareholder and corporate levels. However, other financing alternatives such as debt financing or retained earnings could also be used. Thus, this study's simulation model results should be interpreted as an upper bound.

4 The EU's new era of fair company taxation: The impact of DEBRA and Pillar 2 on the EU Member States' effective tax levels

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Abstract: The European Union (EU) intends to fight aggressive tax planning of multinational enterprises (MNEs), resulting in highly reduced effective tax burdens, and distortions caused by non-harmonised tax systems of the EU Member States. To eradicate tax distortions in the EU, the European Commission proposed a directive on a debt-equity bias reduction allowance (DEBRA). Under DEBRA, the different tax treatment of debt and equity financing of companies shall be tackled by introducing both a notional allowance on equity (ACE) and a new limitation on interest deduction in the EU Member States. To fight aggressive tax planning of MNEs, the EU has introduced the minimum tax directive (Pillar 2), which imposes an effective minimum tax rate of 15%. In this simulation study, the impact of the two measures and their interaction on effective tax levels is assessed. Thus, the effect on the countries' location attractiveness and the scale of investment can be measured. We find that DEBRA leads to a substantial reduction of the effective tax levels of equity-financed companies in countries, which do not have an ACE regime in place. Contrary, in countries with a combined profit tax rate below 15%, Pillar 2 increases the EATR. The simulation of the interaction of both regulations shows that the effect of Pillar 2 dominates that of DEBRA. In addition, the results hold under a common tax base in accordance with the recently proposed Business in Europe: Framework for Income Taxation directive (BEFIT).

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4.1 Introduction

The European Commission aims at moving towards a fair, efficient, and growth-friendly taxation by eradicating tax distortions caused by non-harmonised tax systems in the EU Member States. Although the European Commission has no direct mandate in collecting taxes or setting tax rates, it can address various issues by introducing initiatives resulting in directives. These directives, in turn, require implementation by the EU Member States within their respective national tax legislation. Three such initiatives are the proposed directive on debt-equity bias reduction allowance (DEBRA)[188], the enacted minimum tax directive (Pillar 2)[189], and the recently proposed 'Business in Europe: Framework for Income Taxation' directive (BEFIT)[190].

One essential cause for tax distortions is the disparate tax handling of debt (interest payments) and equity (dividend payments) financing for companies, which prevents the attainment of financing neutrality. Therefore, DEBRA intends to abolish the debt-equity distortion through two measures. First, it provides for an allowance on equity (ACE) to mirror the tax deductibility of interest payments. Second, it tightens the deductibility of actual interest expenses (exceeding borrowing costs). DEBRA consequently leads to a promotion of equity financing for companies by reducing the effective tax burden.

Whereas DEBRA decreases the tax burden, Pillar 2 leads to a higher tax burden for companies. The directive was enacted in the end of 2022 and requires EU Member States to adjust their national tax code in a way that they impose a 15% minimum effective tax rate (ETR) on large companies. Pillar 2 especially affects multinational enterprises (MNEs). Nonetheless, there is an ongoing debate regarding whether this milestone[191] constitutes an effective strategy for addressing the race to the bottom in ETRs and whether it aligns with EU law. This uncertainty is exacerbated by a pending case before the General Court of the EU.[192]

Besides those relatively new approaches, the EU announced BEFIT, which, among other rulings, is a new attempt to introduce EU-wide harmonised rules for the calculation of the corporate tax base, succeeding the formerly failed Common Corporate Tax Base (CCTB)[193] and Common Consolidated Corporate Tax Base (CCCTB)[194] proposals. All proposals aim at a

[188] European Commission 2022a.
[189] Council Directive 2022/2523/EU 2022.
[190] European Commission 2023.
[191] OECD 2021.
[192] Pending case before the General Court T-143/23 2023.
[193] European Commission 2016b.
[194] European Commission 2011; European Commission 2016a.

reduction of disparities in tax burdens, complexity in cross-border operations, and opportunities for tax planning within the EU.

In this article, we describe the functioning of DEBRA and Pillar 2 as well as the interaction of both directives. In addition, we conduct a simulation study to determine the extent to which DEBRA and Pillar 2 distort firms' investment decisions in and across EU Member States and, therefore, influence countries' tax location attractiveness. Furthermore, we assess the impact of the two measures under harmonised corporate tax base rules as proposed by BEFIT. Hence, we rely on the harmonised depreciation rates and inventory valuation of BEFIT.[195] Thus, we can eliminate the impact of varying tax bases of the EU Member States. Our article builds on well-established simulation studies using the Devereux/Griffith methodology to measure the impact of policy reforms on countries' location attractiveness.[196]

DEBRA, Pillar 2, and harmonised corporate tax base rules are all highly relevant policy approaches, which is why they are already addressed in the literature. The literature on DEBRA is limited to a few qualitative normative-analytical evaluation articles, as DEBRA is not yet in force.[197] *Bettens*[198] assesses not only DEBRA but also its legislative interactions with Pillar 2. The empirical literature on DEBRAs' real effects is still lacking due to the pending implementation. However, there is a wide range of empirical studies that confirm the effectiveness of the ACE[199] and interest deduction limitation[200] regimes, which are combined under DEBRA, in combating the tax debt-equity bias.

A wide range of literature qualitatively evaluates the conceptual opportunities and challenges of Pillar 2.[201] There is currently no empirical evaluation of the real effects of Pillar 2, as its implementation is still in progress. Nevertheless, fiscal revenue estimates for Pillar 2 have been published by several authors.[202] Moreover, *Johannesen*[203] assesses the net welfare effect of

[195] European Commission 2023.
[196] E.g., Bräutigam, Spengel, and Streif 2017; Müller, Spengel, and Steinbrenner 2022.
[197] Gaut and McDonnell 2022; Ismer 2022; Kemmeren 2023. For an analysis in German literature, see Schnitger and Schäfer 2022; Hohlwegler, Grausam, and Berndt 2023.
[198] Bettens 2022.
[199] E.g., Bernasconi, Marenzi, and Pagani 2005; Panteghini, Parisi, and Pighetti 2012; Princen 2012; Van Campenhout and Van Caneghem 2013; Schepens 2016; Hebous and Ruf 2017; Branzoli and Caiumi 2020.
[200] E.g., Overesch and Wamser 2010; Buettner et al. 2012; Buettner, Overesch, and Wamser 2016; Hebous and De Mooij 2018.
[201] E.g., Devereux 2023; Dourado 2022; Bammens and Bettens 2023; Eberhartinger and Winkler 2023.
[202] Devereux et al. 2020; Janeba and Schjelderup 2023; Tørsløv, Wier, and Zucman 2023.
[203] Johannesen 2022.

Pillar 2 by a theoretical model. In the future, it is expected that research will focus on empirical evidence regarding the influence of Pillar 2 on profit shifting[204].

Compared to DEBRA, the literature on BEFIT is even more limited. It consists so far of a few qualitative comments based on the available information on the directive,[205] as the EU only recently published the proposal. However, there are several studies assessing the former CCCTB and CCTB proposals. *Nicolay & Spengel*[206] provide a qualitative policy evaluation of the CCCTB proposal of 2016, while *Spengel et al.*[207] use a model-based approach to assess the impact of each element of the harmonised tax base as described in the CCTB proposal of 2016. No empirical studies are available since none of the proposals have become law.

The underlying concept of the tax attractiveness of a location is also well covered in the literature. A broad range of studies documents the effects of taxes on location decisions for economic activities of firms.[208] A meta-study by *Feld & Heckemeyer*[209], which assesses the literature on foreign direct investment flows, indicates that the location of economic activity is highly sensitive to differing ETRs across countries. Furthermore, our approach to measure countries' tax-related location attractiveness using the Devereux/Griffith methodology is well established in scientific literature.[210]

Overall, the studies that are most similar to our paper are *Hanappi & González Cabral*[211] and *Bares et al.*[212]. *Hanappi & González Cabral* use forward-looking ETR metrics to demonstrate the impact of Pillar 2 on MNE group-specific investment decisions in the context of profit shifting. In contrast, we apply a different modelling methodology and concentrate on the per country implications for investment of Pillar 2. The simulation study by *Bares et al.* focuses on the dispersion of the EATR by including a proxy for profit shifting of an MNE resident in the OECD countries. Instead of analysing the tax planning behaviour of firms in a worldwide cross-border setting, we focus on the effect of the interaction between Pillar 2 and DEBRA on the domestic effective tax burdens of EU Member States.

[204] For an overview of the academic literature on profit shifting, see Riedel 2018; For a recent estimation, see Janský and Palanský 2019.
[205] Avi-Yonah 2023; Prinz 2023.
[206] Nicolay and Spengel 2017.
[207] Spengel et al. 2019.
[208] De Mooij and Ederveen 2006; Devereux and Maffini 2007; Hebous, Ruf, and Weichenrieder 2011; Barrios et al. 2012.
[209] Feld and Heckemeyer 2011. For further empirical evidence, see Becker, Fuest, and Riedel 2012.
[210] Devereux and Griffith 2003; Pfeiffer and Spengel 2017; Spengel, Nicolay, et al. 2018; Müller, Spengel, and Steinbrenner 2022.
[211] Hanappi and González Cabral 2022.
[212] Bares, Devereux, and Güçeri 2021.

Our simulation study fits best to the well-established literature on tax policy evaluations.[213] Hence, our article enables a preliminary estimation of the tax effects for EU Member States in relation to the implementation of Pillar 2 and DEBRA. Overall, our article contributes to the existing research in two ways. First, to the best of our knowledge, we are the first to analyse the interaction effects of DEBRA and Pillar 2 in terms of ETRs, including several sensitivity tests to incorporate recent economic developments and BEFIT's harmonised rules for depreciation and inventory valuation. Second, we provide a comprehensive policy evaluation of the (proposed) directives for the EU Member States regarding investment location decisions by applying a simulation study. A simulation study is particularly valuable as empirical studies cannot yet be performed due to the lack of post-implementation periods.

The article is organised as follows: In Section 4.2, we provide a theoretical overview on DEBRA and Pillar 2, where we focus on the relevant parameters for the following simulation study. In Section 4.3, we introduce the Devereux/Griffith methodology used for the simulation and present our main results. As part of the main results, we evaluate the effects of DEBRA and Pillar 2 separately and of both initiatives in combination considering different scenarios, e.g., including BEFIT's harmonised tax base. Section 4.4 concludes.

4.2 Qualitative overview

4.2.1 Functioning of DEBRA

In May 2022, the European Commission presented the proposal for DEBRA, a legislative initiative aimed at facilitating sustainable and long-term corporate financing within the EU by reducing the tax-induced distortions between debt and equity financing.[214] The proposal includes two measures that apply independently of each other: an ACE and a limitation to interest deduction. The ACE aims to equalise the tax treatment of debt and equity by allowing taxpayers to deduct a notional interest rate for equity, providing a tax benefit comparable to that of interest payments on debt. The limitation to interest deduction restricts the deductibility of interest payments for tax purposes, thereby preventing excessive debt financing and reducing the directive's impact on the EU Member States' tax revenues.[215]

According to the proposal, DEBRA will apply to all taxpayers subject to corporate taxation in one or more EU Member States. This encompasses permanent establishments in one or more EU Member States of companies that are tax residents in a third country. However, financial

[213] Evers, Miller, and Spengel 2015; Müller, Spengel, and Steinbrenner 2022.
[214] European Commission 2022a.
[215] It should be noted that DEBRA could open up new tax planning models via group financing, see, e.g., Heckemeyer and Nippel forthcoming.

undertakings are exempted from the directive's provisions, recognising their distinct nature and regulatory frameworks. Under the proposal, EU Member States are expected to adopt DEBRA into national law by 31 December 2023 and to apply its provisions from 1 January 2024. However, a grandfathering rule has been included, allowing EU Member States that already apply a domestic ACE under national law to defer the application of DEBRA's provisions. The deferral is allowed for a period of up to 10 years for taxpayers who have already benefited from the domestic ACE as of 1 January 2024.

With regard to the ACE, the proposed directive stipulates that the ACE is equal to the allowance base multiplied by the notional interest rate (Article 4). Moreover, the allowance base consists of the annual increase in equity, which is defined as the difference between the level of net equity at the end of the current and the previous tax period. In this context, net equity is defined as the taxpayer's equity less participations in the capital of associated enterprises[216] and own shares. The notional interest rate consists of two components, a risk-free interest rate and a risk premium. The risk-free interest rate is currency-specific and with a maturity of 10 years as of 31 December of the year preceding the relevant tax period. The proposed directive refers to the corresponding interest rate published by the European Insurance and Occupational Pensions Authority (EIOPA).[217] Thus a risk premium of 1% is added to the risk-free interest rate.[218]

According to the proposed directive, the ACE is deductible from the tax base in the tax period in which the net increase in equity occurs and in the nine consecutive tax periods. This approximates the tax treatment and the maturity of debt. To prevent abuse, the deduction is limited to 30% of the taxpayer's annual EBITDA. If the ACE exceeds the taxpayer's net taxable income in a given year, DEBRA provides for an unlimited carryforward of the excess allowance. If, in this given year, the capital allowance exceeds the 30% EBITDA threshold, the excess may be carried forward for a maximum of five years. It should be noted that in the event of a net equity decrease and a corresponding negative allowance base, a negative ACE will become taxable, i.e., it is added to the tax base. However, this recapture is limited to the amount of previously obtained ACE. We are not able to capture EBITDA, including the modelling of the carryforward, as our simulation study is based on a one-period model.

Prior to the DEBRA proposal several EU Member States already introduced an ACE to mitigate the debt-equity bias. As of 2022, Belgium, Cyprus, Italy, Malta, Poland, and Portugal offer an

[216] An associated enterprise as defined in Article 3(1) is deemed to exist, in particular, if the taxpayer holds a participation of more than 25% in the voting rights, capital or profit of the enterprise.
[217] It refers to Article 77e (2) Directive 2009/138/EC.
[218] For small and medium-sized enterprises (SMEs), the risk premium is increased to 1.5% to reflect the higher risk premium they bear in order to obtain financing.

ACE, whereby all legislations show comparable approaches to DEBRA.[219] Italy, Malta, and Portugal determine new equity similarly to DEBRA, whereas Belgium, Cyprus, and Poland apply different reference points. In nominal terms, the notional interest rates in 2022 differ strongly between countries ranging from 0% in Belgium to 8.04% in Malta, but the methods to determine the rates are comparable to DEBRA. Only Portugal applies a fixed rate of 7%. The deductions of notional interest are capped in all countries and carryforwards of excess notional interest are possible in Italy, Malta, Poland, and Portugal. Lastly, all countries have anti-abuse measures in place. In conclusion, when DEBRA replaces the national measures, it can be advantageous or disadvantageous depending on the generosity of the national regime.

Besides addressing the debt-equity bias on the equity side, DEBRA also considers the debt side by limiting the tax deductibility of interest payments to 85% of the exceeding borrowing cost, which are defined as the difference between tax-deductible interest paid and taxable interest received[220] (Article 6). As ATAD also provides an interest deduction limitation (Article 4 ATAD, so-called 'interest limitation rule') the interaction between both is regulated in DEBRA. First, the exceeding borrowing costs are determined under the rules of both directives. In comparison to DEBRA, ATAD limits the deduction of exceeding borrowing cost to 30% of the taxpayer's EBITDA.[221] After calculating the exceeding borrowing costs under both directives, the lower of the two is the applicable deductible amount of interest. Hereby, any exceeding borrowing costs that cannot be deducted due to the interaction of DEBRA and ATAD can be carried back for three years or carried forward infinitely.

Contrary to DEBRA, ATAD is already enacted in the EU Member States, which is why all countries limit interest deductibility. The national rulings are in line with ATAD but differ across countries as there is some leeway for the transposition into national law.[222] Overall, the regulatory framework in the EU is inconsistent, which is why the interaction of the existing interest limitation rules and DEBRA as well as the impact of DEBRA's interest limitation rule will differ across countries. It should be noted that ATAD's interest limitation rule cannot be modelled in our study as it is derived from the EBITDA, which cannot be captured by the Devereux/Griffith methodology. Nonetheless, our results are still highly informative, as under the application of DEBRA, ATAD could only lead to a lower deduction limit than 85%, so our analysis represents a minimum standard scenario.

[219] Hohlwegler et al. 2023; see Appendix 14 for an overview of national ACE legislations.
[220] Defined according to Article 2 Anti-Tax Avoidance Directive (ATAD, Council Directive 2016/1164/EU 2016.
[221] Some exceptions allow for deductions above the threshold or even full deductions.
[222] KPMG EU Tax Center 2022, 4 et seq.

4.2.2 Functioning of Pillar 2

The mandate for the EU Member States to implement a global minimum tax became effective with the enactment of the directive in late 2022. This directive obliges the states' authorities to transpose it into national tax law by the end of 2023.[223] While in 2021, a total of 137 countries agreed on a global minimum tax directive as part of the OECD/G20 Inclusive Framework on Base Erosion and Profit Shifting, the EU acts as a first mover. It remains unclear whether the non-EU countries in the Inclusive Framework indeed will implement the minimum tax. Pillar 2 aims at fighting aggressive tax planning by levying an effective minimum tax rate of 15% on profits generated by large companies. The large company is indicated by an annual consolidated revenue above 750 Mio. EUR (Article 2).

To calculate the so-called top-up tax, a company has to determine its ETR under a jurisdictional blending approach, i.e., all constituent entities in a jurisdiction are aggregated. The ETR is defined as the ratio between the adjusted covered taxes of all entities in one jurisdiction and their net qualifying income in this jurisdiction. First, the net qualifying income is derived from the net income used for the preparation of the consolidated financial statements (Article 15), which must be prepared on the basis of an acceptable accounting standard (including IFRS and US GAAP). The financial accounting net income has to be adjusted for various items (Article 16). Second, the covered taxes are derived by adjusting the current tax expenses according to external accounting standards for temporary differences (e.g., deferred taxes).

To collect the top-up tax, Pillar 2 builds on three different main mechanisms. First, under the income inclusion rule (IIR) the residence state of the parent company imposes a top-up tax on all low-taxed subsidiaries within the group (Article 5). The top-up tax increases the ETR up to the 15% threshold. Second, the undertaxed profits rule (UTPR) is applied as a backstop if the IIR is not implemented in the ultimate or intermediate parent company's residence state (Article 12 et seq.). Under the UTPR certain intra-group payments are no longer tax deductible which leads to an increase in the effective tax burden.[224]

Besides the interlocked system consisting of the IIR and the UTPR, the qualified domestic minimum top-up tax (QDMTT) is the third mechanism (Article 11). Low-tax countries can electively introduce the QDMTT and thereby directly impose a top-up tax on companies that are resident in their territory. Thus, the low-tax countries can increase the tax burden for entities belonging to large groups to the 15% threshold, while maintaining their low-tax benefits for

[223] Council Directive 2022/2523/EU 2022.
[224] Council Directive 2022/2523/EU 2022, no. 5.

any other resident company.[225] The QDMTT takes precedence over IIR and the UTPR and is credited against the international minimum tax.

To reach the final top-up tax, the substance-based income exclusion must be considered (Article 28). It exempts a so-called routine profit from substantial economic activity, i.e., tangible assets and costs associated with employees, from the top-up tax. In the year of introduction, the substance-based income exclusion amounts to 8% of the carrying value of the eligible tangible assets and 10% of the costs associated with employees. Both percentage levels are reduced continuously to 5% within 10 years (Article 27 and Article 46). Overall, considering the average company taxation within the EU Member States, we expect the ETR to be above the 15% threshold in the majority of these countries.

4.2.3 Potential interactions

Our analysis also explores the potential interaction effect of DEBRA and Pillar 2, as both have opposite objectives and contrary impact on the effective tax burden of affected companies. On the one hand, DEBRA mitigates the debt-equity bias by reducing the effective tax burden for equity-financed investments. In certain cases, the reduction can lead to an effective tax burden below 15% triggering the application of Pillar 2. On the other hand, Pillar 2 increases the company-specific ETR to the 15% level. Consequently, the induced reduction effect by DEBRA could be immediately eliminated by Pillar 2, except for profits for which the substance-based income exclusion applies. Furthermore, a shift of tax revenues to other jurisdictions could be caused, as the top-up tax can be collected by a country other than the one applying the tax-reducing DEBRA.[226] However, in our setting we only focus on domestic cases as the cross-border tax planning strategies of MNEs are mainly firm-dependent.

Another interaction effect exists as some EU Member States already apply an ACE. For those countries the effect of DEBRA depends on the notional interest deduction under their national tax law. If DEBRA is less generous than the national regulation, the effective tax burden increases and the top-up tax from Pillar 2 is less significant.

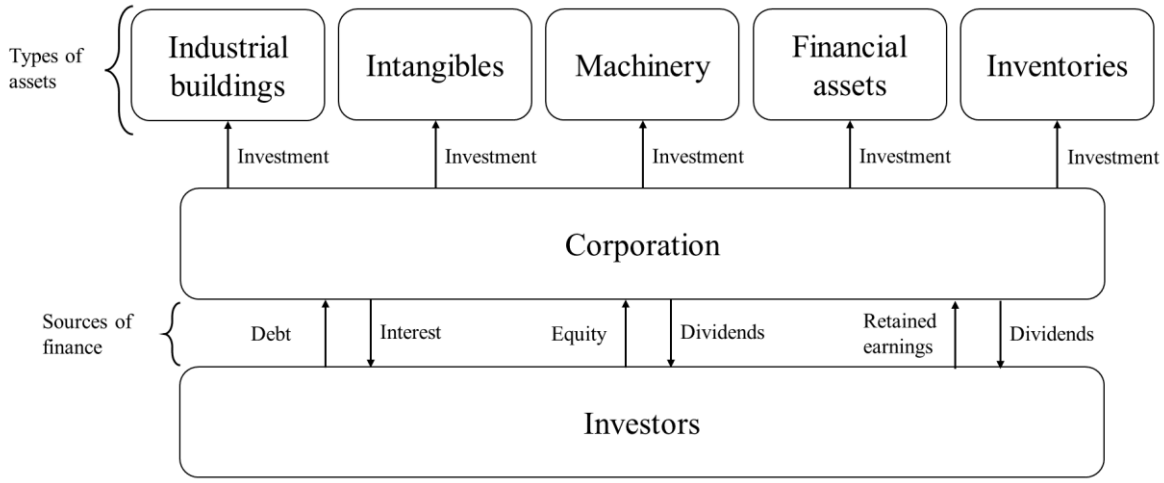
[225] Council Directive 2022/2523/EU 2022, no. 13.
[226] Bettens 2022, 916 et seq.

4.3 Quantitative evaluation

4.3.1 Methodology

To measure the impact of the introduction of Pillar 2 and DEBRA on the location attractiveness for capital investments, we rely on the Devereux/Griffith methodology.[227] The model company and the associated investment and financing flows are shown schematically in Figure 6. This methodology allows for an in-depth policy evaluation as it not only considers the statutory tax rates but incorporates several country-specific factors like the type of tax systems including tax bases and tax rates of profit and non-profit taxes at the corporate level.[228] The impact of these tax parameters is measured in terms of after-tax returns of corporate investments. Thus, we are able to measure the influence of taxes on the location attractiveness of countries for investments as well as the extent of tax distortions,[229] both caused by the introduction of Pillar 2 and DEBRA.

Figure 6: Schematic illustration of Devereux/Griffith methodology



Notes: The figure displays the considered investment setting of a domestic corporation that is financed by an investor. The latter undertakes an investment in the corporation by debt, equity, retained earnings or a mix of these sources. The domestic corporation decides to pass the additional capital to invest in five different assets: Intangibles, buildings, machinery, financial assets, and inventory (20% each). The taxation of the investor is not considered in our setting as DEBRA and Pillar 2 intend to impact solely the corporation.
Source: Own illustration.

In general, the methodology is based on the neoclassical investment theory and assumes a discrete, hypothetical investment decision of an (at least) marginal investment of a profit-maximising company. It should be noted that the model is one-periodic, and we only observe a domestic case meaning that no cross-border transactions are considered. Two types of investments are distinguished on the basis of their outcome, namely, marginal investments, which

[227] Devereux and Griffith 1999; Devereux and Griffith 2003.
[228] Spengel et al. 2021.
[229] Lammersen 2005, 10 et seq.

earn a return equal to their cost of capital (CoC), and investments with an assumed positive pre-tax return, where the location attractiveness of the investment is expressed by the effective average tax rate (EATR). The CoC demonstrates how taxation affects both the level of investment and a country's attractiveness for investment expansion, relative to other potential investment destinations. The CoC is interpreted relative to the real market interest rate. Hence, if the CoC is lower (higher) than the real market interest rate, the corporate investment is more (less) attractive than the alternative investment as a consequence of taxation.[230] The CoC show the impact of taxation on the scale of investments. However, when companies have to make investment location decisions that involve determining the geographical allocation of economic returns, the EATR serves as the appropriate metric.[231] A higher (lower) EATR signals a higher (lower) attractiveness of the location for the investment, and hence, indicates where to rather (not) allocate economic returns.[232] For a comprehensive analysis, we use both indicators, with tax base regulations and non-income taxes being the main drivers of the CoC and tax rate changes being the main drivers of the EATR.[233]

To measure the impact of the new tax regulations, we compare the CoC and the EATRs before and after a fictitious implementation of DEBRA and Pillar 2 in the tax year 2022. The tax parameters are taken from the tax research platform of IBFD. In Table 7, the economic parameters for the Devereux/Griffith methodology are displayed. For most parameters we rely on the well-established assumptions of previous scientific articles and reports.[234] However, we have adjusted the nominal interest rate to the current economic situation as it has high impact on measuring the effects of DEBRA. Thus, we use the 10-year risk-free interest rate published by EIOPA as of 31 December 2022 as our nominal interest rate. It must be noted that certain parameters are changed in the following analyses to incorporate Pillar 2 and DEBRA, as well as to carry out sensitivity tests.

Our sample includes all 27 EU Member States, except Estonia and Latvia, as they have a fundamentally different corporate income tax (CIT) system to which DEBRA cannot be applied.[235] We also include a common tax base scenario in our analysis as it offers two valuable pieces of insight. First, a harmonised corporate tax base was envisioned several times by the EU,[236] most

[230] Fischer, Müller, and Spengel 2023.
[231] Devereux and Griffith 1998, 337; Devereux and Griffith 2003, 33 et seq.
[232] Devereux and Griffith 1998; Devereux and Griffith 2003.
[233] Spengel, Nicolay, et al. 2018.
[234] Spengel et al. 2021.
[235] Moreover, Estonia officially claims that the country will introduce Pillar 2 earliest in 2030, see ERR News 2023.
[236] Nicolay and Spengel 2017.

recently by BEFIT[237]. Therefore, in addition to the baseline scenario, we implement the common tax base in accordance with BEFIT in all countries as it accounts for the potential influence of the proposed directive. Second, by including an EU-wide harmonised tax base calculation, we eliminate potential distortions from differing tax bases and show the pure tax rate effects of DEBRA and Pillar 2. Thus, we can better compare the effects of DEBRA and Pillar 2 across EU Member States.

For the tax base regulations in our model, we follow BEFIT applying a straight-line depreciation over 28 years for buildings, and over five years for intangibles (Article 22). For other tangibles assets BEFIT refers to the useful life in accordance with an acceptable accounting standard, either IFRS or national GAAP (Article 7). For the purposes of the BEFIT's common tax base, we follow the IFRS' approach, which is based on the useful life. Hence, we assume a useful life of seven years.[238] Furthermore, regarding financial assets, a depreciation is not permitted (Article 27). For inventories, we apply the weighted average cost method (Article 29).[239]

In the following, we show the results for our analysis of the effects of DEBRA, Pillar 2, and their interaction on the EU Member States' effective tax levels. Moreover, we include different scenarios for robustness checks. Regarding our applied methodology, it must be taken into account that the interpretation of the results has its limitation due to the usage of a stylised simulation company. However, the scientifically broadly accepted Devereux/Griffith methodology still provides an opportunity to measure the effects of these new tax regulations.

Table 7: Economic assumptions

Assumptions on types of taxes and tax bases			
Company level	Corporate income tax* including surcharges, local business taxes, non-profit taxes		
Tax base*	Depreciation, inventory valuation, deductibility of interest expenses		
Assumptions on assets and financing			
Types of assets	Intangibles, buildings, machinery, financial assets, inventory (20% each)		
Types of financing*	Retained earnings (55%), debt (35%), new equity (10%)		
Assumptions on depreciation, inflation, interest rate and pre-tax rate of return			
Economic depreciation period	Intangibles 15.35%	Buildings 3.10%	Machinery 17.50%
Inflation rate (π)		2%	
Real interest rate (r)*		1.071%	
Nominal interest rate (i)*		3.092%	
Pre-tax rate of return (p)		20%	

Notes: The table displays the economic assumptions for the parameters used in the Devereux/Griffith methodology. '*' indicates that these parameters may vary in the following simulation study in order to incorporate Pillar 2, DEBRA, or sensitivity analyses. **Source:** Own illustration based on Spengel 2003, 88.

[237] European Commission 2023.
[238] For the national tax depreciation per asset group, see Appendix 16.
[239] European Commission 2016b.

4.3.2 Main results: DEBRA

4.3.2.1 Baseline scenario

In modelling DEBRA, we assume a notional interest rate of 4.092%, comprising a nominal interest rate of 3.092% and a risk premium of 1%. Moreover, we incorporate a limitation of interest deductibility of 85%. In addition, regarding the source of financing of the investment, the financing mix described in Table 7 is applied. As DEBRA has an impact on the tax base rather than the tax rate, we first investigate the effect on the CoC. Figure 7 shows the comparison of the CoC under national tax law and under DEBRA. Under the status quo of each country's national legislation, the CoC ranges from -0.47% (Portugal) to 2.01% (Spain). DEBRA reduces the spread of the CoC, resulting in a range from 0.45% (Portugal) to 1.52% (Malta).

For the majority of EU Member States, the CoC is higher under the status quo of national tax law than after the implementation of DEBRA. Three countries show an increasing effect, namely Cyprus, Malta, and Portugal, caused by more generous national ACE regimes, explained in the following paragraph. For the first-mentioned subsample of countries, the effect caused by DEBRA ranges from -1.43 pp. (Spain) to -0.16 pp. (Poland).[240] This net negative effect consists of two contradictory effects. First, DEBRA's interest deduction limitation rule increases the CoC by limiting the ability to deduct interest payments from the tax base. Second, DEBRA's ACE reduces the CoC due to the additional deduction of notional interest from the tax base. The latter effect dominates the former, resulting in a net negative effect of DEBRA on the CoC for most countries.[241] A net negative effect on the CoC suggests that DEBRA increases the optimal level of corporate investment.

As of 2022, six countries have already implemented an ACE in their national tax law that differs to varying degrees from the ACE implemented under DEBRA.[242] For those countries whose national tax law provides for a less generous ACE than DEBRA, we find a net negative effect of the proposed directive on the CoC. Belgium, Italy, and Poland grant notional interest rates of 0%, 1.3% and 2.75%, respectively, under their national tax laws from 2022. The ACE under DEBRA, with its notional interest rate of 4.092%, provides for a higher deduction from the tax base, resulting in a net negative impact of DEBRA on the CoC in the aforementioned countries. In contrast, the CoC increases in countries whose national tax law provides for a more generous

[240] In countries with high tax rates, such as Spain or Germany, the additional deduction from the ACE is worth more than in countries with lower tax rates, resulting in larger relative net negative effects in the former countries.
[241] The composition of the net negative effect of DEBRA on the CoC is shown in Appendix 17. The columns 'ACE only' and 'Interest deduction limitation rule only' show the effect of implementing the two parts of DEBRA separately.
[242] See Appendix 14 for an overview of the already existing ACE regimes in the EU.

ACE than DEBRA. For these states the DEBRA reduces the tax attractiveness of equity financing. For Cyprus, Malta, and Portugal, DEBRA increases the CoC because the currently existing national ACE regimes provide for notional interest rates of 5.629%, 8.04% and 7%, respectively, which are higher than the 4.092% granted under DEBRA.

Comparing the CoC under the status quo of the countries' national tax laws with the real interest rate of 1.071%, Figure 7 shows that in almost all countries the CoC is higher than the real interest rate. Thus, an alternative investment on the capital market is more attractive than the corporate investment. Exceptions are Cyprus, Poland, and Portugal, where the CoC under the status quo is below the real interest rate due to the ACE implemented in their national law. In contrast, although Malta has a generous national ACE, its CoC are comparatively high. This is because our modelling approach assumes that earnings are retained when calculating the CoC, hence Malta's ETR is 35% and not 5%.[243]

As noted above, the implementation of DEBRA has a net negative effect on the CoC for all countries except Cyprus, Malta, and Portugal. As a result, for the majority of countries the CoC falls below the real interest rate under DEBRA. Hence, DEBRA makes corporate investment more attractive than the alternative of investing in the capital market. Exceptions are Finland, Hungary, and Malta whose CoC remains above the real interest rate even under DEBRA.

For simplicity, we assumed so far, the same notional interest rate for all countries based on the euro-specific risk-free interest rate. However, according to DEBRA, the notional interest rate should be based on the national currency-specific interest rate (Article 4). The effect of DEBRA on the CoC when introducing currency-specific notional interest rates for the non-euro countries is shown by the black frames in Figure 7.[244] For Bulgaria, Denmark and Sweden, the currency-specific interest rate is very close to the Euro rate. Accordingly, the CoC under DEBRA remains almost the same regardless of which interest rate is used. In contrast, for countries where the currency-specific interest rate is higher than the Euro rate (Croatia, Czech Republic, Hungary, Poland, and Romania), we observe a decrease in the CoC when implementing DEBRA based on the currency-specific interest rate. The decrease in the CoC can be explained by the fact that the notional interest rate increases when using the higher currency-specific interest rate, resulting in higher deductions from the tax base.

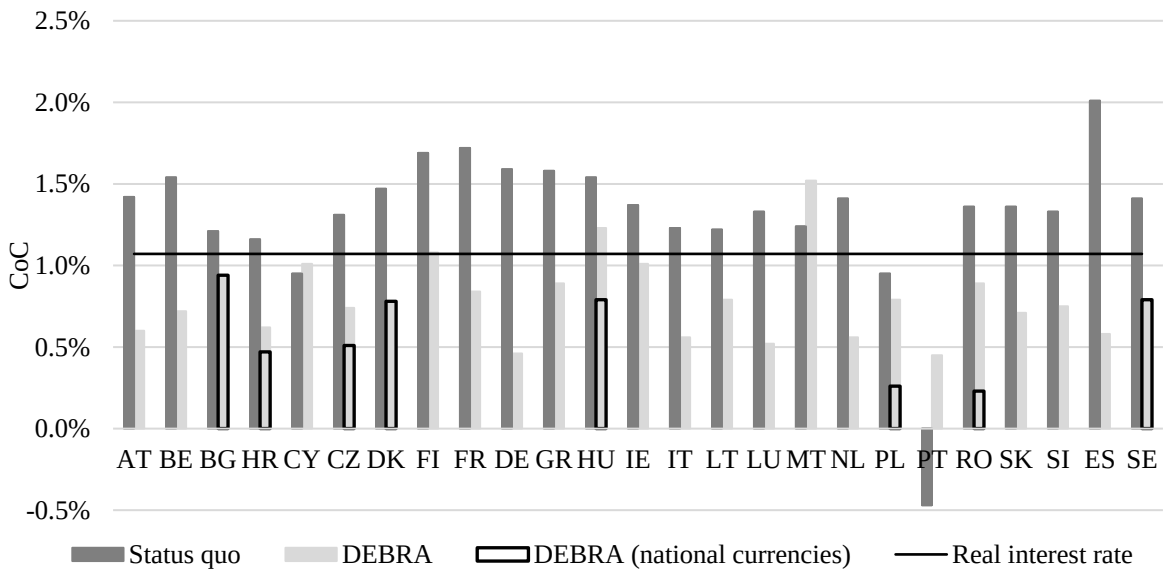
[243] In Malta, registered shareholders (resident and non-resident) may claim a refund of six sevenths of the tax paid by the distributing company on the distributed profits. This leads to an effective tax rate of 5% on distributed profits, compared to an effective tax rate of 35% on retained profits. For further information, see Cassar Torregiani 2023, chapter 6.1.2. et seq.

[244] See Appendix 15 for an overview of the relevant currency-specific risk-free interest rates.

In addition to the effect of DEBRA on the CoC, we also consider the countries' EATRs displayed in Figure 8. Our results confirm, the implementation of DEBRA has a net negative impact on the EATR for the majority of countries, which is in line with the effects found for the CoC. As the EATR reflects the tax location attractiveness of a country, a decrease in the EATRs due to DEBRA implies that the proposed directive makes countries more attractive from a tax perspective. Exceptions are those countries with more favourable national ACE regimes. Due to the less generous notional interest rate of DEBRA, the EATRs increase in Cyprus (0.29 pp.), Malta (1.33 pp.), and Portugal (3.17 pp.), reducing the countries' location attractiveness under tax considerations.

The impact of DEBRA on the CoC and the EATR is highly dependent on the nominal interest rate assumed in the model. The interest rate is used not only to discount future cash flows but also to determine the notional interest rate under DEBRA. We therefore conduct an interest rate sensitivity analysis with a low, medium, and high interest rate scenario for the CoC and the EATR.[245] The CoC and EATRs develop almost linearly across the different interest rates, proving that our results are largely robust to interest rate changes.[246]

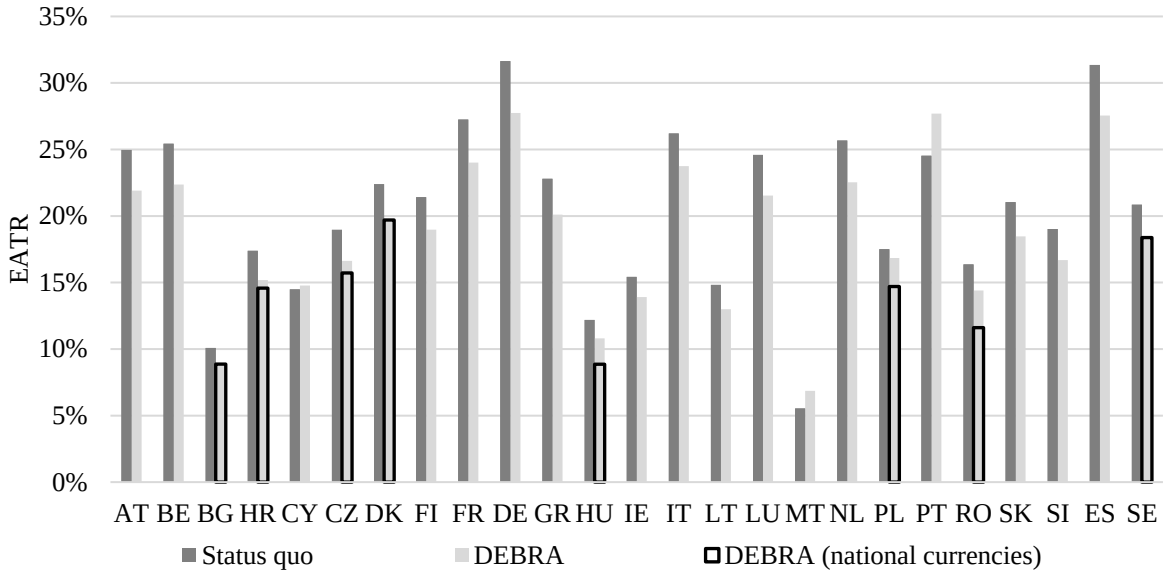
Figure 7: CoC under status quo and DEBRA (2022)



Notes: The figure compares the CoC under the sample states' status quo (dark grey bars) and under application of DEBRA with a notional interest rate of 4.092% and an interest deduction limitation of 15% (light grey bars). Moreover, the national currency scenario for DEBRA is included (black frames on the light grey bars), where the notional interest rates amount to 4.032% (BG), 5.151% (HR), 5.602% (CZ), 4.082% (DK), 9.609% (HU), 7.648% (PL), 9.556% (RO) and 4.01% (SE). The real interest rate of 1.071% is indicated by the flat black line.
Source: Own calculation and illustration.

[245] See Appendix 18, Appendix 19, Appendix 20.
[246] See Appendix 21 and Appendix 22.

Figure 8: EATRs under status quo and DEBRA (2022)



Notes: The figure compares the EATRs of the sample states' status quo (dark grey bars) and under application of DEBRA with a notional interest rate of 4.092% and an interest deduction limitation of 15% (light grey bars). Moreover, the national currency scenario for DEBRA is included (black frames on the light grey bars), where the notional interest rates amount to 4.032% (BG), 5.151% (HR), 5.602% (CZ), 4.082% (DK), 9.609% (HU), 7.648% (PL), 9.556% (RO) and 4.01% (SE). For all countries interest deductibility is reduced by 15%.
Source: Own calculation and illustration.

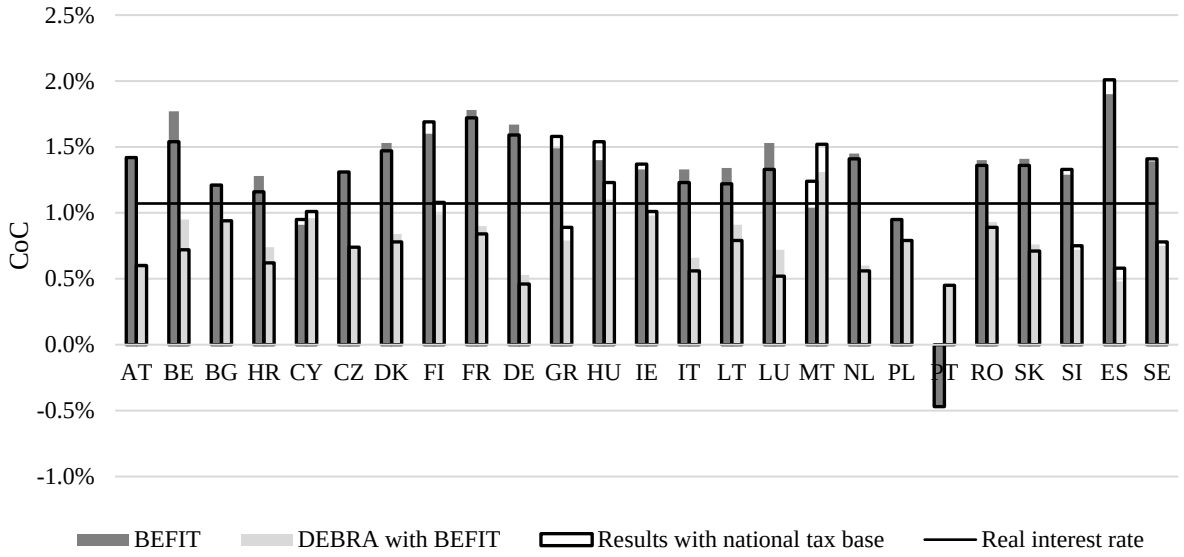
4.3.2.2 Scenario BEFIT's common tax base

In the following, we present the results for a common tax base scenario for our sample countries. As outlined in Section 4.3.1, our common tax base is adapted from BEFIT. First, we evaluate the impact of BEFIT's common tax base on the EU Member States' CoC and EATRs. Second, we compare the interaction between BEFIT's common tax base and DEBRA with the sole implementation of DEBRA.

Figure 9 presents the results for the CoC. Considering the effect of the introduction of BEFIT's common tax base, the absolute CoC range from -0.48% (Portugal) to 1.90% (Spain) compared to the status quo ranging from -0.47% (Portugal) to 2.01% (Spain). Again, Portugal has negative CoC due to its generous national ACE. In comparison to the CoC under the national tax base, we find under BEFIT's common tax base a decrease in 10 countries and an increase in 13 countries.[247] The effect on the CoC ranges from -0.20 pp. (Malta) to 0.23 pp (Belgium). Overall, applying BEFIT's common tax base does not change the attractiveness of a corporate investment compared to an alternative investment as the CoC do not fall below or exceed the real interest rate. The only exception is Malta, where the corporate investment becomes more attractive as the CoC fall below the real interest rate.

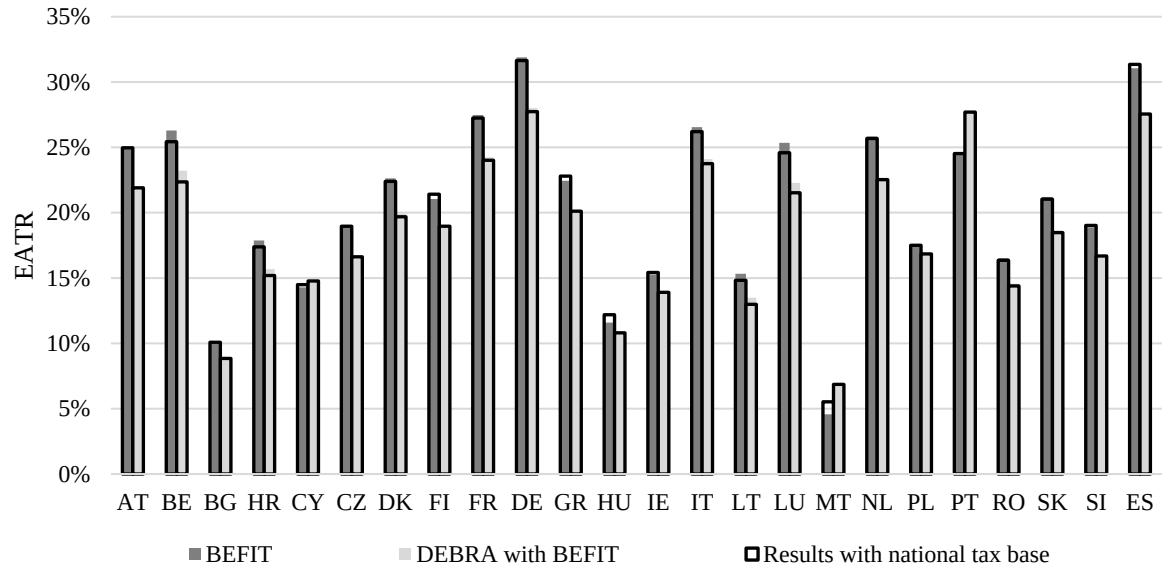
[247] In two countries (Czech Republic and Poland) no change in CoC is found.

Figure 9: Interaction of DEBRA and BEFIT (CoC)



Notes: The figure compares the sample states' CoC under BEFIT's common tax base (dark grey bars) and under a joint application of BEFIT's common tax base and DEBRA (light grey bars). Moreover, to compare the BEFIT's common tax base scenario with the national tax base scenario, the CoC of the sample states under the national tax base (black frames on the dark grey bars) and under a joint application of the national tax base and DEBRA (black frames on the light grey bars) are included. Under DEBRA, the notional interest rate is 4.092% and interest deductibility is reduced by 15%. BEFIT's common tax base assumes straight-line depreciation of buildings (28 years), machinery (7 years) and intangibles (5 years). Financial assets are not subject to depreciation. For inventories the weighted average cost method is applied. The real interest rate is 1.071% and indicated by the flat black line.
Source: Own calculation and illustration.

Figure 10: Interaction of DEBRA and BEFIT (EATRs)



Notes: The figure compares the sample states' EATRs under BEFIT's common tax base (dark grey bars) and under a joint application of BEFIT's common tax base and DEBRA (light grey bars). Moreover, the CoC of the sample states under the national tax base (black frames on the dark grey bars) and under a joint application of the national tax base and DEBRA (black frames on light grey bars) are included. Under DEBRA, the notional interest rate is 4.092% and interest deductibility is reduced by 15%. BEFIT's common tax base assumes straight-line depreciation of buildings (28 years), machinery (7 years) and intangibles (5 years). Financial assets are not subject to depreciation. For inventories the weighted average cost method is applied.

Source: Own calculation and illustration.

Similar effects can be observed for the EATRs, which are displayed in Figure 10, leading to a slight increase in EATRs for 14 sample countries after implementing BEFIT's common tax base. Considering the subsample of countries with decreasing EATRs, the effect in EATRs ranges from -0.02 pp. (Poland) to -0.96 pp. (Malta). In contrast, the other subsample shows effects in EATRs ranging from 0.06 pp. (Austria, Bulgaria) to 0.86 pp. (Belgium). BEFIT's common tax base, thus, leads to a slightly lower location attractiveness than under the national tax base for 14 countries of our sample.

Two factors can explain the country-specific reactions to BEFIT's common tax base. First, the magnitude of the tax rate determines the depreciation value. The higher the tax rate, the higher the absolute decrease in CoC and EATRs caused by depreciation. Second, the design of the national regulation influences the effect size of the common tax base. The depreciation value is determined by calculating its net present value (NPV). Hence, a high initial depreciation is advantageous. Regarding straight-line depreciation, shorter depreciation periods under BEFIT's common tax base than under national tax law will result in a higher NPV and, therefore, in lower CoC and EATRs. In addition, many countries allow for declining balance designs or declining balance designs with a switch to straight-line depreciation. These allow for higher depreciation in the early years of the investment, generally resulting in a high NPV, and lower effective tax levels.[248] As BEFIT's common tax base does not consider such tax benefits, the CoC and EATRs increase. Considering the valuation of inventories, the LIFO (FIFO) method is the most (least) favourable as we assume inflation. The effect of the weighted average cost method lies in between either increasing or decreasing the CoC and EATRs. In addition, the non-depreciation of financial assets leads to direct expensing, and therefore results in lower CoC and EATRs in most countries.

In conclusion, the country-specific reactions to BEFIT's common tax base are an interplay of different factors affecting different assets. As the majority of countries in the sample receive an unchanged or more favourable treatment of buildings, intangibles, inventories and financial assets than under their national tax base, the CoC and EATRs decrease with the degree of more favourable treatment. The deviating results for eleven countries are due to an overall less favourable treatment of buildings, intangibles, and inventories.

When interacting BEFIT's common tax base with DEBRA, the effect of the common tax base is passed through. Figure 9 and Figure 10 include the effects under the application of DEBRA

[248] Replacing them by straight-line depreciation leads to lower NPV and higher CoC/EATRs. Several countries also apply special rules for the first years of depreciation, positively affecting the NPV.

with the BEFIT's common tax base. For both the CoC and EATR, the effects of DEBRA under a common tax base are comparable to the ones under the national tax base. Therefore, all the findings of Section 4.3.2.1 still hold. In terms of investment decisions, in all countries the attractiveness of corporate or alternative investment remains unchanged compared to DEBRA under the national tax base. This is because no country falls below or exceeds the real interest rate due to BEFIT's common tax base. In addition, in some countries, the interaction of DEBRA and BEFIT's common tax base increases the location attractiveness through even lower EATRs than under the sole application of DEBRA in several countries.[249]

Overall, the impact of BEFIT's common tax base is marginal. On average, the CoC and EATRs are increased or decreased by less than 1 pp. by BEFIT's common tax base. When DEBRA is included in the model, the effect of BEFIT's common tax base is passed through. It can be inferred that different designs of a common tax base would lead to the same result, although the CoC and EATRs could change by a different amount and in the opposite direction.

4.3.3 Main results: Pillar 2

4.3.3.1 Baseline scenario

Regarding Pillar 2 for the application an ETR below 15% is required. To identify EU Member States that fulfil this requirement, we build on the combined profit tax rate, which includes the statutory corporate income tax with surcharges as well as local business taxes and takes into account the deductibility of the taxes from the tax base. We acknowledge that the companies' actual ETRs might differ due to alternative aspects like other taxes paid, loss carryforwards, or tax credits.[250] Nevertheless, we consider the combined profit tax a good proxy. Thus, we apply Pillar 2 in Bulgaria, Cyprus, Ireland, and Malta. Although Malta has a statutory corporate tax rate of 35%, it is included as low-tax country since the system of tax refunds effectively reduces the tax rate to 5% upon profit distribution.[251] For the following simulation study, we focus on the implementation of the IIR including the substance-based income exclusion. In our model, we do not consider any employment expenses and therefore solely include the 8% asset-based carve-out. In the baseline scenario, we assume that the investment is either financed by a debt-equity mix (see Table 7) or by 100% new equity.

Our main measure in this chapter is the EATR as it is mainly influenced by tax rate changes. Since the global minimum tax leads to an increase in the tax rate, this measure is best suitable

[249] See Appendix 23 for an overview of the results.
[250] The number of countries most probably affected by the global minimum tax does not change when also taking into account non-profit taxes and existing ACE regimes.
[251] Cassar Torregiani 2023, chapter 6.1.2. et seq.

to interpret the effects of Pillar 2.[252] The EATRs for the baseline scenario, i.e., considering the current tax regulations in the aforementioned countries, are presented in Figure 11. For both financing cases, the EATRs increase in all sample countries through the application of Pillar 2. The increases range from 1.59 pp. (Ireland) to 8.14 pp. (Malta) under the financing mix. Compared to the pure equity financing case, the absolute EATRs of the financing mix in all countries, except Malta, are marginally lower both in the status quo setting and after the implementation of Pillar 2. This is caused by the deductibility of interest payments from the tax base. However, the generous ACE in Malta causes that its EATR under pure equity financing is lower than under the financing mix. In general, the effect of Pillar 2 on the EATR is larger in all countries under new equity financing. In this scenario, the increase in the EATR through the implementation of Pillar 2 ranges from 1.71 pp. (Ireland) to 10.96 pp. (Malta). Due to the very low EATR under the current tax system in Malta, the rising effect of Pillar 2 is high. On the other hand, the EATRs in the remaining countries increase only moderately since their combined corporate income tax rates are relatively close to the threshold of 15%.

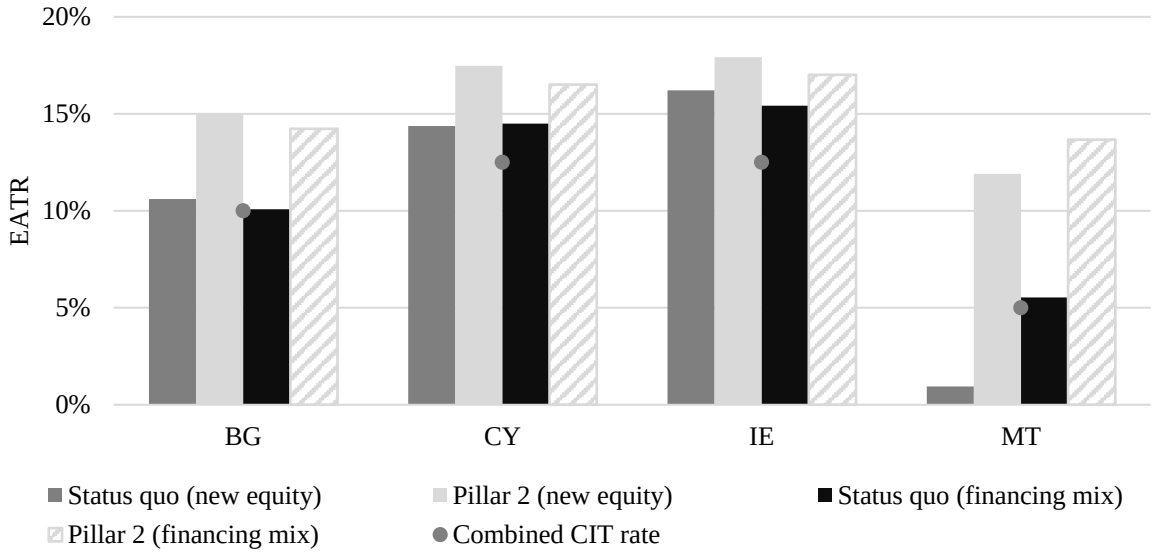
Overall, the increase in the EATR leads to a decrease in the location attractiveness of the sample countries relative to their current tax systems. Our results show that the EATRs of low-tax countries approach the effective tax burden in countries not affected by Pillar 2. However, the EATR as a measure of location attractiveness only builds on the tax burden, and does not consider other tax factors (e.g., complexity of the national tax code) and non-tax factors (e.g., availability of employees from the national labour market).

To test for robustness, we include the reduced substance-based income exclusion of 5%, which is reached after 10 years. As the substance-based carve-out is not dependent on the source of financing, we expect the EATRs to increase throughout all financing scenarios. The increase is triggered as the carve-out intends to exclude certain income from the scope of the minimum tax. Thus, a smaller relative amount of income is taxed under the regular low-tax regime in the specific state. Hence, the decreasing effect of the carve-out is reduced leading to a higher EATR.

Considering the actual results displayed in Figure 12, the EATRs increase for all financing scenarios in all four sample states, when the reduced carve-out of 5% compared to the 8% carve-out is applied. The reduction effect of the EATRs ranges from -0.29 pp. (Bulgaria) to -1.16 pp. (Malta) under financing mix and new equity.

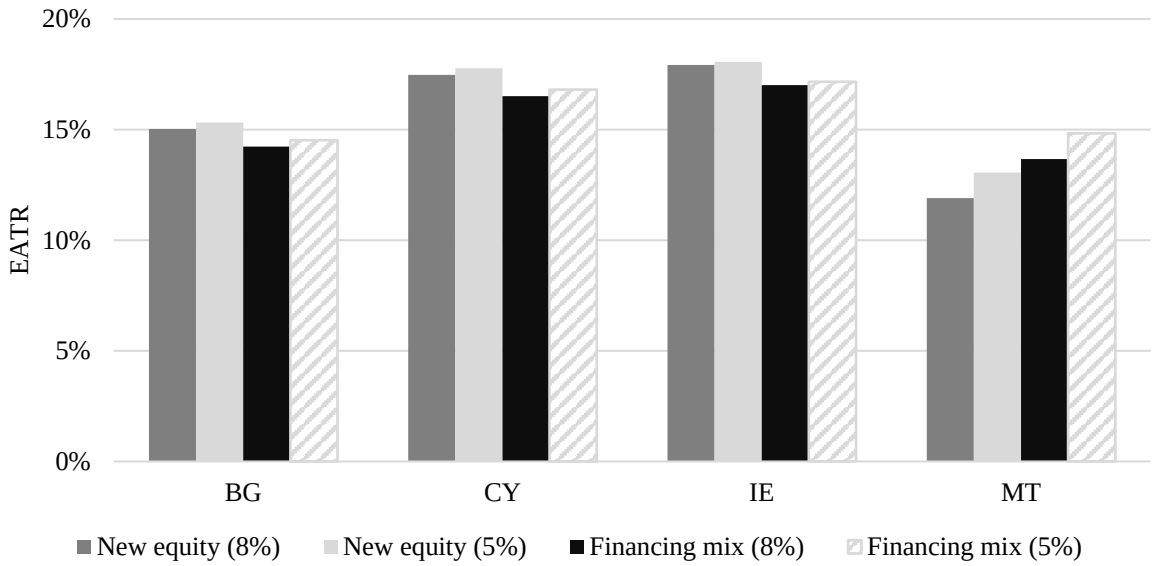
[252] As the CoC is primarily driven by income tax base regulations and non-income taxes, this metric is not as meaningful as the EATR for the analysis of the effect of Pillar 2. Nevertheless, the results for the effect on the CoC are shown in Appendix 24 and Appendix 25.

Figure 11: EATRs under status quo and Pillar 2 (2022)



Notes: The figure compares the EATRs under the status quo and under the application of Pillar 2 (light grey coloured and dashed bars). Moreover, it distinguishes between different sources of financing, either 100% new equity financing (grey coloured bars) or mixed financing sources (black coloured and light grey dashed bars). The grey dots indicate the combined CIT rate that reasons the application of Pillar 2 in the displayed EU Member States. In Malta, we assume that profits are distributed, and shareholders claim a tax refund, resulting in a combined income tax burden of 5%.
Source: Own calculation and illustration.

Figure 12: EATRs under Pillar 2 with 8% and 5% carve-out (2022)

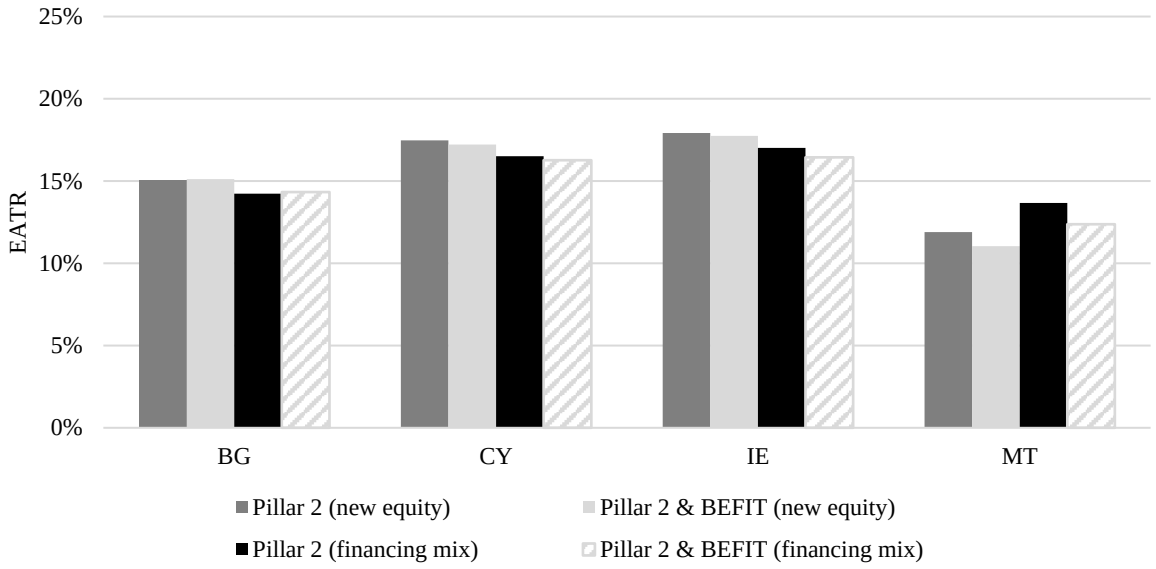


Notes: The figure compares the EATRs under the application of Pillar 2 including the 8% carve-out and the 5% carve-out (light coloured/dashed bars). Moreover, it distinguishes between different sources of financing, either 100% new equity financing (dark and light grey coloured bars) or mixed financing sources (black coloured and light grey dashed bars). In Malta, we assume that profits are distributed, and shareholders claim a tax refund, resulting in a combined income tax burden of 5%.
Source: Own calculation and illustration.

4.3.3.2 Scenario BEFIT's common tax base

In the following, we incorporate the BEFIT's common tax base for our Pillar 2 sample based on the assumptions outlined in Section 4.3.1. As the pure effect of a common tax base on the CoC and EATRs has already been investigated in Section 4.3.2.2, we focus on the interaction effect of a BEFIT's common tax base and Pillar 2 on the EU Member States' EATRs.[253] In Figure 13 the EATRs after the application of Pillar 2 are displayed and compared with the results under the national tax base (Figure 11) with those under the BEFIT's common tax base. As the EATR is primarily driven by income tax rates, the introduction of a common tax base has only minor impact on the effect of Pillar 2. Thus, compared to the EATRs for Pillar 2 under the national tax base, the change in EATRs by including BEFIT's common tax base ranges from -0.86 pp. (Malta) to 0.09 (Bulgaria) for the new equity scenario. Due to the deductibility of interest payments, the absolute EATRs are marginally lower in the financing mix scenario. Overall, the effect of implementing Pillar 2 is very similar under both tax base definitions: Under the national (BEFIT's common) tax base, the increase of the EATRs range from 1.71 pp. (1.53 pp.) in Ireland to 10.96 pp. (10.10 pp.) in Malta for the new equity scenario. For the financing mix scenario, the change in EATRs ranges from 1.59 pp. (1.02 pp.) in Ireland to 8.14 pp. (6.84 pp.) in Malta.

Figure 13: Interaction of Pillar 2 and BEFIT (2022)



Notes: The figure compares the EATRs under the application of Pillar 2 and under additional introduction of BEFIT's common tax base (light grey coloured and dashed bars). Moreover, we distinguish different sources of financing, either 100% new equity financing (dark grey and light grey bars) or mixed financing sources (black and dashed grey bars). BEFIT's common tax base assumes straight-line depreciation of buildings (28 years), machinery (7 years), and intangibles (5 years). Financial assets are not subject to depreciation. For inventories the weighted average cost method is applied.
Source: Own calculation and illustration.

[253] For the effect on the CoC, see Appendix 25.

4.3.4 Interaction of DEBRA and Pillar 2

After examining the effects of the two regulations separately, we consider the interaction effect between DEBRA and Pillar 2 measured by the EATR[254]. Both regulations can only apply to companies with an annual consolidated revenue above 750 Mio. EUR, i.e., companies within the scope of Pillar 2. All other companies are only affected by DEBRA and the results from Section 4.3.2 hold. In our analysis, we also include a variant of the results that includes the common tax base. For reasons of comparability, we assume 100% new equity financing for all calculations.[255]

In the following, we examine the interaction between Pillar 2 and DEBRA. Table 8 shows the EATRs for the status quo, Pillar 2, DEBRA, and the interaction scenario as well as the difference to the status quo. For the interaction part, our sample consists of the four countries for which the combined tax rate is below 15% (see Section 4.3.3).[256]

For Bulgaria and Ireland, the interaction of both measures leads to EATRs that lie between the sole application of DEBRA and Pillar 2. However, for Cyprus and Malta, the EATRs are higher in the interaction scenario than in the Pillar 2 scenario. This is due to the ACE currently available in both countries, as they are more generous than the allowance under DEBRA. Overall, the effect of Pillar 2 predominates since the EATRs in the interaction scenario are much closer to the Pillar 2 scenario than to the DEBRA scenario. Thus, the effect of DEBRA is reversed to a certain extent by the application of Pillar 2. Finally, compared to the status quo, under the two new regulations the effective tax burden increases in all countries. These countries have a relatively high combined tax rate compared to the remaining countries. Thus, the tax-reducing effect of DEBRAs' ACE outweighs the effect of the Pillar 2 top-up tax. Therefore, in Pillar 2 applying Member States DEBRA cannot lead to its politically intended effects.[257] However, overall, DEBRA and Pillar 2 result in more harmonised EATRs in the EU.

[254] For the CoC results see Appendix 26 and Appendix 27.
[255] The change from a financing mix to 100% new equity financing under DEBRA strengthens the effect of the ACE and eliminates the effect of the interest deduction limitation. As a result, the DEBRA EATRs are lower for the 100% equity financing than for the financing mix.
[256] It should be noted that in countries that have nominal tax rates very close to 15% i.e., Croatia (18%), Lithuania (15%), or Romania (16%), the introduction of DEBRA could result in an ETR below 15% triggering the application of Pillar 2. Due to methodological boundaries, we do not model this scenario in our simulation study.
[257] Hence, DEBRA is not a policy measure that should impact the EU-wide tax base but can be far more targeted through unilateral action.

Table 8: Interaction of DEBRA and Pillar 2 (national tax base)

Country	Status quo	DEBRA		Pillar 2		Interaction	
	EATR	EATR	Δ in pp.	EATR	Δ in pp.	EATR	Δ in pp.
BG	10.61%	8.60%	-2.01	15.03%	4.42	14.22%	3.61
CY	14.37%	14.62%	0.25	17.47%	3.10	17.85%	3.48
IE	16.21%	13.70%	-2.51	17.92%	1.71	16.91%	0.70
MT	0.94%	2.36%	1.42	11.90%	10.96	12.40%	11.46

Notes: The table displays the EATRs for the status quo, under application of DEBRA and Pillar 2, and the interaction, i.e., simultaneous application of DEBRA and Pillar 2. For all scenarios 100% new equity financing is assumed to secure comparability. The columns named 'Δ in pp.' show the difference between the countries' CoC of the column-specific scenario and the respective CoC for the status quo.
Source: Own calculation and illustration.

In Table 9, we moreover implement a common tax base in all countries. Comparing the results displayed in Table 8 with the ones in Table 9, we observe that the common tax base results in an increase in the EATRs of less than 1 pp. for all scenarios. Moreover, the direction and the magnitude of the effects are similar to those under non-harmonised tax bases. Thus, the interaction between DEBRA and Pillar 2 is also only marginally affected by a small increase in EATRs, yielding results similar to those in Table 8. Nonetheless, it should be noted that the results presented depend on the specific design of the common tax base and alternative designs could change the EATRs by different amounts and in the opposite direction.

Table 9: Interaction of DEBRA and Pillar 2 (BEFIT's common tax base)

Country	Status quo	DEBRA		Pillar 2		Interaction	
	EATR	EATR	Δ in pp.	EATR	Δ in pp.	EATR	Δ in pp.
BG	10.67%	8.67%	-2.00	15.12%	4.45	14.51%	3.84
CY	14.17%	14.42%	0.25	17.22%	3.05	17.41%	3.24
IE	16.06%	13.56%	-2.50	17.74%	1.68	16.73%	0.67
MT	-0.02%	1.39%	1.41	11.04%	11.06	11.54%	11.56

Notes: The table displays the EATRs for the status quo, under application of DEBRA and Pillar 2, and the interaction, i.e., simultaneous application of DEBRA and Pillar 2. For all scenarios 100% new equity financing, and the application of BEFIT's common tax are assumed. The common tax base assumes straight-line depreciation of buildings (28 years), machinery (7 years) and intangibles (5 years). Financial assets are not subject to depreciation. For inventories the weighted average cost method is applied. The columns named 'Δ in pp.' show the difference between the countries' EATR of the column-specific scenario and the respective EATR for the status quo.
Source: Own calculation and illustration.

4.4 Concluding remarks

In this simulation study, we examine the effects of DEBRA and Pillar 2 in quantitative terms. Moreover, we include the interaction effects between the two directives and with a common tax base reflecting the BEFIT initiative by the EU Commission. To measure the effects, we apply the well-established Devereux/Griffith methodology and calculate the CoC and EATR before and after a (potential) implementation of DEBRA and Pillar 2.

First, our quantitative analysis of DEBRA shows that in general the CoC and EATRs of the sample countries are increased by the interest deduction limitation and reduced by the ACE. Combining both policy measures leads to a net decrease of the CoC and EATRs. The net decrease in CoC indicates a higher attractiveness of corporate investment compared to an alternative investment. Correspondingly, the net decrease of the EATRs suggests a higher location attractiveness from a tax perspective. The opposite outcome can be observed for Cyprus, Malta, and Portugal as their national ACEs are more generous than DEBRA's. Hence, in these states the equity financing becomes less attractive in terms of taxation. These results are robust to variations in interest rates. We also replace the euro-specific interest rate with currency-specific interest rates. When the currency-specific interest rates are higher than the euro-specific interest rate, the CoC and EATRs are again lower than under the euro-specific interest rate. When interacting BEFIT's common tax base with DEBRA, the effects of a pure application of BEFIT influence the joint outcome. Thus, the CoC and EATRs are either further decreased or increased based on the compared to the national tax burden.

Second, considering the implementation of Pillar 2 in our simulation study, only four EU Member States, i.e., Bulgaria, Cyprus, Ireland, and Malta, are included in our sample since they have a combined corporate tax rate below 15%. Our quantitative assessment of Pillar 2 builds on the EATR to measure the tax rate effects. The introduction of Pillar 2 increases the EATRs for all sample states as politically intended, and this effect holds for both the new equity financing and financing mix scenarios. However, the average effect is larger for the new equity scenario. The EATRs under Pillar 2 only marginally increase in all sample countries through the application of a common tax base. Hence, the effect of implementing Pillar 2 is comparable under both tax base definitions. Overall, the increase of EATRs under Pillar 2 results in a reduced location attractiveness of the sample states from a tax perspective.

Finally, in the interaction scenario we show the results for a simultaneous application of DEBRA, Pillar 2 and BEFIT's common tax base. In our simulation, we find, that the effect of Pillar 2 dominates the impact of DEBRA. Thus, EATRs in the interaction scenario are slightly lower than under the pure application of Pillar 2, but significantly higher than in the DEBRA scenario. When the common tax base is included in the simulation, all EATRs increase by less than 1 pp. Hence, the findings for DEBRA and Pillar 2 still hold and the effect of BEFIT's common tax base is again marginal.

5 Unternehmen im Metaverse – Eine steuerrechtliche Einordnung

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Zusammenfassung: Die technologischen Entwicklungen beeinflussen nicht nur die Geschäftsmodelle von Unternehmen, sondern auch deren steuerrechtliche Behandlung. Insbesondere dem Metaverse wird ein großes wirtschaftliches Potential zugesprochen. Grundsätzlich ist das Metaverse eine digitale Plattform, die auf der Verschmelzung von realem und virtuellem Raum basiert, welche mittels Web 3.0 Technologien und der Nutzung von Virtual-Reality-(VR-)Geräten umgesetzt wird. Kernkomponenten des Metaverse sind dabei die Blockchain-Technologie sowie darauf gespeicherte Non-Fungible-Token (NFTs). Für Unternehmen bieten sich durch das Metaverse vielfältige Möglichkeiten der Wertschöpfung. Der nachfolgende Beitrag ordnet das Metaverse begrifflich ein und analysiert die verschiedenen Geschäftsmodelle anhand von praxisnahen Fallstudien. Anschließend erfolgt eine grundlegende ertragsteuerliche Würdigung der Geschäftsmodelle, wobei neben den allgemeinen steuerrechtlichen Folgen insbesondere die Behandlung von NFTs und Kryptowährungen sowie mögliche steuerliche Reportingpflichten untersucht werden.

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[258] Dieses Kapitel basiert auf dem veröffentlichten Artikel in Steuer und Wirtschaft, siehe Farwick, Müller und Spengel 2023.

5.1 Hintergrund

Die Verschmelzung virtueller Umgebungen mit der realen Welt ist in vielen Bereichen des täglichen Lebens und Wirtschaftens nicht mehr wegzudenken. Schon jetzt ermöglichen virtuelle Kunstausstellungen einer Vielzahl von Personen unabhängig von deren tatsächlichen Aufenthaltsort die Chance, Kunst neu zu erleben. Im Rahmen einer solchen Ausstellung bietet bspw. die Kunsthalle Mannheim in Kooperation mit der metaverse-ähnlichen Anwendung Decentraland den virtuellen Besuch der „CryptoGallery #ONE“ des Künstlers Christoph Faulhaber an.[259] Auch die EU Kommission erkennt die Potentiale des Metaverse, nicht nur für den Kulturbereich, sondern u.a. für die Arbeitswelt und die Medizinforschung in einem offiziellen Statement an.[260] In bestehenden metaverse-ähnlichen Anwendungen werden bereits heute von Unternehmen hohe Umsätze erzielt[261] und auch auf Seiten des Konsumenten wird das wirtschaftliche Potential erkennbar, da sich bereits heute 55% der am Metaverse Interessierten einen Kauf von virtuellen Gütern im Metaverse vorstellen könnten.[262] Daneben befasste sich auch die Finanzrechtsprechung in Deutschland jüngst mit der Umsatzsteuerbarkeit von Geschäftsvorgängen in einer metaverse-ähnlichen Anwendung.[263] Dennoch ist zu erwähnen, dass aufgrund technischer Restriktionen das volle Potential des Metaverse heute noch nicht ausgeschöpft werden kann.[264]

Das Metaverse stellt eine digitale Plattform dar, die konzeptionell auf der Verschmelzung vom physischen mit dem virtuellen Raum basiert[265] und offen sowie dezentral gestaltet werden kann. In seiner eigentlichen (visionären) Form besteht das Metaverse noch nicht,[266] wobei bereits verschiedene privatwirtschaftliche Unternehmen eine Vielzahl von unabhängigen, regelmäßig nicht interoperablen metaverse-ähnlichen Plattformen anbieten.[267] Neben den Unternehmen als Betreibern nutzen auch Dritte diese Plattformen für gewerbliche Aktivitäten. Die steuerrechtliche Behandlung dieser gewerblichen Aktivitäten ist mit einem hohen Maß an Unsicherheit sowohl für die Steuerpflichtigen als auch für den Fiskus behaftet.[268]

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[259] Kunsthalle Mannheim 2023.
[260] Vgl. European Commission 2022c.
[261] So erzielte z.B. Adidas innerhalb des ersten Wochenendes mit einer NFT-Kollektion im Metaverse einen Umsatz von über 43 Mio. USD, vgl. Hernández 2021.
[262] Vgl. Deloitte 2022.
[263] Vgl. BFH 2021.
[264] So bauen u.a. Disney und Facebook die Stellen in ihren Metaverse-Projekten ab.
[265] Vgl. Hackl, Lueth und Di Bartolo 2022; Wagener 2023
[266] Hierfür sind insbesondere technologische Einschränkungen als Ursache anzuführen. Zwar gibt es einige Blockchain-basierte Spiele oder soziale Netzwerke, die sich selbst als Metaverse bezeichnen, diese unterscheiden sich aber fundamental von der Vision des offenen und dezentralen Metaverse.
[267] Vgl. Hierzu auch Ball 2022, 50 et seq. Bisher werden Metaversen von bekannten globalen Software- und Plattformunternehmen (bspw. Apple und Google) sowie anderen Unternehmen (Luxusmarken-, Softwareunternehmen usw.) betrieben. Vgl. Griese 2022. Im Folgenden wird aus Lesbarkeitsgründen der Singular Metaverse verwendet.
[268] Bspw. adressiert die OECD die besonderen Implikationen der digitalen Wirtschaft für die Steuersysteme bereits seit dem Jahr 2015 im Rahmen des Base Erosion and Profit Shifting Projekts. Vgl. OECD 2015c, 9

Der nachfolgende Beitrag gibt eine erste ertragsteuerrechtliche Einordnung von gewerblicher Aktivität im Metaverse. Sowohl in der praktischen als auch wissenschaftlichen Literatur mangelt es an einer ebensolchen Analyse.[269]

Kapitel 5.2 erläutert und ordnet zunächst den Begriff des Metaverse sowie die dazugehörigen Technologien ein. Anschließend werden in Kapitel 5.3 die verschiedenen Formen der Geschäftsmodelle und deren Wertschöpfung im Metaverse anhand von Fallstudien dargestellt. In Kapitel 5.4 erfolgt die ertragsteuerliche Einordnung ebendieser Geschäftsmodelle. Die ertragsteuerrechtliche Einordnung fokussiert insbesondere die steuerrechtliche Behandlung von NFTs sowie Kryptowährungen, welche eine grundlegende Bedeutung für fast alle Geschäftsmodelle besitzen. Darüber hinaus werden auch mögliche steuerliche Reportingpflichten für beteiligte Parteien analysiert. Kapitel 5.5 schließt mit einem Fazit.

5.2 Begriffsdefinition Metaverse

Für eine folgerichtige ertragsteuerliche Einordnung ist das Metaverse zunächst begrifflich abzugrenzen. Es mangelt derzeit an einer abgeschlossenen und einheitlichen Definition.[270] Daher werden im Folgenden neben den Charakteristika der derzeit existierenden metaverse-ähnlichen Plattformen auch die visionären Ansätze eines einheitlichen Metaverse dargestellt und zusammenfassend gegenübergestellt (vgl. Table 10).

Grundsätzlich bildet das Metaverse einen virtuellen Raum ab, der auf die Verschmelzung und somit wechselseitige Beziehung zwischen der digitalen und realen Welt abzielt. Figure 14: Grundlegender Aufbau des Metaverse14 zeigt den konzeptionellen Aufbau des Metaverse. Die Partizipation der Nutzer im Metaverse erfolgt über personalisierte, kontrollierbare und reaktionsfähige Avatare,[271] die juristisch als zentrales Zurechnungsobjekt angesehen werden können.[272] Durch die Verschmelzung können gewöhnliche physische Objekte ein virtuelles Gegenstück im virtuellen Raum erhalten, wie bspw. reale Schuhe, die auch virtuell von einem Avatar im Metaverse getragen werden können. Zudem können digitale Zwillinge (*digital twins*) von realen Objekten, z.B. Produktionsmaschinen, im Metaverse integriert und dort benutzt werden. Andererseits besteht die Möglichkeit virtuelle Objekte mittels Augmented-Reality- (AR)-Anwendungen in die reale Umgebung der Nutzer einzublenden. Bereits seit einigen Jahren bietet bspw. Google die Möglichkeit, dass verschiedene 3D-Objekte (z.B. Haustiere) realitätsgetreu

[269] Für eine erste ertragsteuerliche Einordnung eines Sachverhalts im Metaverse mit ausschließlich zwei Akteuren Lüdenbach 2023a; Lüdenbach 2023b.
[270] Vgl. Ball 2022, 33; Weinberger 2022.
[271] Vgl. Yang et al. 2022, 128.
[272] Vgl. Kaulartz, Schmid und Müller-Eising 2022, 524.

über die Handykamera in die erfasste Umgebung eingeblendet werden können (sog. AR-Suche).[273]

Table 10: Unterschiede heutiges und zukünftiges Metaverse

Nr.	Eigenschaft	Aktuelle metaverse-basierte Plattformen	Zukünftiges Metaverse
(1)	Nutzung von AR/VR-Endgeräten	Maximal optional	Obligatorisch
(2)	Einmaligkeit von Gütern	Keine 100%ige Sicherheit, da verschiedene Blockchains	Sichergestellt, da einheitliche Blockchain (DLT)
(3)	Prozesse in Echtzeit und synchron für unbegrenzte Nutzeranzahl	Technologisch begrenzt; nur für eine begrenzte Nutzeranzahl synchron abbildbar	Technologisch unbegrenzt
(4)	Organisation und Entwicklung	(Überwiegend) zentral Unternehmen, Plattformanbieter	Dezentral Vielzahl von regelmäßig unabhängigen Beteiligten
(5)	Interoperabilität von Netzwerken (Offenheit)	Sehr eingeschränkt	Uneingeschränkt
(6)	Währung	Plattformeigene oder an Börsen gehandelte Kryptowährungen	Im Metaverse einheitliche Kryptowährung

Information: Die Tabelle stellt charakteristische Eigenschaften des Metaverse dar. Dabei werden die Unterschiede zwischen den aktuell bereits existierenden metaverse-basierten Plattformen und dem in Zukunft geplanten Metaverse gegenübergestellt.
Quelle: Eigene Darstellung.

Das Metaverse bedient sich der sogenannten Web 3.0 Technologie, deren zugrundeliegende Idee eines immersiven Erlebnisses sich dem Metaverse überschneidet.[274] Zentrale Komponente für das Metaverse und die darin stattfindenden Transaktionen bildet die Blockchain, die einen Anwendungsbereich der Distributed-Ledger-Technologie (DLT) darstellt.[275] Bezüglich der Hardware sollen AR- und/oder Virtual-Reality-(VR)-Systeme die beabsichtige Verschmelzung von realer Welt und virtueller Realitäten in 3D inklusive virtueller Güter als Non-Fungible Token (NFT), die ebenfalls auf der Blockchain gestützt sind, umsetzen. So werden bereits heute (z.B. im Decentraland) VR-Endgeräte eingesetzt, um eine realitätsnahe Wahrnehmung zu erreichen mit der sich die Nutzer durch das Metaverse bewegen. Im zukünftigen Metaverse (vgl. Table 10) ist der Einsatz von AR- oder VR-Geräten obligatorisch (1). Bei den NFTs handelt es sich um nicht austauschbare kryptografische Token, d.h. einmalige und einzigartige virtuelle Güter, die einen eindeutigen Eigentümernachweis an (virtuellen) Referenzobjekten beinhalten können.[276] Technisch betrachtet ist der ‚Eigentümer' des NFT auf der Blockchain als

[273] Siehe hierzu Google 2023.
[274] Die Web 3.0 Technologie zeichnet sich u.a. durch Dezentralisierung, Künstliche Intelligenz, Blockchain und Konnektivität aus. Für eine ausführlich Erläuterung vgl. Hackl, Lueth und Di Bartolo 2022, 14 et seq.
[275] Vgl. BMF 2022, no. 6.
[276] Vgl. Völkle 2021, 542.

sogenannter *owner* eingetragen und kann mittels seines *private key* sowie dem zugrunde liegenden *smart contract* über den NFT verfügen.[277] Der *smart contract* ist kein Vertrag im rechtlichen Sinne, sondern ein Softwarecode mit Befehlsketten (insbesondere Wenn-Dann-Bedingungen), über welchen eine manipulationssichere (unveränderbare) Transaktion auf der Blockchain erstellt werden kann.[278] Durch Interaktion mit dem *smart contract* wird der NFT (*minting*) erzeugt und ermöglicht eine spätere Übertragung.[279]

Im Folgenden bildet der NFT, vereinfacht gesprochen, ein Referenzobjekt (d.h. ein (im-)materielles Wirtschaftsgut) und die damit verbundenen Rechten und Pflichten ab.[280] Eine Vervielfältigung des NFTs, d.h. des zugrundliegenden Tokens selbst, ist nicht möglich.[281] Derzeit kann allerdings durch den Einsatz von verschiedenen Blockchains noch nicht sichergestellt werden, dass das zugrundeliegende Referenzobjekt nur einmal verkauft wird. Demzufolge könnte ein Referenzobjekt auf verschiedenen Blockchains mehrfach verkauft werden.[282] Zukünftig soll daher eine einheitliche Blockchain oder ein einheitliches DLT-System im Metaverse eingesetzt werden (2). Daneben bilden auch Cloud Computing und 5G-fähige Mobilfunknetze wichtige Grundlagen zur Umsetzung.[283]

Für die Verschmelzung beider Welten ist neben VR- und AR-Anwendungen erforderlich, dass die Prozesse im Metaverse in Echtzeit und synchron bei einer unbegrenzten Anzahl von Nutzern abgebildet werden.[284] Bspw. müssen Musikkonzerte inklusive Ton, Bild und Verhalten anderer Avatare bei allen Nutzern identisch und in Echtzeit auf dem Endgerät abgebildet werden. Hierbei bestehen heute noch technische Restriktionen, die in Zukunft durch technologische Innovationen ausgeräumt werden sollen (3).[285]

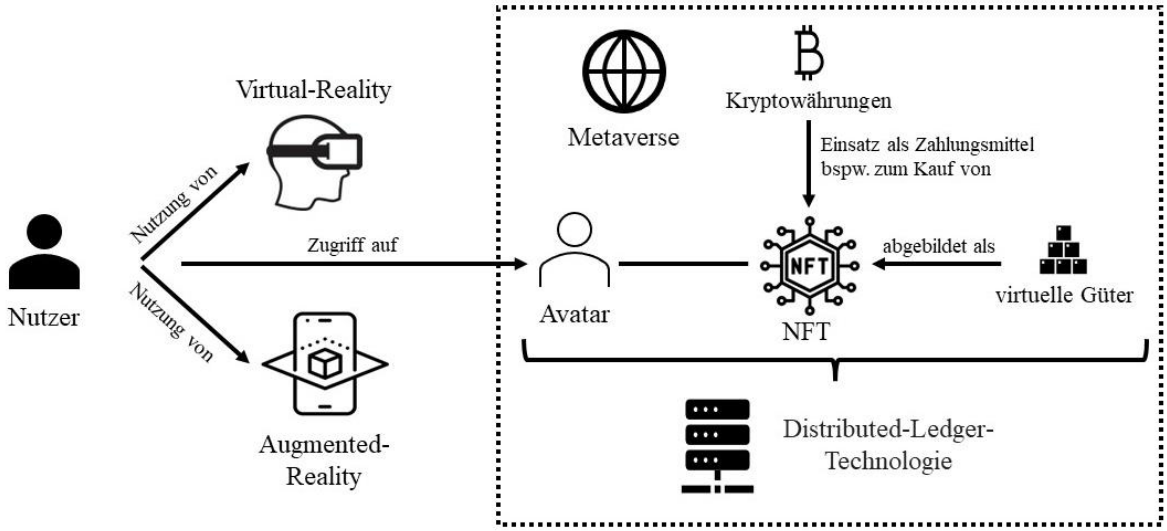
Das zukünftige Metaverse zeichnet sich insbesondere durch die Eigenschaften Dezentralität und Offenheit aus, die derzeit existierende metaverse-ähnliche Plattformen noch nicht vollständig umsetzen. Die Dezentralität des Metaverse wird dadurch definiert, dass verschiedene Personengruppen und Unternehmen das Metaverse aufbauen, weiterentwickeln und organisieren. Eine Bündelung von Marktmacht einzelner großer Plattformanbieter soll somit vermieden werden.[286] Derzeit werden metaverse-ähnliche Plattformen von einzelnen gewinnorientierten,

[277] Vgl. Heine und Stang 2021, 757.
[278] Vgl. Heine und Stang 2021, 756; Richter 2022, 3470; Frick 2023, 344.
[279] Vgl. Schaden, Wagner und Zawodsky 2022, 153; Frick 2023, 344.
[280] Ausführlich vgl. dazu auch Bruns, Helbig und Hassa 2022, 155 et seq.
[281] Vgl. Link 2022, 1706; Frick 2023, 344.
[282] Vgl. Wagener 2023.
[283] Vgl. Hackl, Lueth und Di Bartolo 2022, 8 et seq.
[284] Vgl. Ball 2022, 61 et seq.
[285] Für eine ausführliche Darstellung der technischen Restriktionen vgl. Ball 2022, 49 et seq.
[286] Vgl. Cao 2022, 6 et seq.; Wagener 2023.

privatwirtschaftlichen Unternehmen betrieben (4).[287] Neben dieser Dezentralisierung der Organisation erfordert die Offenheit des Metaverse, dass das Netzwerk interoperabel sein muss. Demnach müssen Nutzer die eigenen Avatare und Objekte von einer in die andere Umgebung mitnehmen und entsprechend benutzen können.[288] Bei derzeit verfügbaren metaverse-ähnlichen Plattformen ist dies nicht immer möglich (5).

Hervorzuheben ist, dass sich im Metaverse laut Literaturmeinungen eine vollumfängliche und funktionsfähige Wirtschaft etablieren wird.[289] Technisch betrachtet, vereint und erweitert das Metaverse u.a. Komponenten von Transaktionsplattformen (z.B. Amazon, Ebay), sozialen Netzwerken (z.B. Facebook, Instagram) und Online-Multiplayer-Spielen (z.B. Animal Crossing, Fortnite). Zur Bezahlung werden derzeit regelmäßig an Börsen gehandelte oder plattformeigene Kryptowährungen verwendet. Hierbei ist es zunächst notwendig mittels gesetzlicher Währung ein virtuelles Guthaben (d.h. Einheiten einer Kryptowährung) zu erwerben.[290] In Zukunft wird eine einheitliche Kryptowährung, ähnlich wie gesetzliche Währung derzeit, als Zahlungsmittel im Metaverse angestrebt (6).

Figure 14: Grundlegender Aufbau des Metaverse



Information: Die Abbildung stellt vereinfacht den grundlegenden Aufbau des Metaverse dar. Der Nutzer setzt VR- und/oder AR-Systeme ein, um auf den Avatar im Metaverse zuzugreifen. Der gestrichelte Kasten grenzt symbolisch das Metaverse von der realen Umgebung ab. Innerhalb des Metaverse, d.h. im gestrichelten Kasten, sind neben den Avatar auch NFTs sowie Kryptowährungen vorhanden, die allesamt auf der DLT beruhen. Die virtuellen Güter, welche mittels Kryptowährungen als Zahlungsmittel erworben werden können, sind dabei als NFT abgebildet.
Quelle: Eigene Darstellung.

[287] Eine Ausnahme bildet Decentraland, die bereits heute mittels der „Decentralized Autonomous Organization" die Dezentralisierung anstreben. Vgl. hierzu Decentraland 2023.
[288] Vgl. Ball 2022, 50 et seq.
[289] Vgl. Hackl, Lueth und Di Bartolo 2022, 25 et seq.; Yang et al. 2022, 123.
[290] Vgl. Yang et al. 2022, 125 mit Beispielen.

5.3 Geschäftsmodelle und Wertschöpfung im Metaverse

Die Geschäftsmodelle im Metaverse sind eine Fortentwicklung der reinen Plattformökonomie, die sich den bestehenden Geschäftsmodellen wie Werbefinanzierung, Abonnement- und Transaktions-Modellen sowie Reward-Systemen bedienen.[291] Im Metaverse werden neue plattformbasierte Monetarisierungssysteme ergänzt, die ähnlich wie bei Onlinespielen z.B. mit Kryptowährungen ausgestaltet sein können.[292] Daneben können Unternehmen bspw. auch ihre Finanzierung durch den Verkauf von NFTs über das Metaverse sichern.[293] Im Folgenden werden exemplarisch verschiedene Geschäftsmodelle im Metaverse identifiziert und näher erläutert.[294] Aufgrund der rapiden technologischen Entwicklungen kann diese Darstellung an dieser Stelle freilich nicht abschließend sein.

Nachfolgende Tabelle zeigt die verschiedenen Möglichkeiten der Wertschöpfung auf sowie die dazugehörigen als Nutzergruppen gruppierten Branchen, die sich aus den jeweiligen Einsatzbereichen des Metaverse ergeben.

Table 11: (Potentielle) Wertschöpfung im Metaverse nach Branchen

Wertschöpfung durch	Entwicklung neuer Geschäftsmodelle	Verschmelzung von Geschäftsmodellen und Nutzung Digital Twin	Nutzung bestehender (Transaktions-) Plattform
Branchen	Forschung Industrie 5.0	Öffentlicher Sektor Bau-/Immobiliengewerbe Berufliche Bildung Kultur-/Veranstaltungsbereich Finanzwesen Sport-/Fitnessbranche	Soziale Netzwerke Onlinehandel Marketing Gaming

Information: Die Tabelle zeigt die verschiedenen Arten der Wertschöpfung im Metaverse in der ersten Zelle auf. Diesen Wertschöpfungsarten werden in der zweiten Spalte die jeweiligen Branchen zugeordnet.
Quelle: Eigene Darstellung in Anlehnung an Bitkom 2022, 23.

5.3.1 Onlinehandel

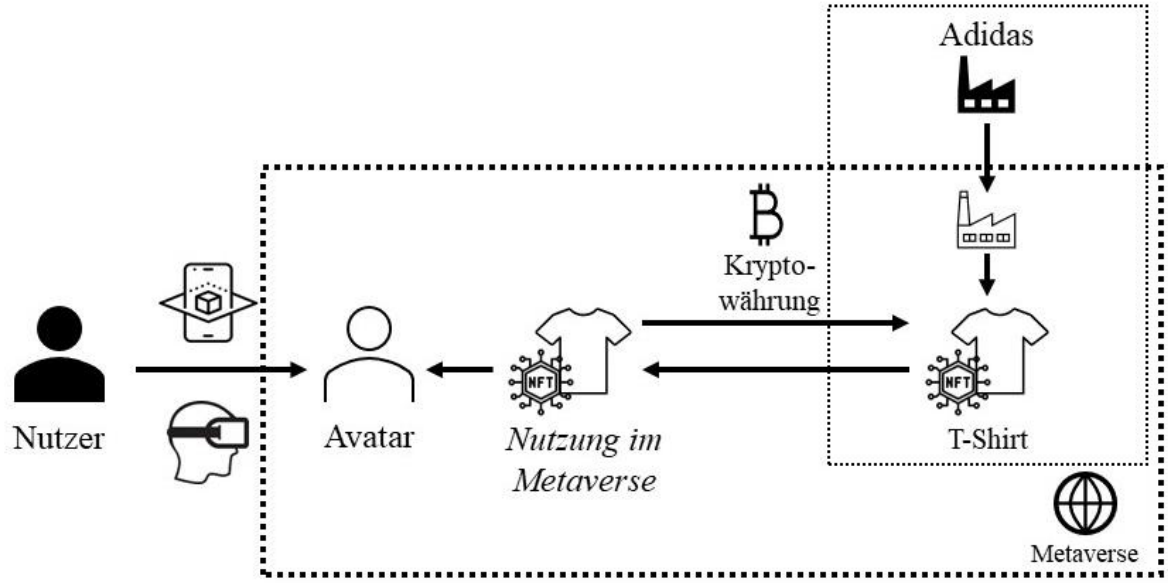
Variante 1: Virtuelle Güter und Dienstleistungen

Zunächst kann das Metaverse als Transaktionsplattform des Onlinehandels genutzt werden. So sind über das Metaverse virtuelle Transaktionen möglich, bei denen NFTs gehandelt werden, wobei die zugrundliegenden Referenzobjekte ebenfalls virtuelle Güter oder Dienstleistungen sind, die außerhalb des Metaverse nicht verwendet werden können. So bot bspw. Adidas NFTs

[291] Vgl. Bitkom 2022, 23.
[292] Vgl. Bitkom 2022, 23.
[293] So wurde bspw. eine Brauerei mittels der Ausgabe von Genussscheinen als NFTs finanziert, vgl. hierzu Metabrew Society 2023.
[294] Folgende Ausführungen in Anlehnung an Bitkom 2022.

in ihrer „Into the Metaverse“-Kollektion an, die virtuelle Oberbekleidung und Sneaker umfasst.[295] Das Vorgehen von Unternehmen wie Adidas ist in nachfolgender Abbildung exemplarisch dargestellt:

Figure 15: Geschäftsmodell Onlinehandel mit rein virtuellen Gütern



Information: Die Abbildung stellt vereinfacht das Geschäftsmodell des Onlinehandels mit rein virtuellen Gütern im Metaverse (gestrichelter Kasten) dar. Der Nutzer greift von der realen Welt auf den Avatar im Metaverse mittels AR- bzw. VR-Technologie zu. Von einem realen Unternehmen kann der Nutzer mittels des Avatars im Metaverse ein T-Shirt erwerben. Als Zahlungsmittel wird dabei Kryptowährung verwendet. Die Nutzung des T-Shirts ist allerdings auf die Metaverse-Umgebung beschränkt.
Quelle: Eigene Darstellung.

Die dick gestrichelte Linie grenzt hierbei den Bereich des Metaverse von der realen Welt ab, wobei der Nutzer AR- oder VR-Technologie nutzt. Die realen Subjekte, d.h. der Nutzer und das Unternehmen Adidas, sind durch Avatare im Metaverse abgebildet. Hierbei wird das virtuelle T-Shirt (Referenzobjekt) als NFT abgebildet. Gegen Bezahlung von Kryptowährung wird dieses von dem Nutzer erworben. Innerhalb des Metaverse kann das virtuelle T-Shirt vom Avatar des Nutzers dann getragen werden. Die erzielten virtuellen Einnahmen können von Adidas in reale Währung umgetauscht werden. Somit führen diese Transaktionen zu einem ‚realen‘ Wert. Adidas kann die Verkäufe in virtuellen Shops im Metaverse abwickeln, die somit auch der Produktpräsentation dienen können.

Darüber hinaus können auch virtuelle Dienstleistungen angeboten werden, bspw. die Vermietung virtueller Grundstücke im Metaverse. Im Bereich des Gamings besteht heute schon im Rahmen klassischer Aufbauspiele die Möglichkeit, z.B. Pflanzen landwirtschaftlich anzubauen zu lassen und die Ernte zu veräußern. Diese Form der grundstücksbezogenen Leistungen stellt

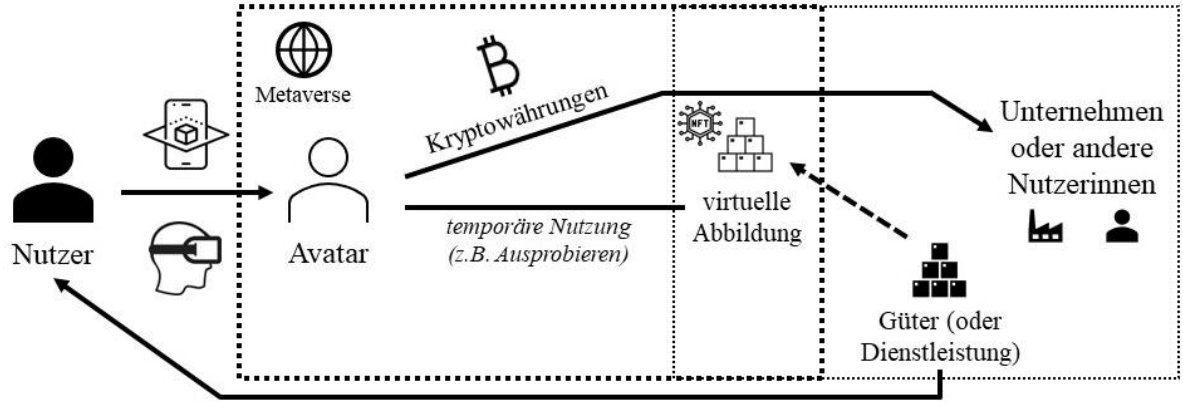
[295] Vgl. Hernández 2021.

wohl das bekannteste Beispiel von gewerblicher Aktivität innerhalb von Onlinespielen dar.[296] Hierbei ist denkbar, dass auch im Metaverse derartige Eigenleistungen zur gewerblichen Aktivität möglich sind.

Variante 2: Nicht-Virtuelle Güter und Dienstleistungen

Neben den rein virtuellen Transaktionen können auch physische Güter und Dienstleistungen als Referenzobjekte innerhalb der Transaktionen verwendet werden. Diese sind ebenfalls als NFT abgebildet. Der Unterschied besteht darin, dass diese Referenzobjekte auch außerhalb des Metaverse eine wirtschaftliche Bedeutung (z.B. in Form von Nutzungsmöglichkeiten) besitzen.

Figure 16: Geschäftsmodell Onlinehandel mit nicht-virtuellen Gütern



Information: Die Abbildung stellt vereinfacht das Geschäftsmodell des Onlinehandels mit nicht-virtuellen Gütern im Metaverse (fett gestrichelter Kasten) dar. Der Nutzer greift von der realen Welt auf den Avatar im Metaverse mittels AR- bzw. VR-Technologie zu. Von einem realen Unternehmen oder anderen Nutzerinnen kann dem Avatar eine virtuelle Abbildung der Güter (oder Dienstleistungen) zur temporären Nutzung zur Verfügung gestellt werden. Bei Zahlung von Kryptowährung an die anbietende Partei wird das reale Gut oder Dienstleistung in der realen Welt erworben.
Quelle: Eigene Darstellung.

Die vorhergehende Abbildung stellt exemplarisch die Struktur eines solchen Geschäftsmodells dar. Bspw. können (physische) Lebensmittel (Referenzobjekte) im Metaverse-Supermarkt bestellt werden, die direkt in der ‚realen' Welt geliefert werden. Hierbei kommt dem Metaverse zunächst die Stellung einer reinen Transaktionsplattform zu, die auf das Zusammenbringen von anbietenden Unternehmen und (potentiellen) Kunden ausgerichtet ist. Auch Dienstleistungen können Grundlage dieser Transaktionen sein, wie die deutsche Kanzlei Gleiss Lutz zeigt. Diese hat ein virtuelles Büro in Decentraland,[297] worüber eine Rechtsberatung für einen ‚realen' Fall in Anspruch genommen werden kann. Insgesamt umfassen die so über das Metaverse abgewickelten Transaktionen regelmäßig auch die Zahlung, da diese mit den (metaverseeigenen) Kryptowährungen abgewickelt werden können.

[296] Vgl. Bitkom 2022, 39.
[297] Vgl. Gleiss Lutz 2023.

Das Metaverse erweitert allerdings die Stellung einer reinen Transaktionsplattform insbesondere dadurch, dass mittels AR und VR realitätsgetreue 3D-Modelle der Güter als Simulation benutzt und betrachtet werden können. Damit wird z.B. das Anprobieren von Kleidung im Geschäft nachgeahmt. Dieses Testen ist in der virtuellen Welt mit geringerem monetärem laufendem Aufwand für die Unternehmen möglich.[298] Im Bereich der Inneneinrichtung können so aber auch Möbelstücke direkt in die eigene Wohnumgebung implementiert werden, was im stationären oder klassischen Onlinehandel nur beschränkt (z.B. in 2D im Ikea Home Planer) möglich ist.

Variante 3: Mischformen

Die vorhergehende Unterscheidung hinsichtlich der Art der Güter und Dienstleistungen bezüglich ihres Bezugs zur realen Welt, kann durch Mischformen durchbrochen werden. Hierbei stehen Geschäftsmodelle im Fokus, die auf eine integrative Nutzung von Referenzobjekten in beiden Welten setzen, d.h. eine Art hybrider NFTs.

In der ersten Variante wird eine Überführung von Referenzobjekten zwischen realer und virtueller Welt ermöglicht. Demnach gibt es bereits erste Ansätze, reale Objekte, insbesondere Kunstwerke und Sammlerstücke, mittels einer 3D-Scan-Technologie als NFT in das Metaverse zu überführen.[299] Die entgegengesetzte Richtung der Überführung wäre bspw. mittels 3D-Druckern denkbar, die virtuelle Referenzobjekte als physische Gegenstände ‚ausdrucken'.[300] In der zweiten Variante werden hybride NFTs angeboten. Dabei wird mit dem Kauf eines NFT (z.B. virtuelles Kunstwerk) gleichzeitig ein physisches Referenzobjekt (z.B. Kunstdruck) erworben.

5.3.2 Werbemodelle

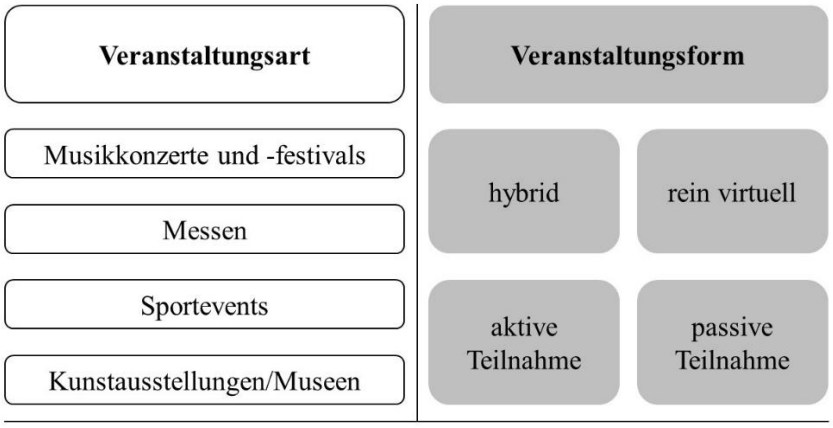
Bereits heute ist der Einsatz von Werbemodellen im Metaverse weitverbreitet und umfasst neben der klassischen (Online-)Werbung auch die Produktplatzierung bzw. Präsentation von Produkten durch Unternehmen. Hierzu nutzen Unternehmen virtuelle Geschäftsräume im Metaverse, um neuste Produkte als virtuelles Gut darzustellen. Dem Nutzer wird dabei die Möglichkeit geboten, diese Produkte zu betrachten und auch testen. Darüber hinaus bietet auch die reine Präsenz von Unternehmen mit virtuellen Räumlichkeiten im Metaverse schon eine Möglichkeit, Werbung für das Unternehmen abzubilden. Neben den unternehmenseigenen Geschäftsräumen kann auch Werbefläche auf Grundstücken von anderen Nutzern oder Unternehmen angemietet werden, die eine Form der grundstücksbezogenen Leistungen darstellen.

[298] Vgl. J.P. Morgan 2022.
[299] Siehe Metahero 2023.
[300] Hierbei wäre aber ein mehrfacher Ausdruck des einzigartigen NFTs möglich.

5.3.3 Unterhaltungserlebnisse

In den letzten Monaten werden vermehrt virtuelle Unterhaltungserlebnisse über das Metaverse abgewickelt, die in der nachfolgenden Abbildung eingeordnet werden. So können verschiedene Veranstaltungsarten (z.B. Messen) in verschiedenen Formen über das Metaverse organisiert werden. Bspw. können neben rein virtuellen Messen auch hybride Ansätze verfolgt werden.

Figure 17: Systematische Einordnung der Unterhaltungserlebnisse



Information: Die Abbildung zeigt eine systematische Einordnung der Unterhaltungserlebnisse im Metaverse auf. In den weißen Kästen (linke Seite) werden verschiedene Veranstaltungsarten präsentiert. Die Veranstaltungsformen (graue Kästen, rechte Seite), können neben der grundlegenden Ausrichtungsweise auf Seiten des Veranstalters auch nach der Art der Beteiligung des Nutzers unterschieden werden.
Quelle: Eigene Darstellung.

Der große Vorteil für Anbieter besteht darin, dass ein nahezu unbegrenztes Publikum mit den Veranstaltungen erreicht werden kann, da keine physischen Begrenzungen (z.B. Größe oder Ort der Veranstaltungslocation) den Kundenkreis im Vergleich zu physischen Veranstaltungen einschränkt. Diese Möglichkeit besteht zwar auch beim reinen Streaming von Veranstaltungen (z.B. Live-Konzerte über YouTube), doch die technische Umsetzung soll mittels ‚lebensnaher' Technologien (wie AR- und VR) sowie Interaktionsmöglichkeiten mit dem restlichen Publikum durch Avatare einer Präsenzveranstaltung ähneln.

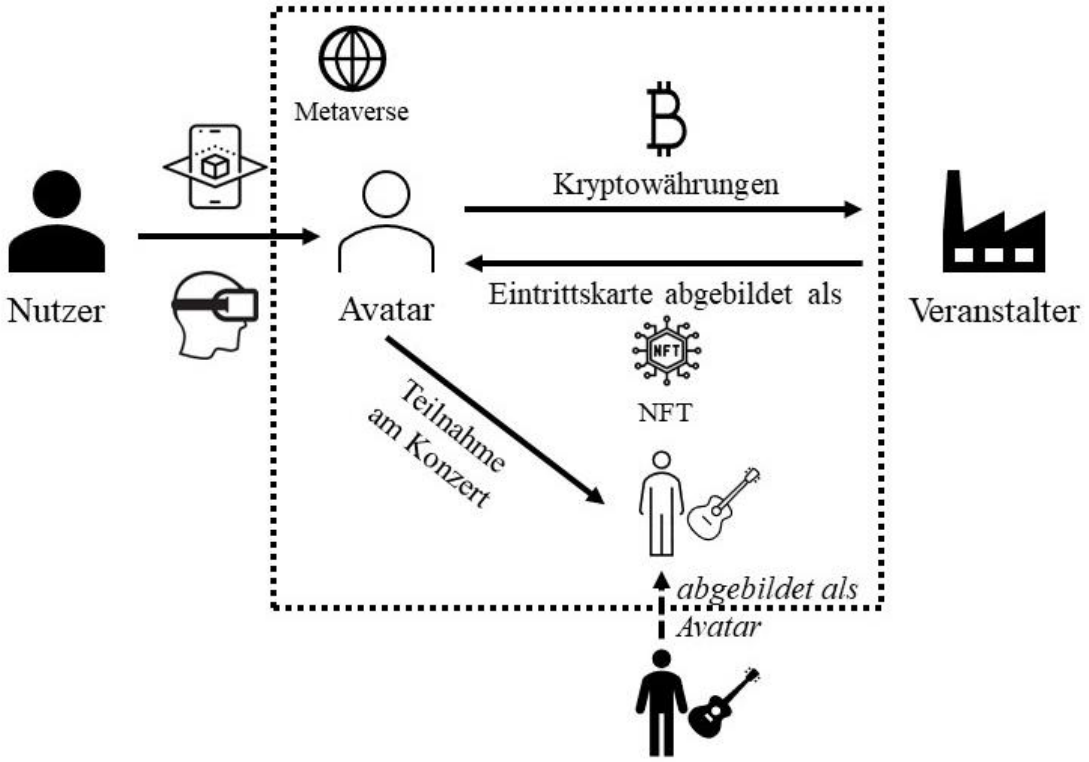
Die konzeptionelle Einordnung der Unterhaltungserlebnisse, in Form eines Musikkonzerts, ist in der nachfolgenden Abbildung (Figure 18) dargestellt. Der Künstler tritt in Form seines Avatars innerhalb des Metaverse auf. Dabei wird die Motion Capture Technik eingesetzt, um seine Bewegungsmuster zu erfassen, die dann auf den virtuellen Avatar übertragen werden. Zudem wird vermehrt an Audiosystemen geforscht, die zu einem immersiven Hörerlebnis führen sollen, was insgesamt zu einem realitätsnahen Musikkonzert im Metaverse führen soll.[301] Die Nutzer erwerben mittels Kryptowährung eindeutig identifizierbare Eintrittskarten vom Veranstalter, die als NFT abgebildet werden. Mittels der NFT-Technologie kann sichergestellt werden,

[301] Vgl. Jin et al. 2022.

dass keine Duplikate der Zugangsberechtigungen erstellt werden können. Wie bei einer Ticketkontrolle auf einem realen Konzert, können so nur Nutzer teilnehmen, die sich für die kostenpflichtige Veranstaltungen durch einen Kauf registriert haben.

Neben der passiven Teilnahme z.B. als Publikum bei einem Musikkonzert, können Nutzer auch aktiv an Veranstaltungen teilnehmen. So können Nutzer aktiv an Disziplinen bei Sportevents teilnehmen und ihre erzielten Leistungen auf ihrem NFT speichern. Mittels der NFTs können somit veranstaltungsbezogene Leistungen aber auch die Teilnahmeinformationen gespeichert werden, die von den Anbietern für Werbezwecke aber auch für Rewardsysteme genutzt werden können. Nimmt ein Nutzer bspw. passiv an einem hybriden Fußballspiel eines Clubs teil, so kann der Club ihm bei regelmäßiger Teilnahme Vergünstigungen über den NFT für reale oder auch hybride Spiele anbieten. Mittels der sichtbaren NFT können diese dann auch eine Art Markenbotschafter für den Club im Metaverse werden.[302]

Figure 18: Geschäftsmodell Unterhaltungserlebnis am Beispiel Musikkonzert



Information: Die Abbildung stellt exemplarisch die Funktionsweise eines Musikkonzerts im Metaverse dar. Dabei werden sowohl der Nutzer als auch der Musiker als Avatar im Metaverse (gestrichelter Kasten) abgebildet. Der reale Veranstalter verkauft als NFT abgebildete Eintrittskarten gegen Zahlung von Kryptowährung im Metaverse. Somit sind die Nutzer-Avatare dann berechtigt am Konzert teilzunehmen.
Quelle: Eigene Darstellung.

[302] Vgl. Bitkom 2022, 39.

5.3.4 Exkurs: New Work Szenarien

Geschäftsmodellübergreifend bestehen für die Wertschöpfung von Unternehmen auch Möglichkeiten, die wichtigste Ressource, das Humankapital, im Metaverse in vielfältiger Weise einzubinden. Insbesondere die Wandlung der Arbeitswelt hin zu Remote-Work[303] kann durch das Metaverse weiterentwickelt werden. Die Arbeit ortsungebunden, also ‚remote' zu verrichten, kann einerseits in Form einer Tätigkeit im Home-Office erfolgen, wobei regelmäßig der Wohnsitz der Arbeitnehmer als Arbeitsort dient. Andererseits kommt auch die Tätigkeit als digitaler Nomade in Frage, wobei der Arbeitnehmer multilokal von verschiedenen Orten (weltweit) arbeitet.[304] Das Metaverse unterstützt diesen Wandel durch virtuelle Unternehmensräumlichkeiten (z.B. Büros), die einen nahtlose Verbindung zwischen den im Unternehmen physisch anwesenden und den remote tätigen Arbeitnehmern schaffen, was über die bisher üblichen Video-Calls hinausgeht. Schon heute können sich Mitarbeiter in interaktiven Meetings im Metaverse treffen, zusammenarbeiten und austauschen.[305]

Neben den 3D-Arbeitsumgebungen können auch 3D-Modelle der Arbeit selbst im Metaverse abgebildet werden: So könnten Städteplaner realitätsnahe Modelle einer neuen Stadtplanung erstellen und diese alleine oder mit einem Team im Metaverse bearbeiten.[306] Zudem kann dieses Konzept auch für die Aus- oder Weiterbildung von Mitarbeitern eingesetzt werden. Es besteht die Möglichkeit Schulungen im Metaverse anzubieten, bei denen bspw. die Maschinenführung für Arbeitnehmer in einem Automobilkonzern virtuell gelehrt und geübt werden kann. Zudem wird das Metaverse bereits heute für das Onboarding neuer Mitarbeiter genutzt, die so auch einen Einblick in die virtuell dargestellten Räumlichkeiten des Unternehmens erhalten.

5.4 Ertragsteuerliche Einordnung der Geschäftsmodelle

Das Metaverse ist als digitale Plattform steuerlich mit existierenden Transaktionsplattformen wie z.B. Amazon vergleichbar. Die nachfolgende Analyse basiert auf den aktuell existierenden metaversebasierten Plattformen, die einem klar identifizierbaren Betreiber (juristische Person) zugerechnet werden können. In diese Plattformen sind gleichzeitig Marktplätze der Betreiber integriert, über die die Transaktionen (z.B. Veräußerungen) abgewickelt werden.[307] Diese Transaktionen erfolgen basierend auf unseren Fallbeispielen zwischen Anbieter (juristische

[303] Vgl. z.B. Franken et al. 2021, 1133.
[304] Vgl. Hannonen 2020, 336.
[305] Z.B. ermöglicht die Anwendung BeamLink von Jingteng Tech ebendiese interaktive Zusammenarbeit von Avataren.
[306] Hierzu z.B. Allam et al. 2022, 773.
[307] Drittanbieter für Marktplätze, der auch in die Plattform integriert wird, ist z.B. Open Sea.

Person) und Nutzer (natürliche Person).[308] Der Anbieter übernimmt stets die Erstellung der NFTs, wobei die Kryptowährungen bereits existieren. Insgesamt wird im Folgenden auf rein inländische Sachverhalte abgestellt.

Der Betreiber erhebt für die Abwicklung der Transaktion wiederum Gebühren vom Anbieter und regelmäßig auch vom Nutzer. Er nimmt dabei die Rolle eines Intermediär ein, der die beiden Transaktionsparteien zusammenbringt, selbst aber grundsätzlich keine Rechte an den von Dritten angebotenen Gütern und Dienstleistungen hat.[309] Der Betreiber vereinnahmt somit Gebühren als gewerbliche Einkünfte (§ 15 EStG), die in Deutschland, wenn die Rechtsform einer Kapitalgesellschaft unterstellt wird, der Körperschaft- und Gewerbesteuer unterliegen. Beim Anbieter stellen die Gebühren abzugsfähige Betriebsausgaben dar. Aus der Transaktion mit dem Nutzer vereinnahmt der Anbieter gewerbliche Einkünfte, die der Körperschaft- und Gewerbesteuer unterworfen werden.

Alle vorhergehend beschriebenen Geschäftsmodelle eint die Verwendung von Kryptowerten, insbesondere NFTs und Kryptowährungen. Die steuerrechtlichen Folgen sind aus Sicht des Anbieters insbesondere von der bilanziellen Behandlung dieser Kryptowerte abhängig, die er dann regelmäßig an den Nutzer veräußert. Demzufolge werden im Folgenden die steuerliche Bilanzierung von NFTs und Kryptowährungen aus Sicht des Anbieters untersucht.

5.4.1 Steuerliche Behandlung von NFTs

Die NFTs stellen nach überwiegender Ansicht zivilrechtlich weder Sachen i.S.d. § 90 BGB noch Rechte dar, was allerdings einer möglichen Aktivierungsfähigkeit als Wirtschaftsgut gem. H 4.2 (1) EStH nicht entgegensteht.[310] Zur Qualifizierung als Wirtschafsgut müssten sie demnach der Handelsbilanz folgend selbstständig verwertbar sein, d.h. dem Betrieb einen Vorteil einbringen.[311] Dies ist in den dargestellten Geschäftsmodellen durch die Monetarisierung der NFTs[312] gegeben (z.B. Veräußerung über digitale Handelsplattformen). Die Bilanzierung des NFTs ist regelmäßig anzunehmen, wenn keine explizite Vereinbarung im *smart contract* hinterlegt ist, die die Einräumung von Nutzungsrechten an dem verknüpften Referenzobjekt

[308] Sowohl der Anbieter als auch der Nachfrager können auch jeweils eine natürliche oder juristische Person darstellen. Zudem sind die Rollen fluide, d.h. eine Person kann je nach Sachverhalt verschiedene Rollen einnehmen. Die Ausführungen basieren auf den identifizierten Fallstudien in Kapitel 5.3.
[309] Im Eigentum des Betreibers kann dagegen z.B. ein Grundstück stehen, dass erstmalig verkauft werden soll.
[310] Vgl. Rapp und Bongers 2021, 2179; Guntermann 2022, 203 et seq.; Tappen und Wehe 2022, 164. Die steuerliche Bilanzierung der NFTs folgt aufgrund des Maßgeblichkeitsgrundsatzes den Grundsätzen der Handelsbilanz, vgl. näher hierzu bspw. Link 2023, 585 et seq.
[311] Vgl. Buchholz 2019, 36 et seq.; Baetge, Kirsch und Thiele 2021, 160 et seq.; Scheffler 2021, no. 42 et seq.; Link 2023, 528 et seq.
[312] Vgl. Buchholz 2019, 36 et seq.; Baetge, Kirsch und Thiele 2021, 165; Link 2022, 1706 et seq. Teilweise werden hierbei hohe Preise erzielt, vgl. bspw. Scheer 2021.

gewährt.[313] Diese explizite Vereinbarung ist notwendig, da der NFT selbst grundsätzlich weder Eigentum noch andere exklusive (Nutzungs-)Rechte an dem virtuellen Referenzobjekt begründet.[314]

Ist dagegen eine solche Vereinbarung gegeben, bleibt zu klären, ob der NFT selbst oder das entsprechende Referenzobjekt zu bilanzieren ist.[315] Einerseits kann der NFT mit einer realen Sache, wie einem Sneaker von Adidas, verknüpft sein (vgl. Kapitel 5.3.1 Variante 2). Mangels Eigentumsfähigkeit an dem NFT[316] kann ein zivilrechtliches Eigentum tokenbasiert nur an dem Referenzobjekt begründet werden. Entsprechendes wäre in dem zugrunde liegenden *smart contract* des NFTs festzuhalten. Bei einer solchen Vorgehensweise sprechen die besseren Argumente für die Bilanzierung des Sneakers, da dessen Eigentumsübertragung mittels des *smart contract*s eindeutig geregelt ist. Dies hätte zur Folge, dass Adidas nicht den NFT, sondern den realen Sneaker in der Bilanz aufzunehmen hätte. Durch einen Verkauf wird der NFT dem Erwerber (hier: Nutzer) zugewiesen und kann, wenn entsprechendes in dem *smart contract* geregelt ist, bspw. als Besitzkonstitut i.S.d. § 930 BGB dienen und die hierfür erforderlichen Willenserklärungen abbilden. Dies kann den tokenbasierten Eigentumserwerb an dem referenzierten Sneaker ermöglichen.[317]

Andererseits kann der NFT mit einem virtuellen Referenzobjekt (bspw. ein virtuelles T-Shirt) verknüpft sein (vgl. Kapitel 5.3.1 Variante 1), wodurch eine andere Einschätzung des Sachverhalts möglich ist. Zwar sprechen sich weite Teile der Literatur für eine Bilanzierung des virtuellen Referenzobjektes aus,[318] da der NFT i.d.R. ein faktisches Ausschlussrecht an dem virtuellen Referenzobjekt vermittle.[319] Allerdings ist auf der Blockchain nicht das Referenzobjekt, sondern lediglich die kryptographische Verknüpfung (z.B. eine Verlinkung) mit diesem gespeichert.[320] Eine permanente und einzigartige Beziehung zwischen NFT und Referenzobjekt kann bei einer Verlinkung nicht vollumfänglich garantiert werden.[321] Auch ein Kopierschutz oder eine sonstige rechtliche Exklusivität wird durch den NFT am virtuellen Referenzobjekt

[313] Vgl. Guntermann 2022, 202; Kirch und Stumm 2022, 247; Richter 2022, 3471 et seq.; Haberer 2023, 462 et seq.
[314] Vgl. Heine und Stang 2021, 757; Hoeren und Prinz 2021, 570 et seq.; wohl a.A. bspw. Krüger 2021, 385; Rapp und Bongers 2021, 2179.
[315] Umsatzsteuerrechtlich unterscheidet bspw. auch die spanische Finanzverwaltung zwischen dem Token selbst und dem Referenzobjekt, vgl. Morales und Menéndez 2022.
[316] Vgl. ausführlicher bspw. Guntermann 2022, 202; Lennartz 2022, 888 et seq.; Richter 2022, 3473.
[317] Vgl. ausführlich zu den zivilrechtlichen Besonderheiten, die sich bei dem analogen Gegenstand nach den §§ 929 et seq. BGB richten, bspw. Richter 2022, 3473 et seq.
[318] Vgl. Krüger 2021, no. 1233; Link 2022, 1708 et seq.; Richter, Anzinger und Tiedchen 2023, no. 1817; Stumm und Kettemer 2023, 265.
[319] Vgl. Link 2022, 1706 et seq.
[320] Vgl. Hoeren und Prinz 2021, 566 et seq.; Figatowski und Feser 2022, 707; Frick 2023, 344; ausführlicher dazu Rauer und Bibi 2022, 23 et seq.
[321] Vgl. Papastefanou 2022, 345; mit möglichen Lösungsansätzen, vgl. Liegmann und Farruggia-Weber 2022, 442.

regelmäßig nicht vermittelt.[322] Bspw. kann bei einer Abschaltung des Servers, auf dem das Referenzobjekt gespeichert ist, eine entsprechende Verlinkung ins Leere führen.[323] Der NFT existiert zwar in Form eines *smart contracts* weiterhin auf der Blockchain, ist dann aber nicht mehr als digitaler Sicherungsmechanismus funktionsfähig.[324] Daher ist u.E. die pauschale Bilanzierung des virtuellen Referenzobjekts auf Basis des möglichen vermittelten Ausschlussrechts abzulehnen.

Im Ergebnis bleibt festzuhalten, dass bei der Bilanzierung weder pauschal auf den NFT noch auf das Referenzobjekt abgestellt werden kann.[325] Vielmehr müssen stets die technischen Feinheiten (z.B. Übertragung von Nutzungsrechten) berücksichtigt werden. Hinsichtlich der konkreten Bilanzierungsfähigkeit dürfe aus Sicht des Unternehmens, welches den NFT erschafft (*minting*) und anschließend veräußert, je nach Sachverhalt das Referenzobjekt bzw. der NFT dem Umlaufvermögen zuzuordnen sein.[326] Der NFT stellt dabei ein selbst geschaffenes immaterielles Wirtschaftsgut dar, welches aufgrund der Zuordnung zum Umlaufvermögen aktivierungspflichtig ist.[327] Sofern der NFT eigentumsrechtlich beim anbietenden Unternehmen verbleibt und eine reine Einräumung von Nutzungsrechten an den Kunden vorliegt, gilt der NFT als selbst geschaffenes immaterielles Wirtschaftsgut des Anlagevermögens, womit ein striktes steuerliches Aktivierungsverbot greift (§ 5 Abs. 2 EStG).

Bezüglich der Bewertung sind bei der Bilanzierung des Referenzobjekts die Prinzipien für das jeweils referenzierte Wirtschaftsgut anzuwenden, wobei der Höhe nach maximal die Herstellungskosten (§ 255 Abs. 2, 2a HGB) anzusetzen sind (§ 6 EStG).[328] Forschungs- und Vertriebskosten dürfen hierbei nicht mit einbezogen werden (§ 255 Abs. 2 S. 4 HGB). Der NFT folgt als selbst geschaffenes immaterielles Wirtschaftsgut den grundlegenden Prinzipien und ist mit den Herstellungskosten zu bewerten. Dennoch besteht aufgrund fehlender finanzrechtlicher Vorgaben[329] bei der Ermittlung der Herstellungskosten eine große Rechtsunsicherheit. Hierbei liegt die Überlegung nahe, dass insbesondere die Personalaufwendungen für das NFT *minting* den

[322] Vgl. Hoeren und Prinz 2021, 566 et seq.
[323] Vgl. Kraetzig 2022, 483.
[324] Vgl. Rauer und Bibi 2022, 23 et seq.
[325] Vgl. im Ergebnis wohl auch Frick 2023, 346; Bruns, Helbig und Hassa 2022, 161; wohl a.A. Krüger 2021, 385; Rapp und Bongers 2021, 2179; Link 2022, 1705 et seq.
[326] Vgl. Scheffler 2018, no. 178.
[327] Vgl. Maier 2023, no. 6. Der NFT ist konzeptionell u.E. nicht mit einem Patent vergleichbar, welches nicht aktivierungsfähig ist.
[328] Bei abnutzbaren Wirtschaftsgütern des Anlagevermögens (§ 6 Abs. 1 Nr. 1 EStG) wäre bei der Folgebewertung die Absetzung für Abnutzung zu berücksichtigen (§§ 7 et seq. EStG).
[329] So wird vom BMF bei Zuordnung zum Umlaufvermögen der Ausweis unter den sonstigen Vermögensgegenständen festgelegt, vgl. BMF 2022, no. 41.

Großteil der Herstellungskosten ausmachen. Die Wertermittlung ist hierbei vom Einzelfall abhängig.

5.4.2 Steuerliche Behandlung von Kryptowährungen

Neben NFTs bilden auch Kryptowährungen die Grundlage für die in Kapitel 5.3 untersuchten Geschäftsmodelle. In diesen Geschäftsmodellen werden Einheiten einer Kryptowährung, sogenannte *payment token*, ausschließlich als Tauschmittel für Geschäfte zwischen Anbieter und Nutzer eingesetzt.[330] Demnach wird beim Kauf eines virtuellen Adidas-T-Shirts (vgl. Beispiel in Kapitel 5.3.1 Variante 1 ein NFT gegen eine bestimmte Einheit an Kryptowährung getauscht. Innerhalb des Ökosystems Metaverse kann eine Kryptowährung somit als Zahlungsmittel anerkannt sein. Bei den einzelnen Einheiten einer Kryptowährung handelt es sich um austauschbare (fungible) Token,[331] die nach Meinung der Finanzverwaltung nicht abnutzbare Wirtschaftsgüter materieller Art darstellen.[332] Die dabei erforderliche selbstständige Bewertbarkeit anhand von Marktpreisen ist durch den regelmäßigen Handel über Börsen, Handelsplattformen und Listen sichergestellt.[333]

In den zugrundeliegenden Geschäftsmodellen zahlen die Nutzer als natürliche Personen Einheiten einer Kryptowährung an den Anbieter. Demnach liegt hierbei ein Tausch in Form eines privaten Veräußerungsgeschäfts i.S.d. § 23 Abs. 1 S. 1 Nr. 2 EStG vor.[334] Voraussetzung dafür ist die Unterschreitung der einjährigen Behaltensfrist.[335] Auf Seiten des Anbieters werden somit Betriebseinnahmen in Form der hingegebenen Einheiten an Kryptowährungen generiert. Für beide Parteien ist somit die Ermittlung des Veräußerungsgewinns[336] notwendig, was von der Bewertung der hingegebenen Einheiten an Kryptowährung abhängig ist. Neben dem Einsatz als Zahlungsmittel, kann auch der Umtausch des erzielten Kryptowährungsguthabens in ein gesetzliches Zahlungsmittel (z.B. Euro)[337] analog einen steuerbaren Veräußerungsvorgang auslösen.

Im Rahmen der Geschäftsmodelle können zwei Vergütungsformen unterschieden werden. Zum einen können Anbieter ein Entgelt in einer gesetzlichen Währung (z.B. Euro) festlegen. Zum

[330] Brinkmann 2023, 689 et seq. Bspw. besteht auch die Möglichkeit der Blockerstellung, d.h. die Erstellung einer plattformeigenen Kryptowährung, durch den Metaversebetreiber, vgl. dazu BMF (2022, May 10), no. 33 et seq.
[331] Vgl. Figatowski und Feser 2022, 706 et seq.
[332] Vgl. BMF 2022, no. 31.
[333] Vgl. BMF 2022, no. 31, 41. Vor dem Schreiben unterstellte die herrschende Literatur das Vorliegen von immateriellen Wirtschaftsgütern an vgl. FG Baden-Württemberg 2021; Skauradszun 2021; überblicksweise Levedag2023, no. 25. In einigen Ländern stellen Kryptowährungen gesetzlich anerkannte Zahlungsmittel dar, vgl. OECD 2020.
[334] Vgl. BFH 2023, no. 42 et seq.
[335] Vgl. BMF 2022, no. 51.
[336] Vgl. BMF 2022, no. 57.
[337] Auch der Tausch in eine andere Kryptowährungseinheit ist hiervon erfasst.

anderen kann das Entgelt auch in Einheiten einer Kryptowährung (z.B. Ethereum) festgelegt werden, wobei bspw. Open Sea den Wert in US-Dollar basierend auf dem aktuellen Umrechnungskurs angibt. Bisher werden regelmäßig nicht-virtuelle Güter und Dienstleistungen zu einer gesetzlichen Währung und virtuelle Güter und Dienstleistungen zu Einheiten einer Kryptowährung angeboten.

Nach Ansicht der Finanzverwaltung ist für die Bewertung des Veräußerungserlös bei Tausch der Kryptowährung gegen Dienstleistungen und Waren das in Euro vereinbarte Entgelt maßgeblich. Bei Ermangelung ist der Marktkurs der hingegebenen Einheit heranzuziehen.[338] Es ist allerdings unklar, ob auch virtuelle Dienstleistungen und Waren vom BMF-Schreiben erfasst werden. Im Tausch gegen andere Kryptowährungen oder sonstige Token wird auf den jeweiligen Marktkurs der Kryptowerte abgestellt,[339] wobei unklar ist, ob auch NFTs unter den Begriff der sonstigen Token fallen[340]. Erfolgt eine Bewertung auf Basis des jeweiligen Marktkurses, bleibt festzuhalten, dass aufgrund der regelmäßig hohen Volatilität große Bewertungsunterschiede und somit Bilanzverzerrungen auftreten können.

5.4.3 Mögliche spezielle steuerliche Reportingpflichten

Die Geschäftstätigkeit im Metaverse kann neben den ertragsteuerlichen Abgabeverpflichtungen auch Reporting-Verpflichtungen nach sich ziehen. Insbesondere für digitale Plattformen (DAC7-Richtlinie[341]) als auch für Kryptowerte (DAC8-Richlinienvorschlag[342]) sind bereits strengere Offenlegungs- und Meldeverpflichtungen für Unternehmen in der EU in Kraft oder für die nähere Zukunft geplant.

Für Betreiber digitaler Plattformen hat die neue DAC7-Richtlinie, die seit dem Jahr 2023 in Deutschland über das Plattformen-Steuertransparenzgesetz (PStTG) Anwendung findet, erweiterte Meldeverpflichtungen zur Folge.[343] Das Metaverse kann grundsätzlich unter den weit gefassten qualifizierenden Plattformbegriff nach § 3 Abs. 1 S. 1 Hs. 1 PStTG fallen, da es sich definitorisch um eine Transaktionsplattform handelt,[344] die es Anbietern ermöglicht, mit Plattformnutzern bestimmte Rechtsgeschäfte abzuschließen. Die nach § 3 Abs. 1 S. 1 Nr. 1–2 PStTG erfassten Rechtsgeschäfte sind solche, die auf die direkte Erbringung der relevanten

[338] Vgl. BMF 2022, no. 60.
[339] Vgl. BMF 2022, no. 58 et seq.
[340] Zur Diskussion vgl. Levedag 2023, no. 26.
[341] Council Directive 2021/514/EU 2021.
[342] European Commission 2022b.
[343] Ausführlich hierzu z.B. Klink und Sixt 2022.
[344] Vgl. Kapitel 5.3.1.

Tätigkeiten durch den Anbieter selbst ausgerichtet sind oder indirekt mit der relevanten Tätigkeit durch die Erhebung und Zahlung einer Vergütung in Zusammenhang stehen.

Die abschließend aufgelisteten relevanten Tätigkeiten nach § 5 Abs. 1 PStTG umfassen die zeitlich begrenzte Überlassung von Nutzungs- und anderen Rechten an unbeweglichem Vermögen (Nr. 1) oder Verkehrsmitteln (Nr. 4), persönlich erbrachte Dienstleistungen (Nr. 2) sowie den Verkauf von Waren (Nr. 3). Alle Tätigkeiten vereint die Notwendigkeit der Entgeltlichkeit (§ 5 Abs. 1 S. 1, Abs. 2 PStTG). Dagegen erfordert nur die persönliche Erbringung von Dienstleistungen implizit keine bestimmte Form der Körperlichkeit von Wirtschaftsgütern.

Übertragen auf die dargestellten Fallstudien in Kapitel 5.3 könnten insbesondere die Geschäftsmodelle im Onlinehandel von der Vorschrift betroffen sein. Bei zugrundeliegenden rein virtuellen Gütern fehlt die erforderliche Körperlichkeit, da sowohl das Referenzobjekt als auch der NFT virtuell sind. Bspw. würde der Verkauf einer Metaverse-Immobilie (Referenzobjekt) nach aktuellem Stand nicht unter § 5 Abs. 1 S. 1 Nr. 1 PStTG fallen, da weder das Referenzobjekt noch der NFT unbewegliches Vermögen sind. Allerdings könnte bspw. die Vermittlung einer Metaverse-Immobilie unter die erfasste Gruppe der Beratungs- und Vermittlungsleistungen fallen (§ 5 Abs. 1 S. 1 Nr. 2 PStTG).[345] Da es nach § 5 Abs. 3 S. 3 PStTG unerheblich ist, ob die Erbringung virtuell oder physisch erfolgt, können Dienstleistungen im Metaverse erfasst werden, sofern ein ausreichend individueller Charakter sichergestellt wird, was z.B. bei einer Rechtsberatung für einen realen Fall vorläge.[346]

Sofern der Anwendungsbereich für den Betreiber eröffnet wird, ist dieser verpflichtet, bestimmte Informationen über den Anbieter sowie dessen Geschäftstätigkeiten zu sammeln, zu überprüfen und schlussendlich den Steuerbehörden auf jährlicher Basis zu übermitteln (§§ 13 et seq. PStTG). Zudem muss der Betreiber die gemeldeten Informationen auch dem betroffenen Anbieter zugänglich machen (§ 22 PStTG). Die Regelungen des PStTG könnte allerdings im zukünftig geplanten dezentral organisierten Metaverse an Grenzen stoßen, da kein eindeutig identifizierbarer Plattformbetreiber mehr existieren soll, sondern eine Vielzahl von Subjekten das Metaverse betreiben.

Darüber hinaus könnte die Umsetzung des DAC8-Richlinienvorschlags[347] für Anbieter von Dienstleistungen mit Kryptowerten und Betreibern von Kryptowerten zu weiteren Reportingpflichten führen. Die Meldepflicht ist dahingehend begrenzt, dass ein meldepflichtiger Nutzer

[345] Vgl. BMF 2023, no. 1.7.
[346] Es bestehen praktischen Herausforderungen bei der Bewertung der Individualität an, vgl. Klink und Sixt 2022, 2648.
[347] European Commission 2022b, no. 9, 14.

vorliegen muss, d.h. ein Kunde des Anbieters muss in der EU ansässig sein.[348] Die Definition der erfassten Kryptowerte basiert auf der MiCA-Richtlinie[349]. Da diese explizit NFTs sowie das dezentralisierte Anbieten der Kryptowerte ausschließt, wird somit der Konzeption des Metaverse widersprochen.[350] Demnach ist basierend auf dem vorliegenden DAC8-Richtlinienvorschlag mit hoher Wahrscheinlichkeit davon auszugehen, dass weder Anbieter im Metaverse noch Betreiber des Metaverse erfasst werden.

5.5 Fazit

Dieser Beitrag ordnet ausgewählte Geschäftsmodelle im Metaverse ein und zeigt das vielfältige Potential für Unternehmen auf. Die dargestellten Geschäftsmodelle bieten unterschiedliche Anknüpfungspunkte für die unternehmerische Wertschöpfung, wobei alle eint, dass sie auf NFTs und Kryptowährungen basieren. Die ertragsteuerliche Einordnung richtet sich demnach nach diesen beiden Kernkomponenten, wobei insbesondere bei den NFTs noch ein hohes Maß an Unsicherheit im Steuerrecht besteht.

Das Metaverse in der geplanten offenen und dezentralen Form besteht aufgrund technologischer Restriktionen noch nicht. Dennoch nutzen Unternehmen bereits heute verschiedene metaverse-ähnliche Plattformen, die in ihrem Aufbau weitestgehend vergleichbar sind. Im Bereich des Onlinehandels nimmt das Metaverse die Stellung einer weiterentwickelten Form der reinen Transaktionsplattformen (z.B. Amazon) ein. Der Einsatz von Web 3.0 Technologien bietet verschiedene Möglichkeiten zur Verbesserung der User Experience, z.B. das virtuelle Ausprobieren von Gütern. Hierbei können neben nicht-virtuellen Gütern und Dienstleistungen auch virtuelle Varianten angeboten werden, die in ihrem Anwendungsbereich auf das Metaverse begrenzt sind. Darüber hinaus bietet das Metaverse eine neue Form der Wertschöpfung für Unterhaltungserlebnisse wie bspw. Sportveranstaltungen und Konzerte. So können derartige Veranstaltungen in der rein virtuellen Umgebung des Metaverse stattfinden, wobei sowohl das Publikum als auch die Teilnehmenden bzw. Künstler realitätsgetreu abgebildet werden können. Neben dem reinen Wertschöpfungscharakter können Unternehmen das Metaverse auch für die betriebliche Bildung, z.B. für die realitätsgetreue Einarbeitung in die Maschinenführung in der virtuellen Umgebung, nutzen.

Für die steuerrechtliche Einordnung der Geschäftsmodelle sind insbesondere die im Vordergrund stehenden Kryptowerte, d.h. NFTs und Kryptowährungen, ausschlaggebend. Eine große Rechtsunsicherheit besteht bisher bei der Bilanzierung von NFTs. Basierend auf den

[348] European Commission 2022b, 14.
[349] European Commission 2020b.
[350] European Commission 2020b, no. 10.

abgebildeten Geschäftsmodellen und Einschätzungen ergibt sich zunächst eine Unterscheidung dahingehend, ob die Übertragung von Nutzungsrechten eindeutig im *smart contract* des NFTs festgeschrieben ist. Sofern dies einerseits nicht der Fall ist, ist der selbstständig verwertbare NFT trotz fehlender Sachen- und Rechteeigenschaft, zu bilanzieren. Andererseits ist bei der expliziten Übertragung von Nutzungsrechten festzustellen, ob der NFT selbst oder das verknüpfte Referenzobjekt zu bilanzieren ist. Liegt ein physisches Referenzobjekt zugrunde, so ist regelmäßig das Referenzobjekt mangels Eigentumsfähigkeit des NFTs zu bilanzieren. Anderes ergibt sich, wenn das Referenzobjekt ein virtuelles Gut ist. Hierbei ist strittig, ob zwischen dem NFT und seinem virtuellen Referenzobjekt eine dauerhafte Verlinkung gesichert ist. Eine pauschale Bilanzierung des virtuellen Referenzobjekts aufgrund eines etwaigen Ausschlussrechts ist dabei u.E. abzulehnen.

In den betrachteten Geschäftsmodellen nehmen Kryptowährungen die Form von Zahlungsmitteln an, welche innerhalb des Metaverse-Ökosystems anerkannt sind. Dennoch unterscheiden sie sich in der steuerrechtlichen Behandlung von den gesetzlich anerkannten Zahlungsmitteln. Bei Hingabe von Einheiten einer Kryptowährung durch den Nutzer zur Bezahlung, stellt dies einen Tauschvorgang und steuerrechtlich ein privates Veräußerungsgeschäft (§ 23 Abs. 1 S. 1 Nr. 2 EStG) dar. Der Tauschpartei, d.h. dem Anbieter, entstehen dabei Betriebseinnahmen, wobei verschiedene Vergütungsentgelte festgelegt werden können. Zum einen können die Entgelte in Form eines gesetzlichen Zahlungsmittels (z.B. Euro) oder in Einheiten einer Kryptowährung angesetzt werden. Von dieser Entgeltform ist die Bewertung der Kryptowährung abhängig. Ist bspw. der Marktkurs der Kryptowährung maßgeblich, kann eine hohe Volatilität zu Bewertungsunterschieden und Bilanzverzerrungen führen.

Im Hinblick auf Reportingpflichten kann die DAC7-Richtlinie die Betreiber des Metaverse als Transaktionsplattform erfassen. Betroffen sind dabei allerdings nur relevante entgeltliche Tätigkeiten. Bezogen auf die Fallstudien könnten insbesondere die Geschäftsmodelle im Onlinehandel unter die Vorschrift fallen. Allerdings sind virtuelle Güter und Dienstleistungen regelmäßig aufgrund der fehlenden Körperlichkeit ausgeschlossen. Unterliegt der Betreiber der DAC7-Richtlinie so ist dieser verpflichtet auf jährlicher Basis, bestimmte Informationen über den Anbieter sowie dessen Geschäftstätigkeiten zu sammeln, zu überprüfen und den Steuerbehörden zu übermitteln.

6 Summary

This dissertation provides valuable insights for academics, policymakers, and practitioners on three central research questions in the field of corporate taxation in a globalised and digitalised economy. First, how do different anti-tax avoidance and anti-discrimination measures affect the effective tax levels and the location attractiveness of the EU Member States? Second, what are the effects of the EU's current tax policy measures, i.e., DEBRA, Pillar 2, and BEFIT, on the location attractiveness and scale of investment in the EU Member States? Third, what are the general functioning, and the tax implications of new digital business models in the metaverse?

Reaching fair and effective taxation within the EU is one central policy object requiring consensus on fighting harmful tax practices by implementing legally binding minimum standards. Thus, **Chapter 2** of this dissertation investigates the effects of the nexus as a harmonised anti-tax avoidance measure for European IP boxes. Due to the high political relevance in the debate on combating BEPS, it is important to assess these effects and contribute to answering the first research question. As the nexus requires a certain level of substance, pure income shifting to IP box states shall be prevented. Our qualitative assessment of the IP box characteristics in the EU confirms that the nexus partially aligned core characteristics and abolished the predominant tax evasion vehicle parameters. Nonetheless, the minimum standard still leaves loopholes for aggressive tax planning, e.g., by allowing for differing loss treatment schemes. Adding qualitative results, we show that the potential reductions in the effective tax levels under the IP box vary strongly by the applied loss treatment scheme. Even though the nexus prevents aggressive subsidies, the reducing effect of the IP box regime in terms of effective tax levels remains significantly high. Hence, states could still increase their location attractiveness by enacting an IP box. More than 60% of our sample states have a subsidy, i.e., negative effective tax levels, by combining the IP box with other national R&D tax incentives, increasing location attractiveness. Overall, the nexus as an anti-tax avoidance measure seems effective to a certain degree. However, policymakers should carefully monitor new aggressive tax planning strategies by combining different R&D tax incentives and follow the development of new technologies to adapt the IP box regime's minimum standards in a targeted and rapid manner.

In addition to anti-tax avoidance measures, fair and effective taxation in a globalised world also requires equal tax treatment of foreign and domestic transactions. Any discrimination against foreign investments in the EU can distort the internal market. Thus, **Chapter 3** adds further

insights to the first research question while analysing the abolishment of discriminating imputation systems in several EU Member States. Generally speaking, an imputation system intends to eliminate economic double taxation of dividends, but several EU Member States restricted the regime to domestic-sourced dividends. My co-authors and I examine the effects of the national shift from discriminating imputation systems to shareholder relief systems in a simulation study. The discrimination caused a domestic investment bias for shareholders from a tax perspective, resulting in a lower location attractiveness of foreign states. Companies in the discriminatory jurisdictions were thereby incentivised to generate profits in their state of residence so that the investors could benefit from the tax advantage. After abolishing the imputation systems' tax-favourable treatment of domestic dividends, the effective tax levels for domestic and foreign dividends aligned throughout the EU Member States. From the shareholders' tax perspective, the foreign investments got equally or even more attractive, potentially leading to a decrease in the scale of investment in the discriminating jurisdictions. Overall, the abolishment of discrimination allowed companies to exploit the potential of inter-state tax differences without facing the disadvantage of double taxation for investors.

Harmonised minimum standards for direct taxes have increasingly been on the EU agenda in recent years. In addition to the fight against BEPS, unequal tax treatment should be resolved. Therefore, three current (proposed) EU directives on direct taxes are the basis for the article in **Chapter 4** examining the second research question. Hence, in the simulation study, my co-authors and I analyse the effective tax levels of DEBRA and Pillar 2, including their interaction effects. Moreover, the common tax base proposal under BEFIT is included. Overall, we strive to provide quantitative insights into the fiscal implications of these recent policy measures. First, for DEBRA, we find a general trend where the effective tax levels in the sample countries tend to rise due to the interest deduction limitation while decreasing with the introduction of the ACE. However, it's important to note that a different pattern emerges for states where their national ACE provisions prove to be more generous than those stipulated in DEBRA, resulting in an opposite effect. Second, the implementation of Pillar 2 leads to an increase in EATRs across all the sample states regardless of the financing scenario, which aligns with the intended policy objectives. Thus, the location attractiveness of the former low-tax states decreases through Pillar 2. Third, the combination scenario reveals that the influence of Pillar 2 takes precedence over the impact of DEBRA. For all scenarios, the findings pertaining to DEBRA and Pillar 2 can be reaffirmed when including BEFIT, proving the influence of the common tax base to be marginal. In summary, it can be shown that the political intentions of the directives can be achieved. Nevertheless, the DEBRA proposal should be critically examined within the

context of a minimum tax, given the inherent contradictory effects that became evident in this study.

Furthermore, in the era of digitalisation, the research article in **Chapter 5** adds to the extensive political and academic debate on how fair and effective the existing tax systems treat digital business models. Hence, this chapter provides an in-depth overview of the general functioning of business models in the metaverse and their corporate tax implications under German tax law. Since the metaverse is a highly current topic, this article is the first in the scientific literature to classify existing entrepreneurial activities for income tax purposes using practical case studies. My co-authors and I show the diverse potential for companies in the metaverse, and we object to the high degree of legal uncertainty in the field of corporate taxation. Our focus for the tax assessment lies on NFTs and cryptocurrencies, as all business models are united by these core components, even though they offer different approaches to value creation. We find a high degree of legal uncertainty, as the tax accounting for NFTs cannot be conclusively clarified based on the current legal situation. Furthermore, the classification of cryptocurrencies as intangible assets and not as legal tender leads to different tax consequences compared to a transaction with a legal tender. Overall, the current German tax system cannot achieve entirely fair and effective taxation for business activities in the metaverse, resulting in challenges for the affected businesses and tax authorities.

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Appendix

A Appendix to Chapter 2

Appendix 1 Scope of qualifying IP and qualifying income (2021)

	BE	CY	FR	HU	IE	IT	LT	LU	MT	NL	PL	PT	SK	ES	CH	UK
Scope of qualifying income																
Royalties	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Capital gains	✓[a]	Ex.	✓	Ex.	x	✓[a]	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓[b]
Sales income/notional royalties	✓	✓	x	✓	✓	✓	x	✓	✓	✓	✓	x	✓	x	✓	✓
Infringement	✓	✓	(x)	(x)	✓	(x)	✓	✓	✓	(x)	✓	✓	x	x	(x)	✓
Scope of qualifying assets																
Patents	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Supplementary protection certificates	✓	✓	✓	✓	✓	(✓)	✓	✓	✓	✓	✓	(x)	x	✓	✓	✓
Software copyright	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	(x)	(x)
Other copyright	x	x	x	(x)	x	(x)	x	(x)	x	x	x	(x)	x	x	x	x
Trademarks	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Designs & models	(x)	x	x	(x)	x	✓	x	x	(x)	x	✓	✓	✓	✓	(x)	X
Utility models	(x)	✓	✓	✓	x	✓	x	✓	✓	✓	✓	✓	✓	✓	(x)	X
Plant breeders' rights	✓	✓	✓	✓	✓	✓	x	✓	✓	✓	✓	(x)	x	(x)	✓	✓
orphan drug designation	✓	✓	✓	✓	✓	(✓)	x	✓	✓	✓	✓	(x)	x	(✓)	(x)	✓
Secret formulas & processes	(✓)	x	✓	(x)	x	✓	(x)	(x)	(x)	x	x	x	x	✓	x	(x)
Know-how	x	x	x	(x)	x	✓	(x)	(x)	x	x	x	x	x	x	x	X

Notes: The table depicts the scope of qualifying income and assets under the national nexus-conform IP box regimes as of 2021. Only qualifying income and assets are subject to the beneficial IP box regimes. We assume, that not explicitly included items are most probably excluded and are marked by (x).
[a] In BE and IT capital gains are subject to a reinvestment condition in order to be qualified.
[b] In UK only proceeds related to the sale of qualifying IP rights qualifies.
Source: Own research and illustration.

Appendix 2 Parameters and weights for Devereux/Griffith methodology

Economic parameters	in %
True economic depreciation rate of intangibles	15.35
Real interest rate	5
Inflation rate	2
Pre-tax rate of return for EATR	20
Weighting of investment	
Current expenses	100

Notes: This table displays the economic parameters and the weighting of the investment for the calculations under application of the Devereux/Griffith methodology. The numbers are displayed in %.
Source: Own illustration based on Evers et al. 2015; Spengel et al. 2020.

Appendix 3 Incorporation of IP Boxes in Devereux/Griffith methodology

For the purpose of determining the impact of the nexus on the effective tax rates of corporations located in IP box jurisdictions within the Devereux/Griffith methodology, we follow the approach of *Evers et al.*[351]. We refer to an R&D investment giving rise to a self-developed patent (corporate level only).

The EATR is used as a measure to estimate the impact of the introduction of the nexus on investment location decisions and on tax planning strategies. It is computed as the difference of the NPV before and after taxes (denoted by R^* and R^t), divided by the discounted pre-tax rate of return p (assumed to be 20%):

$$EATR = (R^* - R^t) / \left(\frac{p}{1+r}\right) \tag{A1}$$

$$R^* = \frac{p-r}{1+r} \tag{A2}$$

To derive the economic rent of the project in the presence of tax (R^t), we model our patent investment as follows: In the first period, the company faces a temporary increase of the capital stock of one unit which is subject to the present value of depreciation allowances (A) according to national tax laws. In this way, parts of the income from the investment are exempted from taxation, i.e., the effect of a tax shield is achieved. In the second period, the investment generates a real financial return of p and a one period cost of depreciation δ. In addition, the income grows with the inflation rate (π) and is subject to corporate income tax at rate τ. To return to its initial level, the capital stock is reduced by $(1-\delta)(1+\pi)$.

$$R^t = \underbrace{-(1-A)}_{\text{R\&D expenses, tax depreciation}} + \underbrace{(1-\tau)\frac{(p+\delta)(1+\pi)}{1+i}}_{\text{Returns generated by a patent}} + \underbrace{(1-A)\frac{(1-\delta)(1+\pi)}{1+i}}_{\text{Reduction in capital stock}} + \underbrace{F}_{\text{Financing term}} \tag{A3}$$

In calculating the NPV of a net income stream, companies are assumed to discount income in the second period in line with the nominal capital market interest rate, i.[352]

In Eq. (A4) the first term with the share of immediately deductible expenses, φ_0 (regularly 100%), represents the immediate written-off R&D expenses. The second term denotes the capitalization of the R&D expenses, which compensates for the immediate depreciation. We follow

[351] Evers, Miller, and Spengel 2015.

[352] It is assumed, as is standard, that the real (r) and nominal interest rates (i) are related as follows: $(1+i) = (1+r)(1+\pi)$.

Evers et al.[353] and assume for simplicity that both processes concern one period, and hence, the two terms balance out each other. As a consequence, we do not consider any timing effects resulting from the fact that R&D expenses remain deductible until a self-developed intangible asset is created. In the case of capitalization, A reflects the NPV of the periodic depreciation, which is composed of the depreciation rate φ over the useful life (l). In the absence of capitalization, the tax allowance corresponds to the immediate depreciation of the R&D expenses (term 1), with which $A = \varphi_0 \tau = \tau$ applies.

$$A = \underbrace{\varphi_0 \tau}_{\text{Immediate Expense}} - \underbrace{\varphi_0 \tau}_{\text{Capitalization}} + \underbrace{\varphi \tau \left\{ \left(\frac{1}{1+i} \right)^1 + \cdots + \left(\frac{1}{1+i} \right)^N \right\}}_{\text{Periodical Depreciation (M, B)}} \quad \text{(A4)}$$

To consider other financing possibilities than retained earnings, R must be modified by an additional financing term F. If companies finance their R&D investment via retained earnings, the initial investment reduces the funds which are available for distribution. This is reflected by the first term of Eq. (A3). In contrast, the financing of the investment with debt, allows the distribution of these funds in the initial period (Eq. (A6) first term). However, then the distribution in the second period is reduced by the amount of the loan repayment and the nominal interest expenses. In all countries, interest expenses are deductible from the corporate income tax base, thus shielding the marginal return from profit taxation. The value of this tax shield is determined by the product of the profit tax rate and the nominal interest rate (see second term of equation A6). For the same reason, we have to add a financing term, if we consider notional income deductions in equity-financed R&D investments (depicted by equation A7). If the (notional) interest deduction equals the capital market interest rate, the marginal return is fully shielded from profit taxation.

Retained earnings (RE) $$F^{RE} = 0 \quad \text{(A5)}$$

Debt (D) $$F^{D} = (1 - \tau\varphi_0) - \frac{(1 - \tau\varphi_0)\big(1 + i(1-\tau)\big)}{1+i} \quad \text{(A6)}$$

NID Adjustment $$F^{NID} = \frac{(1 - \tau\varphi_0)\tau i_{NID}}{1+i} \quad \text{(A7)}$$

To incorporate the IP box regimes into the effective tax measures, we substitute the regular corporate income tax rate τ with the preferential IP box tax rate τ_{IP}.

[353] Evers, Miller, and Spengel 2015.

The previous literature on the modelling of IP boxes in the Devereux/Griffith methodology assumed that all IP income is classified as tax-beneficial income.[354] We remove this assumption in the following, since we account for the nexus in the calculation of the EATR. Due to the associated application of the substance requirement, the reduced IP box tax rate τ_{IP} can no longer generally replace the regular corporate income tax rate in the model. Accordingly, we determine a modified IP box tax rate ($\tau_{IP\ nexus}$, where $\tau_{IP\ nexus} \leq \tau_{IP}$), which takes into account the different case constellations, i.e., directly applicable IP box tax rate as well as indirectly reduced IP box tax rate through partial exemption.

Thus, we have to compute a modified IP box tax rate, which accounts for the nexus ratio $\varphi_{IP} = \frac{\min(1.3 \times E_{qualified}, E_{overall})}{E_{overall}}$. To do so, we first determine the overall tax burden T of a multinational company exploiting a patent investment (see equation A8). This overall tax burden comprises the share of tax-privileged income, subject to the IP box tax rate (equation A8, term 1), as well as a possible residual of non-tax-privileged income, subject to the regular corporate income tax rate (equation A8, term 2). This residual can arise due to partial non-compliance with the substance requirement, i.e., that the qualified R&D expenditure does not correspond to the total R&D expenditure ($E_{qualified} \neq E_{overall}$), e.g., due to outsourcing of R&D activities to related companies.

$$T = \tau_{IP}(\varphi_{IP} \times I_{overall}) + \tau(I_{overall} - \varphi_{IP} \times I_{overall}) \tag{A8}$$

We resolve equation A8 according to the implicit effective tax rate ($\frac{T}{\text{share of qualifying IP related income}}$) in order to determine the modified IP box tax rate under the nexus:

$$\tau_{IP\ nexus} = (\tau_{IP} - \tau) \times \varphi_{IP} + \tau \tag{A9}$$

Besides the direct effect of the reduced tax rate on IP income, the generosity of an IP box depends on the treatment of expenses. Within our sample, all countries allow current R&D expenses incurred in the creation of a self-developed intangible asset to be expensed immediately when they are incurred. Further we observe that all current IP box regimes apply the net income approach in line with the nexus. Thus, the value of the tax allowance of current expenses is determined by the preferential IP box tax rate. For mandatory capitalization, we make the simplifying assumption that the immediate deduction and subsequent capitalization occur in the same period. Therefore, the IP box rate is decisive for the NPV of the periodical depreciation

[354] Evers, Miller, and Spengel 2015; Pfeiffer and Spengel 2017.

allowances. Further, with respect to financing costs, i.e., (notional) interest expenses, the net income approach mandates that the tax shield is determined by the IP box tax rate ($i * \tau_{IP}$).[355]

As the majority of countries does not require the initial capitalization of development costs, a recapture mechanism of previous R&D expenditure is required to ensure the equal treatment of income and expenses. Otherwise, the asymmetrical treatment of income and current expenses results in a tax shield based on the regular taxed profit being greater than the tax burden of the income based on the modified IP box tax rate, so that $EATR \leq 0$. All countries have either an initial capitalization or a recapture mechanism in place. For countries implementing a capitalization mechanism, we follow the procedure of an initial capitalization with subsequent periodical depreciation. If not stated otherwise in the national tax law, we assume a depreciation period of five years. However, if countries rely on the threshold approach, i.e., taxing IP income up to the development expenses at the general corporate income tax rate, the preferential IP box rate does not necessarily apply immediately when IP income is earned. As already stated by *Evers et al.*[356] this version of the recapture of R&D expenses cannot be precisely modelled in the two-period framework of the Devereux/Griffith methodology. It is unsuitable, since the income from IP does not exceed the current R&D expenses on the basis of the standard data set until the fourth period. This results from the comparison of revenues and R&D expenditures, which are assumed to be constant over time. The time effects are taken into account by discounting and generating the first payback in t_1, i.e., $I_{overall} > E_{overall} \leftrightarrow \sum_{t=1}^{T} \left(\frac{(p+\delta)(1+\pi)}{1+i}\right)^t > 1 \leftrightarrow T > 4$. We, therefore, follow their approach and assume that the NPV of tax allowances is therefore based on the preferential IP box rate and is best approximated by $A = \tau_{IP}$.[357]

[355] Evers 2015, 103.
[356] Evers, Miller, and Spengel 2015.
[357] Evers, Miller, and Spengel 2015, 512.

Appendix 4 Derivation of modified IP tax rate for given IP box tax rate

The tax liability (T) for a given IP box tax rate is given by:

$$T = \tau_{IP}\left(\frac{\min\left(1{,}3 \times E_{qualified}, E_{overall}\right)}{E_{overall}} \times I_{overall}\right)$$

$$+ \tau\left(I_{overall} - \frac{\min\left(1{,}3 \times E_{qualfied}, E_{overall}\right)}{E_{overall}} \times I_{overall}\right)$$

to simplify: $\frac{\min\left(1{,}3 \times E_{qualified}, E_{overall}\right)}{E_{overall}} \times I_{overall} = \varphi_{IP}$

$$T = \tau_{IP} \times \varphi_{IP} \times I_{overall} + \tau \times (I_{overall} - \varphi_{IP} \times I_{overall})$$

$$T = \tau_{IP} \times \varphi_{IP} \times I_{overall} + \tau \times I_{overall} - \tau \times \varphi_{IP} \times I_{overall}$$

$$T = I_{overall}[(\tau_{IP} \times \varphi_{IP}) + \tau - \tau \times \varphi_{IP}]$$

Since the tax liability is generally calculated by multiplying the tax rate by the taxable income, i.e., $T = \tau \times I_{overall}$, it follows that:

$$T/I_{overall} = \tau_{IP\,nexus} = [(\tau_{IP} \times \varphi_{IP}) + \tau - \tau \times \varphi_{IP}]$$

$$\tau_{IP\,nexus} = (\tau_{IP} - \tau) \times \varphi_{IP} + \tau$$

Assumption: $I_{overall} = \frac{(p+\delta)(1+\pi)}{1+i}$

If a company has less than 76.92% of qualifying IP expenditures, the applicable nexus tax rate is increasing in the amount of regularly taxed IP income.

Appendix 5 CoC for equity-financed, self-developed patent (2014, 2021)

	BE	CY	FR	HU	IE	IT	LT	LU	MT	NL	PL	PT	ES	SK	CH	UK	ø
Pre-nexus (2014)																	
No qualifying expenses																	
Regular tax system	3.67	5.53	5.00	5.00	5.00	3.92	5.00	5.00	5.00	5.00	5.00	7.62	5.00	5.00	5.18	5.00	5.18
Full self-development																	
Self-development (IP box)	-1.88	5.10	0.44	2.86	.	.	.	5.23	5.00	5.00	.	3.57	1.53	.	.	5.00	3.67
Post-nexus (2021)																	
No qualifying expenses																	
Acquired patent	5.38	4.75	6.51	5.37	5.53	5.57	5.35	6.23	3.60	6.24	5.29	3.55	6.24	5.99	5.93	5.87	5.46
Outsourced to related party (regular tax system)	5.00	4.32	5.00	5.00	5.00	4.70	5.00	5.00	2.79	5.00	4.53	2.84	5.00	5.00	5.18	5.00	4.65
Full self-development																	
Self-development (IP box)	5.00	4.96	5.00	5.17	5.00	4.85	5.00	5.00	4.89	5.00	4.88	3.92	5.00	5.43	5.18	5.00	4.91
Change in generosity																	
Δ IP box	6.88	0.14	4.56	2.31	.	.	.	-0.23	0.00	0.00	.	0.35	3.47	.	.	0.00	

Notes: The table presents the CoC for an equity-financed investment in a self-developed patent in our sample of IP box states in %. Two representative years for the pre-nexus and post-nexus era, i.e., 2014 and 2021, are displayed to capture the maximum transition period. The impact of the IP box regimes is depicted by presenting the CoC for two extreme scenarios, namely no qualifying expenses and full self-development of the patent. Based on the post-nexus terminus, we refer to the indication by share of qualifying expenses. The first scenario represents our baseline scenario in which the domestic company generates revenue by licensing out a patent for which it has not incurred qualifying expenses to be eligible for the IP box. Thus, we assume that the company has fully outsourced the development of the patent to an affiliated company via contract R&D, which allows for immediate expensing of these costs as they are incurred. In 2014 there was no definition of qualifying expenses. Thus, we refer to the treatment under the regular tax system to approximate our baseline scenario for 2014. In the post-nexus era, the company is also not eligible for a potential uplift under the nexus ratio as no qualifying expenses exist. This comparison of both extremes allows us to quantify the maximum tax benefit that a company could receive on a (self-developed) patent investment based on the existing IP box regimes. The values for the situation before the nexus introduction in 2014 are taken from a previous publication by Evers et al. 2015. For non-IP box countries, we estimated the CoC as of 2014. None of the non-IP box countries stipulates a capitalization of R&D expenses. The change in generosity is measured by Δ IP box that compares the CoC under the IP box regime (full self-development) in 2021 to 2014.
Source: Own calculation and illustration

Appendix 6 EATRs for equity-financed, self-developed patent (2014, 2021)

	BE	CY	FR	HU	IE	IT	LT	LU	MT	NL	PL	PT	ES	SK	CH	UK	ø
Pre-nexus (2014)																	
CIT	33.99	12.5	35.41	19.00	12.50	31.29	15.00	29.22	35.00	25.00	19.00	30.00	30.00	22.00	21.15	21.00	24.5
IP box rate	6.80	2.50	16.76	9.50	.	.	.	5.84	0.00	5.00	.	15.00	12.00	.	.	10.00	8.34
No qualifying expenses																	
Regular tax system	21.11	11.69	26.56	14.25	9.38	19.76	11.25	21.92	26.25	18.75	14.25	31.68	22.50	16.5	16.57	15.75	18.64
Full self-development																	
Self-development (IP box)	-26.95	2.34	-6.41	-2.54	.	.	.	5.47	0.00	3.75	.	5.17	-2.95	.	.	7.50	8.34
Post-nexus (2021)																	
CIT	25.00	12.50	33.00	9.00	12.50	27.70	15.00	24.94	35.00	25.00	19.00	21.00	21.00	25.00	19.70	19.00	21.52
IP box rate	3.75	2.50	11.70	4.50	6.25	12.98	5.00	4.99	1.75	9.00	5.00	10.50	10.50	10.00	9.18	10.00	7.35
No qualifying expenses																	
Acquired patent	20.18	8.30	27.07	8.42	11.69	22.92	12.73	23.33	21.71	23.38	15.44	18.65	23.38	19.64	18.52	17.77	18.32
Outsourced to related party (regular tax system)	18.75	6.41	21.71	6.75	9.38	19.76	11.25	18.70	19.08	18.75	12.36	16.22	18.75	15.75	15.50	14.25	15.21
Full self-development																	
Self-development (IP box)	2.81	1.66	8.25	4.21	4.69	9.79	3.75	3.74	0.77	6.75	3.17	7.26	7.50	9.82	7.70	7.50	5.59
Change in generosity																	
Δ IP box	29.76	-0.68	14.66	6.75	.	.	.	-1.73	0.77	3.00	.	2.09	10.45	.	.	0.00	

Notes: The table presents the EATR for a profitable equity-financed investment of in a self-developed patent in our sample of IP box states in %. The table compares two representative years for the pre- and post-nexus era, i.e., 2014 and 2021, to capture the maximum transition period. The impact of the IP box regimes is depicted by presenting the EATRs for two extreme scenarios, namely no qualifying expenses, and full self-development of the patent. Based on the post-nexus terminus, we refer to the indication by share of qualifying expenses. The first scenario represents our baseline scenario in which the domestic company generates revenue by licensing out a patent for which it has not incurred qualifying expenses to be eligible for the IP box. Thus, we assume that the company has fully outsourced the development of the patent to an affiliated company via contract R&D, which allows for immediate expensing of these costs as they are incurred. In 2014 there was no definition of qualifying expenses. Thus, we refer to the treatment under the regular tax system to approximate our baseline scenario for 2014. In the post-nexus era, the company is also not eligible for a potential uplift under the nexus ratio as no qualifying expenses exist. This comparison of both extremes allows us to quantify the maximum tax benefit that a company could receive on a (self-developed) patent investment based on existing IP box regimes. The values for the situation before the nexus introduction in 2014 are taken from a previous publication by Evers et al. 2015. For non-IP box countries, we estimated the EATRs as of 2014. None of the non-IP box countries stipulates a capitalization of R&D expenses. The change in generosity is measured by Δ IP box that compares the EATRs under the IP box regime (full self-development) for each country in 2021 to 2014. **Source:** Own calculation and illustration.

Appendix 7 Selected R&D tax incentives in IP box states (2021)

	Tax incentive	Incentive rate	Qualifying expenditures	Carryforward	Limitation
BE	Immediate deduction	100%	Current	.	.
	R&D tax credit/super deduction	13.5% (one-shot); 20.5% (spread) [a]	Capitalised R&D expenses	4 years	.
CY	Immediate deduction	100%	Current	.	.
FR	Immediate deduction	100%	Current	.	.
	R&D tax credit	30% (below 100 Mio. EUR); 5% (above 100 Mio. EUR)	Current, depreciation	3 years; refund afterwards	.
HU	Immediate deduction	100%	Current	.	.
	Super deduction	100%	Current	5 years	≤ 50 Mio. HUF per year
IE	Immediate deduction	100%	Current	.	.
	R&D tax credit	25%	Current	1 year carryback; indefinitely carryforward/refund over 33 months	Cap of refund: maximum(amount payroll taxes in the current and previous accounting period, CIT paid in the 10 preceding accounting periods)
IT	Immediate deduction	100%	Current	.	.
	R&D tax credit	12% 6%	Current, intangibles	Indefinitely	≤ 3 Mio. EUR per year ≤ 1.5 Mio. EUR per year
LT	Immediate deduction	100%	Current	.	.
	Super deduction	200%	Current	Indefinitely	.
LU	Immediate deduction	100%	Current	.	.
MT	Immediate deduction	100%	Current	.	.
	R&D tax credit[b]	25%	Current	Indefinitely	≤ 15 Mio. EUR per project
NL[c]	Immediate deduction	100%	Current	1 year carryback; 6 years carryforward	.
PL	Immediate deduction	100%	Current	.	.
	Super deduction	100%	Current	6 years	.
PT	Immediate deduction	100%	Current	.	.
	R&D tax credit	32.5% (volume) 50% (incremental)	Current, intangibles	8 years	. ≤ 1.5 Mio. EUR

	Tax incentive	Incentive rate	Qualifying expenditures	Carryforward	Limitation
SK	Immediate deduction	100%	Current	.	.
	Super deduction	200% (volume) 100% (incremental)	Current	5 years	.
ES	Immediate deduction	100%	Current	.	.
	R&D tax credit	25% (volume) 42% (incremental) 8%	Current intangibles	18 years; refund (optional): 1 year after the tax credit generation (20% discount)	If R&D tax credits for the fiscal year exceed 10% of the tax due, the tax credits may offset up to 50% of the gross tax due. Otherwise, the tax credits may offset only up to 25% of the gross tax due.
CH	Immediate deduction	100%	Current	.	.
	Super deduction[d]	50%	Current (labour+35% uplift)		Relief limitation to 70% of the income before special deductions (e.g., enhanced deduction, IP box deduction, NID)
UK	Immediate deduction	100%	Current	.	.
	R&D tax credit (taxable)	13%[e]	Current, intangibles	Indefinite	.

Notes: The table presents selected input-oriented R&D incentives that are available for current R&D expenses and/or capitalised intangible assets in the IP box country sample. The selection is based on the possible implementation in our methodology, i.e., if they refer to the corporate income tax, and the relevance of the tax incentives for the considered investment in a (self-developed) patent.

[a] Under the tax credit/super deduction in BE only the one-shot deduction is available for patents.

[b] The R&D tax credit scheme in MT shall have a budget of 5 Mio. EUR and an overall budget of 20 Mio. EUR.

[c] As the Dutch R&D Wage WHT (withholding tax) Reduction is redeemable against payroll WHT, we do not consider its application in our estimations.

[d] The super deduction in CH is only available on the cantonal level.

[e] As the UK R&D tax credit is taxable, the value of the tax credit is reduced to 10.53% (=13%*(1-19%)) based on the statutory CIT rate.

Source: Own research and illustration.

Appendix 8 Sensitivity of effective tax levels by variations of nexus ratio (2021)

	BE	CH	CY	ES	FR	HU	IE	IT	LT	LU	MT	NL	PL	PT	SK	UK	ø
EATR																	
Nexus ratio																	
0	18.75	15. 50	8.30	18.75	21.71	8.42	9.38	19.76	11.25	18.70	19.08	18.75	12.36	16.22	19.64	14.25	15.68
10	16.68	14.49	7.44	17.29	19.96	7.87	8.77	18.37	10.28	16.76	16.31	17.19	11.14	14.96	18.37	13.37	14.33
20	14.61	13.47	6.57	15.83	18.21	7.32	8.16	17.07	9.30	14.81	13.65	15.63	9.93	13.73	17.09	12.50	12.99
30	12.53	12.46	5.71	14.36	16.46	6.78	7.55	15.78	8.33	12.87	11.11	14.07	8.72	12.52	15.81	11.62	11.67
40	10.46	11.44	4.85	12.90	14.71	6.23	6.94	14.50	7.35	10.92	8.69	12.51	7.52	11.35	14.54	10.74	10.35
50	8.39	10.43	3.98	11.44	12.96	5.68	6.33	13.22	6.38	8.98	6.39	10.95	6.33	10.20	13.26	9.86	9.05
60	6.32	9.42	3.12	9.98	11.21	5.14	5.72	11.94	5.40	7.03	4.20	9.39	5.15	9.08	11.98	8.99	7.75
70	4.25	8.40	2.26	8.51	9.46	4.59	5.11	10.67	4.43	5.09	2.13	7.83	3.98	8.00	10.70	8.11	6.47
76.92	2.81	7.70	1.66	7.50	8.25	4.21	4.69	9.79	3.75	3.74	0.77	6.75	3.17	7.26	9.82	7.50	5.59
80-100	2.81	7.70	1.66	7.50	8.25	4.21	4.69	9.79	3.75	3.74	0.77	6.75	3.17	7.26	9.82	7.50	5.59
Minimum share of own qualifying expenses																	
Target-EATR																	
5	66.37	.	38.23	94.02	95.51	62.48	71.81	.	64.10	70.44	56.78	88.14	61.23	94.34	.	.	80.88
7.5	54.30	.	9.27	76.92	.	16.81	30.82	.	38.46	57.59	46.70	72.12	40.43	73.32	.	76.92	61.94
10	42.23	54.26	.	59.83	66.93	.	.	75.20	12.82	44.74	36.61	56.09	19.64	52.30	75.52	48.43	43.00
15	18.10	4.93	.	25.64	38.35	.	.	36.68	.	19.03	16.45	24.04	.	10.26	36.35	.	5.12

Notes: The table presents the sensitivity of the EATR to different levels of the nexus ratio (i.e., the share of own qualifying R&D expenditures in overall R&D expenditures), and shares of own qualifying expenses in %. The underlying scenario assumes an equity-financed investment in a self-developed patent. Due to the permitted uplift of 30% for expenses in the nexus ratio, which is introduced in all IP box regimes, the full benefit of the IP box is achieved at a nexus ratio of 76.92%. "." indicates that the specific target-EATR cannot be reached either because the regular EATR is already below the target-EATR or because the maximum IP box benefit is not sufficient to reach the target-EATR.
Source: Own calculation and illustration.

Appendix 9 Effective tax levels for debt-financed, self-developed patent (2021)

	BE	CH	CY	ES	FR	HU	IE	IT	LT	LU	MT	NL	PL	PT	SK	UK	ø
CoC																	
No qualifying expenses																	
Acquired patent	3.06	4.04	4.54	3.92	3.85	4.68	4.54	3.68	4.12	3.92	3.25	3.92	4.24	3.50	4.14	4.24	3.98
Self-development (regular tax system)	3.26[a]	3.66	4.13	3.26	3.11	4.37	4.13	3.33	3.96	3.26	2.56	3.26	3.68	2.81	3.54	3.68	3.50
Full self-development																	
Self-development (IP box)	4.74	4.38	4.92	4.30	4.28	4.85	4.56	4.16	4.65	4.65	4.88	4.37	4.65	3.90	4.62	4.30	4.51
EATR																	
No qualifying expenses																	
Acquired patent	11.48	10.94	7.34	14.68	17.61	5.29	7.34	16.10	7.51	14.65	20.56	14.68	11.16	18.50	12.33	11.16	12.58
Self-development (regular tax system)	12.22	9.41	5.57	12.22	14.99	3.90	5.57	14.83	6.81	12.19	18.33	12.22	8.89	16.12	9.98	8.89	10.76
Full self-development																	
Self-development (IP box)	1.56	4.06	1.47	4.37	5.05	2.64	2.65	6.85	2.10	2.09	0.71	3.90	2.10	7.19	6.17	4.37	4.38

Notes: The table depicts the sensitivity of our results for a marginal (CoC) and a profitable investment (EATR) in a self-developed patent to the stream of financing, i.e., debt financing. All numbers are in %. The impact of the IP box regimes is depicted by including two extreme scenarios, namely no qualifying expenses and full self-development of the patent. Based on the post-nexus terminus, we refer to the indication by share of qualifying expenses. The first scenario represents our baseline scenario in which the domestic company generates revenue by licensing out a patent for which it has not incurred qualifying expenses to be eligible for the IP box. Thus, we assume that the company has fully outsourced the development of the patent to an affiliated company via contract R&D, which allows for immediate expensing of these costs as they are incurred. This comparison of both extremes allows us to quantify the maximum tax benefit that a company could receive on a patent investment based on existing IP box regimes.

[a] In BE a general investment credit applies to patent acquisitions, which allows for an increased depreciation above 100% over the useful life. The omission of this credit in the scenario of self-development drives the increase in the CoC in the debt-financing scenario.

Source: Own calculation and illustration.

Appendix 10 Effective tax levels for debt-financed, self-developed patent under IP box regimes and R&D tax incentives (2021)

	BE	CH	CY	ES	FR	HU	IE	IT	LT	LU	MT	NL	PL	PT	SK	UK	ø
CoC																	
IP box	4.74	4.38	4.92	4.30	4.28	4.85	4.56	4.16	4.65	4.65	4.88	4.37	4.65	3.90	4.62	4.30	4.51
R&D tax incentive	2.68	1.73	4.13	2.12	-4.68	2.42	-1.44	-1.33	-2.86	3.26	-4.33	3.26	-0.79	-5.81	-6.50	1.20	-0.43
both incentives	4.16	4.17	4.92	-1.16	-2.34	4.06	-0.75	0.08	2.55	4.65	-0.27	4.37	3.60	-3.52	-0.33	2.00	1.64
EATR																	
IP box	1.56	4.05	1.47	9.67	17.86	2.64	2.65	6.85	2.10	2.09	0.71	3.90	2.10	7.19	6.17	4.37	4.71
R&D tax incentive	4.19	1.65	5.57	-5.46	-12.70	-4.98	-18.78	-1.98	-22.15	12.19	-4.06	12.22	-9.18	-13.39	-29.69	-1.12	-5.48
both incentives	-1.22	3.10	1.47	-20.20	-24.39	-1.10	-22.25	-10.71	-7.90	2.09	-24.57	3.90	-2.90	-24.09	-16.00	-5.98	-9.42

Notes: The table depicts the sensitivity to the stream of financing of the effective tax burden under the IP box regime and/or national input-oriented R&D tax incentives. All numbers are in %. The effective tax burden is indicated by CoC (marginal investment) and EATR (profitable investment) for a debt-financed patent investment in 2021. We assume that the mandatory net approach of the post-nexus IP box regimes also applies for the input-oriented R&D tax incentives and the combined application of both kind of incentives. The selection of R&D tax incentives is based on the possible implementation in our methodology, i.e., incentive must be linked to the corporate income tax, and the relevance of the tax incentives for the considered investment in a (self-developed) patent. In CY, LU and NL the R&D scenario captures the baseline scenario without any R&D tax incentive. We do not consider the Dutch R&D incentive as it is applicable against payroll taxation instead of the corporate income tax.
Source: Own calculation and illustration.

B Appendix to Chapter 3

Appendix 11 Corporate tax systems in EU Member States (1999, 2019)

States[1]	1999	2019	Year(s) of change(s)	Discrimination between 1999-2019
AT	SR[a, d, e]	SR[a, d, e]	-	no
BE	SR[a, d, f]	SR[a, d, e]	-	yes[2]
BG	SR[a, d, e]; EX [h]	SR[a, d, e], EX [h]	-	no
CY	SR[a, d, e]	EX[d, e, i]	2003	no
CZ	SR[a, d, e]	SR[a, d, e]	-	no
DE	IM [d]	SR[a/c, d, e]	2001, 2009	yes
DK	SR[a, d, e]	SR[a, d, e]	-	no
EE	EX [d, e]	EX[d, e]	-	no
EL	EX[d], CS[e]	SR[a, d, e]	2009	no
ES	IM[d]	SR[a, d, e]	2007	yes
FI	IM[d]	SR[c, i]/DIT[d, e]	2005	yes
FR	IM[d]	SR[c, d, e]	2005, 2009, 2013	yes
HR	EX[d, e]	SR[a, d, e]	2001, 2005, 2012	no
HU	SR[a, d, e, g]	SR[a, d, e, g]	-	no
IE	CS[d, e]	CS[d, e]	-	no
IT	IM[d]	SR[a, d, e]	2004, 2018	yes
LT	SR[a, d, e]	SR[a, d, e]	-	no
LU	SR[c, d, e]	SR[c, d, e]	-	no
LV	EX[d, e]	EX[d, e]	-	no
MT	IM[d, e]	IM[d, e]	2007	yes
NL	SR[a, d, e]	SR[a, d, e]	2001	no
PL	SR[a, d, e]	SR[a, d, e]	-	no
PT	IM[d, e]	SR[a/c, d, e]	2002	no
RO	SR[a, d, e]	SR[a, d, e]	-	no
SE	SR[a, d, f]	SR[a, d, f]	-	no
SI	SR[c, d, e]	SR[a, d, e]	2007	no

States[1]	1999	2019	Year(s) of change(s)	Discrimination between 1999-2019
SK	SR[a, d, e]	SR[a, d, e]	2004, 2017	no
UK	SR[d, 3]	SR[d, e]	2016	yes

Notes: The table shows the corporate tax systems on dividends in all EU Member States in 1999 and 2019. The year(s) of change(s) corresponds to the year of the fundamental change of the type of system. The last column indicates if the Member State's system discriminated against foreign- and domestic-sourced dividend payments within the considered period. Discrimination occurs if the relief mechanisms are limited to domestic-sourced dividends. Following this study's modelling, we assume an individual shareholder who is subject to the maximum tax rate and has a qualified shareholding in a corporation. The abbreviations are defined as follows: CS = Classical system; DIT = Dual income tax system; EX = Exemption system; IM = Imputation system; SR = Shareholder relief system. To further explain the systems, the following indices are utilised: [a] reduced flat tax rate; [b] reduced scheduler or progressive tax rate (upper limit); [c] partial exemption; [d] applicable to domestic dividends, [e] applicable to foreign dividends, [f] foreign dividends if paid out through domestic (corporate) intermediary, [g] limited by threshold, [h] for dividends received from listed companies, and [i] defense contribution applies (flat rate). Indices can co-exist.

[1] For some countries, the first information about their corporate tax systems was not available for 1999. Thus, the respective classifications related to the following year: Croatia-2001; Lithuania-2004.

[2] Foreign-sourced dividends are taxed by way of an assessment. Thus, a municipal surcharge applied which was not the case for dividends paid in Belgium. Consequently, foreign-sourced dividends carried a heavier tax burden. The ECJ declared the difference in treatment as incompatible with the free movement of capital, see ECJ C-233/09 2010. Following the judgment, the municipal surcharge no longer applied to dividends received from EEA Member States. As this discrimination, however, results from a difference in treatment with regard to municipal surcharges and not the relief mechanism of the corporate tax systems, we do not consider Belgium in the calculations.

[3] The classification of the UK system applicable in 1999 was extensively debated in the literature; see, e.g., for an overview, Tontsch 2002. In this study's setting, we follow the classification as a shareholder relief system according to *Harris* as the defining feature of the imputation system is not fulfilled. The ACT was imposed with respect to the shareholder's tax base which constitutes a withholding tax rather than an imputation system; see Harris 1996, 164.

Source: Own calculation and illustration.

Appendix 12 CoC on domestic and foreign investments of individual, qualified shareholder (1999-2019)

	1999	2001	2003	2005	2007	2009	2011	2013	2015	2017	2019
DE											
CoC domestic	4.72	4.72	4.83	5.35	5.00	7.38	7.44	7.44	7.44	7.52	7.54
CoC foreign lowest [country]	2.70 [SE]	1.32 [SE]	1.32 [SE]	2.02 [SE]	2.09 [NL]	4.65 [NL]	4.63 [NL]	4.58 [NL]	4.77 [NL]	4.05 [NL]	3.94 [NL]
CoC foreign highest [country]	9.66 [FR]	5.60 [FR]	5.54 [FR]	6.15 [FR]	5.90 [FR]	9.05 [FR]	8.59 [ES]	8.94 [ES]	9.54 [FR]	8.53 [FR]	8.55 [FR]
CoC foreign (EU-15)	7.54	3.93	4.00	4.46	4.16	7.05	6.87	6.95	6.99	6.73	6.61
CoC foreign (EU-10)	7.44	3.98	3.74	4.11	3.89	6.50	6.41	6.47	6.44	6.01	6.06
Δ CoC (EU-15)	2.82	-0.79	-0.83	-0.89	-0.84	-0.33	-0.57	-0.49	-0.45	-0.79	-0.93
Δ CoC (EU-10)	2.72	-0.74	-1.09	-1.24	-1.11	-0.88	-1.04	-0.97	-1.00	-1.51	-1.48
ES											
CoC domestic	6.01	6.02	6.00	6.00	9.00	8.82	8.59	8.95	8.77	8.39	8.39
CoC foreign lowest [country]	3.43 [SE]	3.39 [SE]	3.58 [SE]	3.69 [SE]	5.04 [NL]	4.86 [NL]	4.77 [NL]	4.57 [NL]	4.87 [NL]	4.18 [NL]	4.06 [NL]
CoC foreign highest [country]	9.84 [FR]	9.40 [FR]	9.26 [FR]	9.26 [FR]	9.01 [FR]	9.04 [FR]	8.34 [FR]	8.72 [FR]	9.54 [FR]	8.53 [FR]	8.55 [FR]
CoC foreign (EU-15)	7.64	7.33	7.37	7.15	7.05	6.95	6.80	6.85	6.90	6.67	6.56
CoC foreign (EU-10)	7.51	7.25	6.87	6.65	6.56	6.50	6.40	6.48	6.44	6.01	6.06
Δ CoC (EU-15)	1.63	1.31	1.37	1.15	-1.95	-1.87	-1.79	-2.10	-1.87	-1.72	-1.83
Δ CoC (EU-10)	1.50	1.23	0.87	0.65	-2.44	-2.32	-2.19	-2.48	-2.33	-2.38	-2.33
FI											
CoC domestic	4.69	4.72	4.72	5.88	6.25	6.03	6.29	5.83	6.03	6.14	6.16
CoC foreign lowest [country]	4.22 [HR]	4.26 [SE]	4.26 [SE]	3.44 [SE]	4.04 [NL]	3.87 [NL]	3.85 [NL]	3.58 [NL]	4.10 [NL]	3.30 [NL]	3.19 [NL]
CoC foreign highest [country]	9.55 [FR]	9.39 [ES]	9.39 [ES]	7.57 [ES]	7.92 [FR]	7.95 [FR]	7.39 [ES]	7.51 [ES]	8.75 [FR]	7.79 [FR]	7.81 [FR]
CoC foreign (EU-15)	7.65	7.41	7.45	5.86	6.15	6.07	5.89	5.80	6.38	6.10	5.99
CoC foreign (EU-10)	7.40	7.16	6.79	5.30	5.65	5.59	5.50	5.40	5.85	5.40	5.45
Δ CoC (EU-15)	2.96	2.69	2.73	-0.02	-0.10	0.04	-0.40	-0.03	0.35	-0.04	-0.17
Δ CoC (EU-10)	2.71	2.44	2.07	-0.58	-0.60	-0.44	-0.79	-0.44	-0.18	-0.74	-0.72

	1999	2001	2003	2005	2007	2009	2011	2013	2015	2017	2019
FR											
CoC domestic	12.92	12.08	10.81	10.14	10.13	9.08	8.38	5.43	5.99	5.32	8.58
CoC foreign lowest [country]	10.80 [SE]	10.45 [SE]	9.42 [SE]	5.15 [SE]	5.55 [NL]	4.56 [NL]	4.50 [NL]	1.16 [NL]	1.25 [NL]	0.32 [NL]	3.61 [NL]
CoC foreign highest [country]	21.26 [ES]	20.81 [ES]	18.85 [ES]	10.69 [ES]	10.28 [ES]	8.85 [ES]	8.62 [ES]	5.33 [ES]	5.21 [ES]	4.96 [ES]	8.41 [ES]
CoC foreign (EU-15)	17.32	16.50	14.86	8.15	8.05	6.94	6.81	3.82	3.81	3.64	6.53
CoC foreign (EU-10)	16.63	15.72	13.60	7.47	7.47	6.51	6.41	3.71	3.69	3.27	6.07
Δ CoC (EU-15)	4.40	4.42	4.05	-1.99	-2.08	-2.14	-1.57	-1.61	-2.18	-1.68	-2.05
Δ CoC (EU-10)	3.71	3.64	2.79	-2.67	-2.66	-2.57	-1.97	-1.72	-2.30	-2.05	-2.51
IT											
CoC domestic	6.70	6.61	8.60	8.38	8.38	8.52	7.48	6.65	5.30	6.75	6.68
CoC foreign lowest [country]	9.25 [SE]	9.20 [SE]	9.20 [SE]	5.32 [SE]	5.62 [NL]	5.86 [NL]	5.93 [NL]	5.05 [NL]	4.54 [NL]	4.18 [NL]	3.96 [NL]
CoC foreign highest [country]	17.22 [ES]	17.30 [ES]	15.98 [DE]	10.12 [ES]	9.74 [ES]	10.30 [FR]	10.10 [ES]	9.44 [ES]	9.14 [FR]	8.71 [FR]	8.56 [FR]
CoC foreign (EU-15)	14.24	13.96	13.37	7.88	7.75	8.22	8.25	7.46	6.79	6.95	6.68
CoC foreign (EU-10)	13.74	13.34	12.72	7.21	7.12	7.68	7.53	6.90	6.24	6.33	6.17
Δ CoC (EU-15)	7.54	7.35	4.77	-0.50	-0.63	-0.30	0.77	0.81	1.49	0.20	0.00
Δ CoC (EU-10)	7.04	6.73	4.12	-1.17	-1.26	-0.84	0.05	0.25	0.94	-0.42	-0.51

Notes: The table shows the development of the CoC in the selected Member States between 1999 and 2019 at two-year intervals in %. The underlying model setting assumes an individual, qualified shareholder who undertakes an investment in a domestic corporation. The corporation then decides whether to invest the additional capital in a domestic (domestic investment) or foreign (foreign investment) subsidiary. The option of an investment split is excluded. A pure equity investment is assumed at the shareholder and corporate levels to clearly identify tax distortions caused by potential double taxation of economic returns in the form of dividend payments. As the foreign investment, the unweighted CoC of the EU-15/EU-10 Member States excluding the shareholder's residence state in the respective year is applied. The table lists the CoC and the delta for the CoC of the domestic and foreign investment (EU-15 and EU-10) for every second year. Moreover, the lower and higher bound of the CoC within the selected EU Member States is included by assuming a foreign investment in the country with the lowest (highest) CoC. The country is indicated in square brackets ('[]') after the CoC value. 'Δ' displays the difference between the CoC of the foreign investment and the CoC of the domestic investment in pp.
Sources: Own calculation and illustration based on several information from Spengel et al. 2020

Appendix 13 EATRs on domestic and foreign investments of individual, qualified shareholder (1999-2019)

	1999	2001	2003	2005	2007	2009	2011	2013	2015	2017	2019
DE											
EATR domestic	47.47	39.57	40.59	39.63	39.45	42.72	42.88	42.88	42.88	43.38	43.46
EATR foreign lowest [country]	45.84 [SE]	16.73 [IE]	20.21 [LT]	16.92 [CY]	15.95 [BG]	26.90 [BG]	27.04 [BG]	27.04 [BG]	27.04 [BG]	27.04 [BG]	27.04 [BG]
EATR foreign highest [country]	61.12 [FR]	40.33 [ES]	40.33 [ES]	40.41 [ES]	38.88 [FR]	48.41 [FR]	47.05 [FR]	48.58 [FR]	52.42 [FR]	47.47 [FR]	47.51 [FR]
EATR foreign (EU-15)	56.11	33.35	32.94	31.32	30.47	40.28	39.33	39.57	39.43	38.19	37.56
EATR foreign (EU-10)	54.97	30.02	27.28	24.70	25.00	34.98	34.33	34.77	34.58	33.05	33.31
Δ EATR (EU-15)	8.64	-6.22	-7.65	-8.31	-898	-2.44	-3.55	-3.32	-3.45	-5.19	-5.90
Δ EATR (EU-10)	7.50	-9.55	-13.31	-14.93	-14.45	-7.74	-8.55	-8.11	-8.30	-10.33	-10.15
ES											
EATR domestic	42.60	42.60	40.73	40.73	45.01	43.42	43.83	46.83	44.02	41.80	41.80
EATR foreign lowest [country]	40.71 [IE]	40.67 [IE]	40.01 [SE]	39.44 [CY]	21.51 [BG]	21.49 [BG]	23.56 [BG]	27.40 [BG]	24.84 [BG]	24.84 [BG]	24.84 [BG]
EATR foreign highest [country]	58.72 [FR]	57.00 [FR]	56.33 [DE]	55.58 [DE]	45.88 [DE]	45.39 [FR]	45.01 [FR]	48.80 [FR]	51.39 [FR]	46.21 [FR]	46.25 [FR]
EATR foreign (EU-15)	52.83	51.98	50.46	49.38	36.68	36.10	36.53	39.58	37.63	36.53	35.89
EATR foreign (EU-10)	51.24	49.97	46.51	44.98	30.94	30.47	31.38	35.08	32.73	31.13	31.40
Δ EATR (EU-15)	10.23	9.37	9.73	8.65	-8.33	-7.32	-7.30	-7.25	-6.39	-5.27	-5.91
Δ EATR (EU-10)	8.64	7.37	5.78	4.25	-14.07	-12.95	-12.45	-11.75	-11.29	-10.67	-10.40
FI											
EATR domestic	19.46	20.33	20.33	30.76	33.77	33.10	33.91	33.13	34.43	35.21	35.27
EATR foreign lowest [country]	28.32 [IE]	28.92 [IE]	31.90 [LT]	17.37 [CY]	19.48 [BG]	19.46 [BG]	19.62 [BG]	20.97 [BG]	26.28 [BG]	26.77 [BG]	26.77 [BG]
EATR foreign highest [country]	52.25 [FR]	50.66 [ES]	50.92 [DE]	41.97 [ES]	43.49 [DE]	42.99 [FR]	41.51 [FR]	43.77 [FR]	51.21 [FR]	46.61 [FR]	46.65 [FR]
EATR foreign (EU-15)	45.20	44.59	44.31	33.19	35.05	34.42	33.32	34.58	38.96	38.09	37.48
EATR foreign (EU-10)	42.42	41.22	38.63	25.45	28.76	28.30	27.59	29.15	33.68	32.60	32.85
Δ EATR (EU-15)	25.74	24.26	23.98	2.43	1.28	1.32	-0.59	1.44	4.53	2.88	2.21
Δ EATR (EU-10)	22.96	20.89	18.30	-5.31	-5.01	-4.80	-6.32	-3.98	-0.75	-2.61	-2.42

	1999	2001	2003	2005	2007	2009	2011	2013	2015	2017	2019
FR											
EATR domestic	62.58	60.01	55.76	53.61	53.42	49.76	48.91	48.09	51.12	47.18	50.36
EATR foreign lowest [country]	61.58 [SE]	60.67 [SE]	57.71 [SE]	35.32 [CY]	34.08 [BG]	29.25 [BG]	30.16 [BG]	30.60 [BG]	30.60 [BG]	30.60 [BG]	31.90 [BG]
EATR foreign highest [country]	74.78 [DE]	73.93 [ES]	71.67 [DE]	54.70 [ES]	53.85 [DE]	48.05 [ES]	48.43 [MT]	46.23 [ES]	46.17 [MT]	44.81 [BE]	46.68 [DE]
EATR foreign (EU-15)	71.05	69.89	67.05	47.04	46.30	41.60	41.37	40.25	39.89	39.16	41.04
EATR foreign (EU-10)	70.18	68.70	64.26	41.69	41.73	36.95	36.99	36.82	36.66	35.43	37.54
Δ EATR (EU-15)	8.47	9.88	11.29	-6.57	-7.13	-8.16	-7.55	-7.84	-11.23	-8.02	-9.32
Δ EATR (EU-10)	7.60	8.69	8.50	-11.92	-11.69	-12.81	-11.92	-11.27	-14.46	-11.76	-12.82
IT											
EATR domestic	41.37	41.24	46.14	44.60	44.60	43.96	41.60	39.34	35.51	39.58	38.76
EATR foreign lowest [country]	52.18 [IE]	52.34 [IE]	53.20 [SE]	24.90 [CY]	23.36 [BG]	27.74 [BG]	28.84 [BG]	26.36 [BG]	23.98 [BG]	28.01 [BG]	26.76 [BG]
EATR foreign highest [country]	69.72 [FR]	68.43 [ES]	68.63 [DE]	48.68 [ES]	47.64 [DE]	50.23 [FR]	49.46 [FR]	48.68 [FR]	50.53 [FR]	48.21 [FR]	47.37 [FR]
EATR foreign (EU-15)	64.18	63.62	63.27	39.68	38.64	41.78	41.80	39.61	37.31	39.35	37.67
EATR foreign (EU-10)	63.21	62.14	60.20	33.76	33.00	37.19	36.24	34.80	32.58	35.33	34.08
Δ EATR (EU-15)	22.81	22.38	17.13	-4.92	-5.96	-2.18	0.20	0.27	1.80	-0.23	-1.09
Δ EATR (EU-10)	21.84	20.90	14.06	-10.84	-11.61	-6.77	-5.36	-4.54	-2.93	-4.25	-4.68

Notes: The table displays the development of the EATRs for selected EU Member States between 1999 and 2019 at two-year intervals in %. We assume an individual, qualified shareholder who undertakes an investment in a domestic corporation. The corporation subsequently decides whether to invest the additional capital in a domestic (domestic investment) or foreign (foreign investment) subsidiary. The option of an investment split is excluded. Moreover, we assume equity investments at the shareholder and corporate level to clearly identify tax distortions caused by potential double taxation of economic returns in the form of dividend payments. As the foreign investment, we consider the unweighted EATR of the EU-15/EU-10 Member States excluding the shareholder's residence state in the respective year. The table lists the EATR and the delta for the EATR of the domestic and foreign investment (EU-15 and EU-10) for every second year. Moreover, we add the lower and higher bound of the EATR for every second year within the selected EU countries by assuming a foreign investment in the country with the lowest and highest EATR. The country is indicated in square brackets ('[]') after the EATR value. 'Δ' displays the difference of the EATR of the foreign investment and the EATR of the domestic investment in pp.
Sources: Own calculation and illustration based on several information from Spengel et al. 2020

C Appendix to Chapter 4

Appendix 14 National ACE regimes in EU Member States

Country	Legislation since	Base of ACE	Determination of notional interest rate	Notional interest rate of 2022	Deduction limitations and carryforwards	Anti-abuse measures
DEBRA	Forthcoming	Difference between equity at end of tax year and equity at end of previous tax year	Risk-free interest rate with maturity of 10 years, as laid down in implementing acts to Article 77e (2) of Directive 2009/138/EC plus 1% risk premium	1.205% (+ 0.5% for SMEs)[358]	30% of EBITDA, 9 years carryforward	Yes
Belgium	2006	One fifth of positive difference between equity at end of taxable period and fifth preceding taxable period	Applicable rate is equal to the average of the benchmark indices (10-year linear bonds) published monthly by the Pension Fund	0% (+ 0.5% for SMEs)	No limitation for taxable income below 1 Mio EUR, above deduction cannot exceed 70% of taxable income; no carryforward	Yes
Cyprus	2015	New equity, which has been brought into business on or after 31 December 2014, but which does not include amounts from capitalization of pre-existing reserves	10-year government bond yield rate of the country where new equity is employed/invested increased by 5 pp.	5.629%	Amount of deduction cannot exceed 80% of taxable income; no carryforward	Yes
Italy	2011	Increase in equity defined as equity contributions and retained earnings (except profits allocated to a non-disposable reserve) less reductions of the net equity, investments in controlled companies and certain intra-group business acquisitions and transactions after 31 December 2010	Rate determined by decree of Minister of the Economy and Finance on 31 January of each year, considering returns of public bonds, which can be increased by a further 3 pp.	1.3%	Deduction cannot exceed 90% of taxable income; unlimited carryforward	Yes

[358] The notional interest rate of 1.205% is derived following Article 4 (2) of DEBRA and Article 77e (2) of Directive 2009/138/EC and is therefore the correct notional interest rate for 2022. In our analysis, we apply a notional interest rate of 4.092%, which is the correct notional interest rate for 2023. We apply this rate to provide more relevant results given the current rising interest rates in the EU.

Country	Legislation since	Base of the ACE	Determination of notional interest rate	Notional interest rate of 2022	Deduction limitations and carryforwards	Anti-abuse measures
Malta	2018	Equity for accounting period ending in year preceding year of assessment less any equity directly employed in form of non-Maltese securities, interest in a partnership, contributions and any other loans or debts	Risk free rate set by reference to yield to maturity on Malta Government Stocks with remaining term of approximately 20 years plus a premium of 5%	8.04%	Amount of deduction cannot exceed 90% of the taxable income; unlimited carryforward	Yes
Poland	2019	Equity as additional payments made to company in manner and on terms specified in separate regulations or profits transferred to company's reserve or supplementary capital	Reference rate of National Bank of Poland applicable on last working day of year preceding tax year, increased by 1 pp.	2.75%	Deductible amount capped at 250,000 PLN (~55,000 EUR) and limited to 3 consecutive years; unlimited carryforward	Yes
Portugal	2008	Equity as amount of contributions made by cash payments or through conversion of shareholders' equity or loans, within scope of incorporation of a company or an increase in share capital	Fixed rate	7%	Deductible amount capped at 140,000 EUR; carryforward limited to 5 consecutive years	Yes

Notes: The table displays key elements of the national ACE regime implemented in the EU Member States as of 2022 and the same key elements of DEBRA for comparison.
Sources: Own illustration based on information from Central Bank of Malta 2023; Council of the European Union 2023; Deloitte 2022; European Commission 2022a; Hohlwegler et al. 2023; IBFD 2023; Narodowsky Bank Polski 2023; PwC 2023.

Appendix 15 National risk-free interest rate (2022)

Currency (EU Member State)	Interest rate
Euro	3.092%
Lev (BG)	3.042%
Kuna (HR)	4.151%
Czech Koruna (CZ)	4.602%
Krone (DK)	3.082%
Forint (HU)	8.609%
Złoty (PL)	6.648%
Leu (RO)	8.556%
Krona (SE)	3.010%

Notes: The table displays the 10-year currency-specific risk-free interest rates published by EIOPA as of 31 December 2022.
Sources: Own illustration based on EIOPA 2023.

Appendix 16 National tax depreciation per asset group

Country	Buildings	Machinery	Intangibles	Inventory	Financial assets
AT	SL (40 years)	SL (7 years)	SL (10 years)	LIFO	FIFO
BE	SL (20 years)	SL (10 years)	SL (5 years), but first-year investment deduction of 13.5%	LIFO	FIFO
BG	SL (25 years)	SL (3 years)	SL (7 years)	Average	FIFO
HR	SL (10 years)	SL (2 years)	SL (2 years)	Average	FIFO
CY	SL (25 years)	SL (10 years)	SL (10 years)	Average	FIFO
CZ	Accelerated depreciation method	Accelerated depreciation method	SL (10 years)	Average	FIFO
DK	SL (25 years)	DB (25%)	SL (1 year)	FIFO	Average
FI	DB (7%)	DB (25%)	SL (10 years)	FIFO	FIFO
FR	SL (20 years)	Switch (32.1%)	SL (5 years)	Average	FIFO
DE	SL (33 years)	SL (7 years)	SL (5 years)	LIFO	FIFO
GR	SL (25 years)	SL (10 years)	SL (10 years)	Average	FIFO
HU	SL (50 years)	SL (2 years)	SL (2 years)	Average	FIFO
IE	SL (25 years)	SL (8 years)	SL (10 years)	Average	FIFO
IT	SL (26 years), but first and last year at half rate	SL (9 years), but first and last year at half rate	SL (3 years)	LIFO	FIFO
LT	DB (25%)	DB (40%)	DB (66%)	LIFO	FIFO
LU	SL (25 years)	Switch (30%), but first-year investment deduction of 2%	SL (5 years)	LIFO	FIFO
MT	SL (45 years), but first-year depreciation of 12%	SL (5 years)	SL (10 years)	FIFO	FIFO
NL	SL (40 years)	SL (7 years)	SL (5 years)	LIFO	FIFO
PL	SL (40 years)	SL (10 years)	SL (5 years)	LIFO	FIFO
PT	SL (20 years)	DB (35.71%)	SL (10 years)	Average	FIFO
RO	SL (40 years)	SL (7 years), but first-year depreciation of 50%	SL (10 years), but first-year depreciation of 50%	LIFO	FIFO
SK	SL (20 years)	Accelerated depreciation method	SL (5 years)	Average	FIFO
SI	SL (33 years)	SL (5 years)	SL (10 years)	Average	FIFO
ES	SL (33 years)	Switch (24%)	SL (10 years)	Average	FIFO
SE	SL (25 years)	DB (30%)	DB (30%)	FIFO	FIFO

Notes: The abbreviations stand for straight-line depreciation (SL), declining balance (DL), declining balance with an option to switch for straight-line depreciation (switch), LIFO, FIFO, and weighted average cost method (average).
Sources: Own illustration based on IBFD 2023.

Appendix 17 Effective tax levels for DEBRA baseline scenario (2022)

Country	Status quo		DEBRA		ACE only		Interest deduction limitation rule	
	CoC	EATR	CoC	EATR	CoC	EATR	CoC	EATR
AT	1.42%	24.97%	0.60%	21.91%	0.55%	21.71%	1.47%	25.17%
BE	1.54%	25.43%	0.72%	22.36%	0.67%	22.16%	1.60%	25.63%
BG	1.21%	10.08%	0.94%	8.85%	0.92%	8.78%	1.22%	10.16%
			[0.94%]	[8.87%]				
HR	1.16%	17.39%	0.62%	15.19%	0.58%	15.04%	1.19%	17.53%
			[0.47%]	[14.58%]				
CY	0.95%	14.49%	1.01%	14.78%	0.97%	14.65%	0.99%	14.62%
CZ	1.31%	18.96%	0.74%	16.63%	0.70%	16.48%	1.35%	19.11%
			[0.51%]	[15.72%]				
DK	1.47%	22.39%	0.78%	19.69%	0.74%	19.51%	1.52%	22.56%
			[0.78%]	[19.70%]				
FI	1.69%	21.42%	1.08%	18.97%	1.04%	18.81%	1.73%	21.58%
FR	1.72%	27.25%	0.84%	24.01%	0.78%	23.80%	1.77%	27.46%
DE	1.59%	31.64%	0.46%	27.74%	0.39%	27.52%	1.66%	31.86%
GR	1.58%	22.80%	0.89%	20.11%	0.84%	19.93%	1.62%	22.98%
HU	1.54%	12.19%	1.23%	10.81%	1.21%	10.74%	1.55%	12.26%
			[0.79%]	[8.86%]				
IE	1.37%	15.42%	1.01%	13.91%	0.98%	13.79%	1.40%	15.54%
IT	1.23%	26.20%	0.56%	23.75%	0.51%	23.57%	1.29%	26.39%
LT	1.22%	14.82%	0.79%	12.99%	0.76%	12.87%	1.25%	14.94%
LU	1.33%	24.59%	0.52%	21.53%	0.47%	21.33%	1.39%	24.79%
MT	1.24%	5.53%	1.52%	6.86%	1.43%	6.45%	1.33%	5.94%
NL	1.41%	25.68%	0.56%	22.53%	0.50%	22.32%	1.47%	25.89%
PL	0.95%	17.51%	0.79%	16.85%	0.75%	16.70%	0.99%	17.66%
			[0.26%]	[14.70%]				
PT	-0.47%	24.53%	0.45%	27.70%	0.38%	27.45%	-0.40%	24.78%
RO	1.36%	16.36%	0.89%	14.40%	0.86%	14.27%	1.39%	16.49%
			[0.23%]	[11.61%]				
SK	1.36%	21.04%	0.71%	18.47%	0.67%	18.30%	1.41%	21.21%
SI	1.33%	19.02%	0.75%	16.69%	0.71%	16.54%	1.36%	19.17%
ES	2.01%	31.35%	0.58%	27.55%	0.52%	27.35%	2.07%	31.55%
SE	1.41%	20.85%	0.78%	18.33%	0.73%	18.16%	1.45%	21.02%
			[0.79%]	[18.38%]				

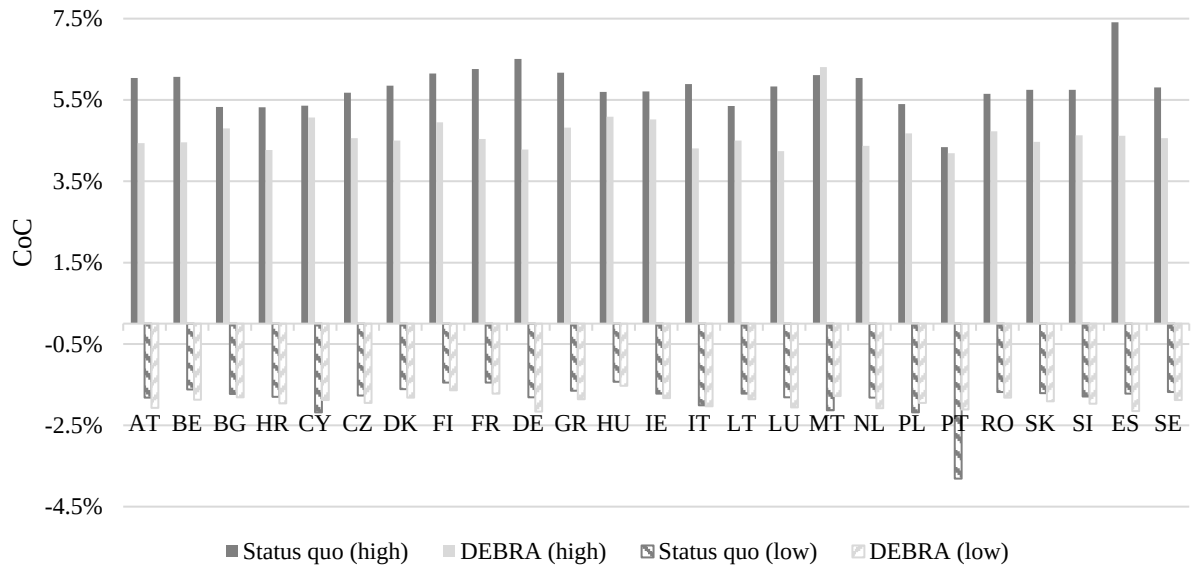
Notes: The table displays the EU Member States' CoC and EATRs under the status quo and under application of DEBRA using a notional interest rate of 4.092% and an interest deduction limitation of 15%. Moreover, the table provides the sample states' CoC and EATRs under separate application of DEBRA's notional interest deduction and interest deduction limitation. In the national currency scenario, the notional interest rates are 4.032% (BG), 5.151% (HR), 5.602% (CZ), 4.082% (DK), 9.609% (HU), 7.648% (PL), 9.556% (RO) and 4.01% (SE). The results of the national currency scenario are given in square brackets ('[]') in the DEBRA columns.
Sources: Own calculation and illustration.

Appendix 18 Effective tax levels for DEBRA with interest rate variation (2022)

Country	Low interest rate		Medium interest rate		High interest rate	
	CoC	EATR	CoC	EATR	CoC	EATR
AT	-2.07%	26.03%	0.60%	21.91%	4.44%	16.66%
BE	-1.87%	26.79%	0.72%	22.36%	4.46%	16.74%
BG	-1.81%	10.63%	0.94%	8.85%	4.80%	6.60%
HR	-1.96%	18.75%	0.62%	15.19%	4.27%	10.51%
CY	-1.88%	16.89%	1.01%	14.78%	5.07%	12.11%
CZ	-1.95%	19.91%	0.74%	16.63%	4.56%	12.46%
DK	-1.82%	23.69%	0.78%	19.69%	4.50%	14.53%
FI	-1.64%	22.23%	1.08%	18.97%	4.95%	14.80%
FR	-1.72%	28.72%	0.84%	24.01%	4.54%	18.00%
DE	-2.16%	32.95%	0.46%	27.74%	4.28%	21.19%
GR	-1.86%	23.54%	0.89%	20.11%	4.82%	15.78%
HU	-1.53%	12.64%	1.23%	10.81%	5.09%	8.41%
IE	-1.83%	16.02%	1.01%	13.91%	5.02%	11.23%
IT	-2.03%	28.45%	0.56%	23.75%	4.31%	17.79%
LT	-1.86%	15.90%	0.79%	12.99%	4.50%	9.14%
LU	-2.06%	26.01%	0.52%	21.53%	4.24%	15.85%
MT	-1.78%	5.32%	1.52%	6.86%	6.31%	9.95%
NL	-2.08%	26.87%	0.56%	22.53%	4.37%	17.02%
PL	-1.95%	19.92%	0.79%	16.85%	4.68%	12.96%
PT	-2.11%	33.08%	0.45%	27.70%	4.19%	20.85%
RO	-1.82%	17.15%	0.89%	14.40%	4.73%	10.88%
SK	-1.91%	22.24%	0.71%	18.47%	4.47%	13.66%
SI	-1.97%	19.83%	0.75%	16.69%	4.63%	12.73%
ES	-2.15%	32.31%	0.58%	27.55%	4.62%	21.59%
SE	-1.88%	21.94%	0.78%	18.33%	4.56%	13.72%

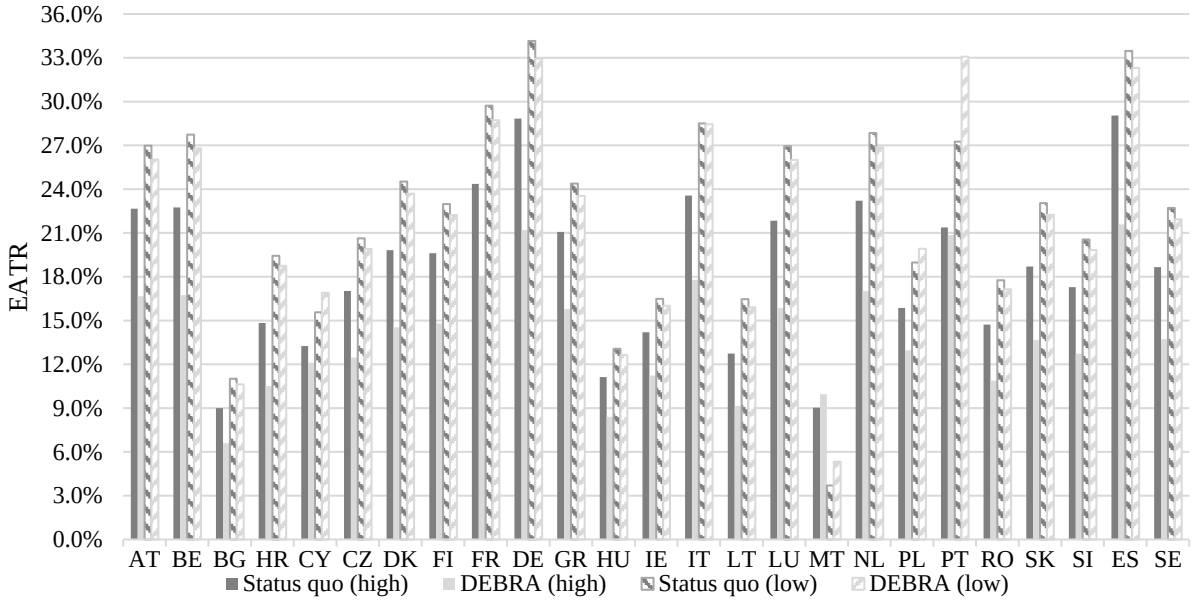
Notes: The table displays the CoC and EATRs under application of DEBRA in different interest rate scenarios. The nominal (notional) interest rate amounts to 0.205% (1.205%) in the low interest rate scenario, to 3.092% (4.092%) in the medium interest rate scenario and to 7.1% (8.1%) in the high interest rate scenario. Only the euro-specific notional interest rate is considered here.
Source: Own calculation and illustration.

Appendix 19 CoC for status quo and DEBRA (high and low interest rate)



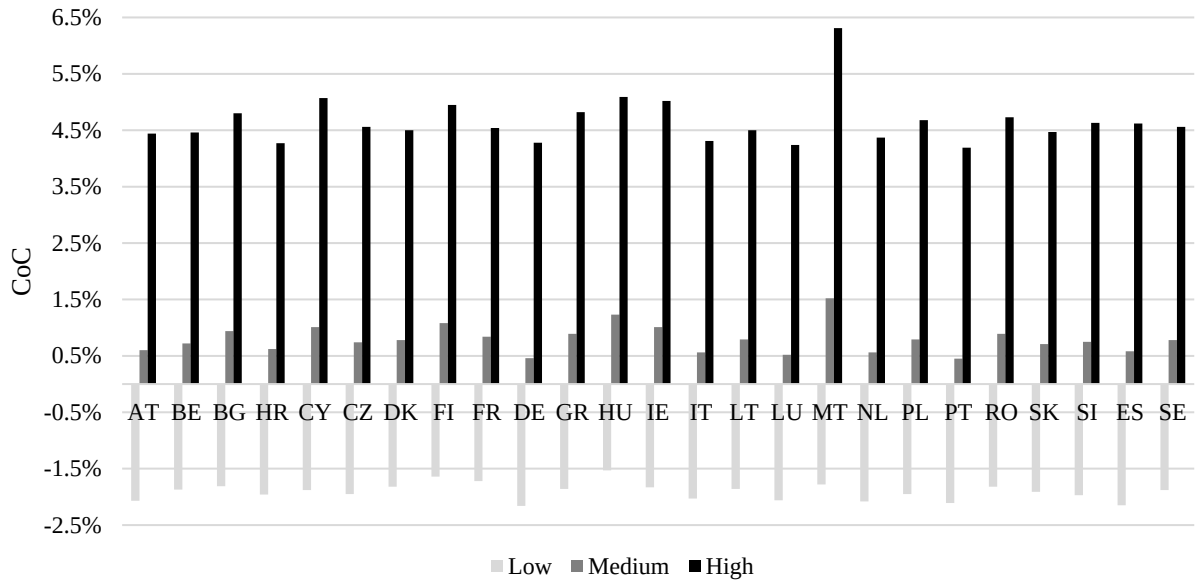
Notes: The figure compares the CoC under the sample states' status quo (dark grey bars) and under application of DEBRA (light grey bars) for a high interest scenario (filled bars) and low interest scenario (dashed bars). For the high interest rate scenario, the nominal (notional) interest rate amounts to 7.1% (8.1%). For the low interest rate scenario, the nominal (notional) interest rate amounts to 0.205% (1.205%). Only the euro-specific notional interest rate is considered here. Under DEBRA interest deductibility is reduced by 15%.
Source: Own calculation and illustration.

Appendix 20 EATRs for status quo and DEBRA (high and low interest rate)



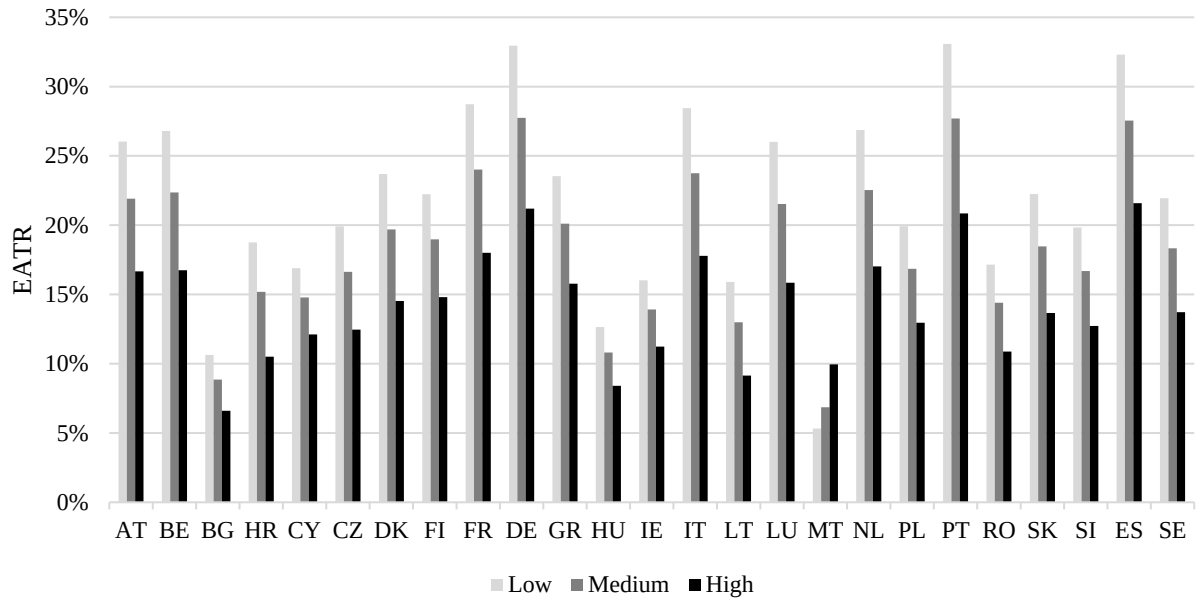
Notes: The figure compares the EATRs under the sample states' status quo (dark grey bars) and under application of DEBRA (light grey bars) for a high interest scenario (filled bars) and low interest scenario (dashed bars). For the high interest rate scenario, the nominal (notional) interest rate amounts to 7.1% (8.1%). For the low interest rate scenario, the nominal (notional) interest rate amounts to 0.205% (1.205%). Only the euro-specific notional interest rate is considered here. Under DEBRA interest deductibility is reduced by 15%.
Source: Own calculation and illustration.

Appendix 21 CoC for DEBRA with interest rate variation



Notes: The figure compares the sample states' CoC under application of DEBRA in different interest rate scenarios. The nominal (notional) interest rate amounts to 0.205% (1.205%) in the low interest rate scenario (light grey bars), to 3.092% (4.092%) in the medium interest rate scenario (dark grey bars) and to 7.1% (8.1%) in the high interest rate scenario (black bars). Only the euro-specific notional interest rate is considered here. In all scenarios interest deductibility is reduced by 15%.
Source: Own calculation and illustration.

Appendix 22 EATRs for DEBRA with interest rate variation



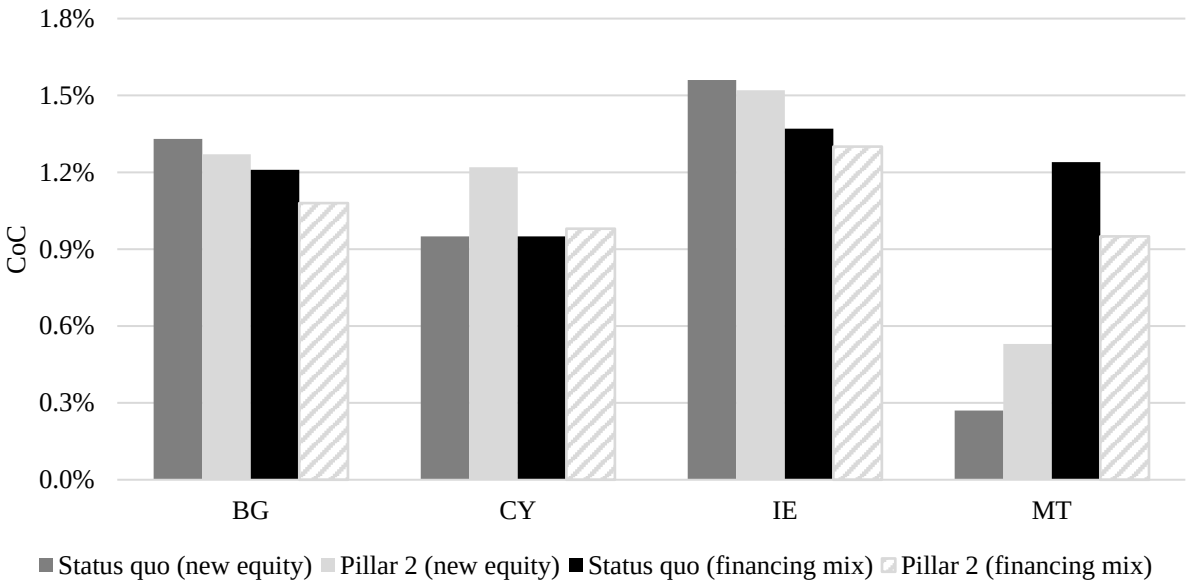
Notes: The figure compares the sample states' EATR under application of DEBRA in different interest rate scenarios. The nominal (notional) interest rate amounts to 0.205% (1.205%) in the low interest rate scenario (light grey bars), to 3.092% (4.092%) in the medium interest rate scenario (dark grey bars) and to 7.1% (8.1%) in the high interest rate scenario (black bars). Only the euro-specific notional interest rate is considered here. In all scenarios interest deductibility is reduced by 15%.
Source: Own calculation and illustration.

Appendix 23 Effective tax levels for DEBRA and BEFIT

Country	Status quo		Status quo (BEFIT)		DEBRA (national tax base)		DEBRA (BEFIT)	
	CoC	EATR	CoC	EATR	CoC	EATR	CoC	EATR
AT	1.42%	24.97%	1.43%	25.03%	0.60%	21.91%	0.62%	21.96%
BE	1.54%	25.43%	1.77%	26.29%	0.72%	22.36%	0.95%	23.22%
BG	1.21%	10.08%	1.22%	10.14%	0.94%	8.85%	0.95%	8.92%
HR	1.16%	17.39%	1.28%	17.88%	0.62%	15.19%	0.74%	15.68%
CY	0.95%	14.49%	0.91%	14.28%	1.01%	14.78%	0.96%	14.57%
CZ	1.31%	18.96%	1.31%	18.96%	0.74%	16.63%	0.74%	16.64%
DK	1.47%	22.39%	1.53%	22.63%	0.78%	19.69%	0.84%	19.93%
FI	1.69%	21.42%	1.60%	21.05%	1.08%	18.97%	0.99%	18.60%
FR	1.72%	27.25%	1.78%	27.48%	0.84%	24.01%	0.90%	24.24%
DE	1.59%	31.64%	1.67%	31.89%	0.46%	27.74%	0.53%	28.00%
GR	1.58%	22.80%	1.49%	22.44%	0.89%	20.11%	0.79%	19.74%
HU	1.54%	12.19%	1.40%	11.59%	1.23%	10.81%	1.10%	10.21%
IE	1.37%	15.42%	1.33%	15.27%	1.01%	13.91%	0.98%	13.76%
IT	1.23%	26.20%	1.33%	26.55%	0.56%	23.75%	0.66%	24.10%
LT	1.22%	14.82%	1.34%	15.33%	0.79%	12.99%	0.91%	13.49%
LU	1.33%	24.59%	1.53%	25.35%	0.52%	21.53%	0.72%	22.29%
MT	1.24%	5.53%	1.04%	4.57%	1.52%	6.86%	1.31%	5.89%
NL	1.41%	25.68%	1.45%	25.84%	0.56%	22.53%	0.60%	22.68%
PL	0.95%	17.51%	0.95%	17.49%	0.79%	16.85%	0.79%	16.83%
PT	-0.47%	24.53%	-0.48%	24.49%	0.45%	27.70%	0.44%	27.66%
RO	1.36%	16.36%	1.40%	16.53%	0.89%	14.40%	0.93%	14.57%
SK	1.36%	21.04%	1.41%	21.21%	0.71%	18.47%	0.76%	18.64%
SI	1.33%	19.02%	1.29%	18.88%	0.75%	16.69%	0.72%	16.55%
ES	2.01%	31.35%	1.90%	31.06%	0.58%	27.55%	0.48%	27.26%
SE	1.41%	20.85%	1.39%	20.77%	0.78%	18.33%	0.75%	18.24%

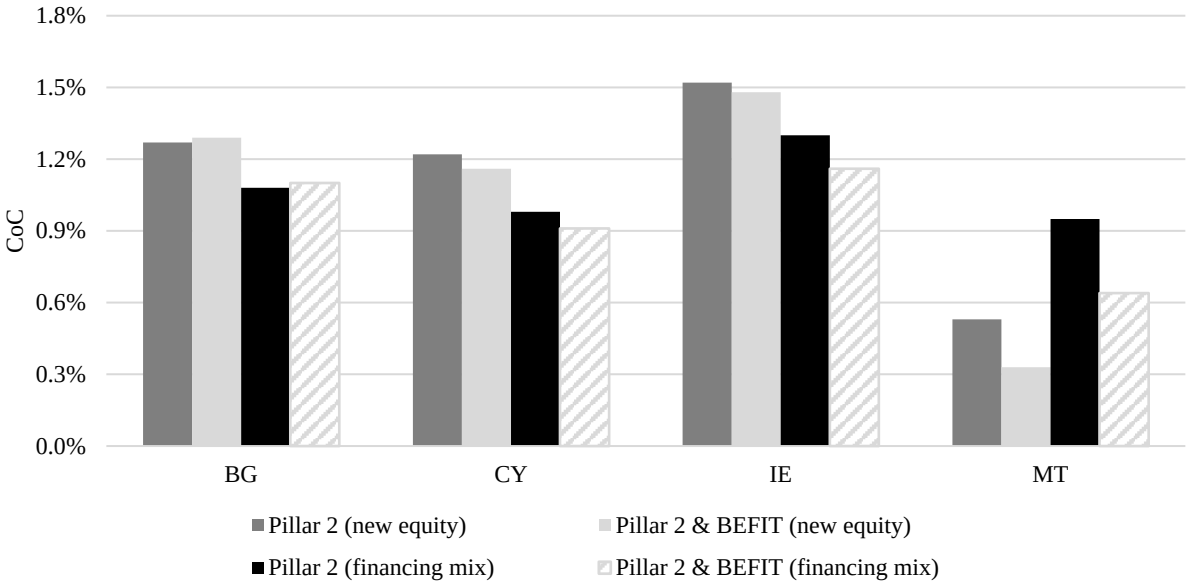
Notes: The table displays the sample states' CoC and EATRs under the status quo or under application of DEBRA, using the national tax base or the common tax base. Under DEBRA, the notional interest rate is 4.092% and interest deductibility is reduced by 15%. The common tax base assumes straight-line depreciation of buildings (28 years), machinery (7 years), and intangibles (5 years). Financial assets are not subject to depreciation. For inventories the weighted average cost method is applied.
Sources: Own calculation and illustration.

Appendix 24 CoC for status quo and Pillar 2 (2022)



Notes: The figure compares the CoC under the status quo and under the application of Pillar 2 (light grey filled and dashed bars). Moreover, it distinguishes between different sources of financing, either 100% new equity financing (grey filled bars) or mixed financing sources (black coloured and light grey dashed bars). In Malta, we assume that profits are distributed, and shareholders claim a tax refund, resulting in a combined income tax burden of 5%.
Source: Own calculation and illustration.

Appendix 25 Interaction of Pillar 2 and BEFIT (CoC)



Notes: The figure compares the CoC under the application of Pillar 2 with national tax bases (dark grey and black bars) and BEFIT's common tax base. Moreover, it distinguishes between different sources of financing, either 100% new equity financing (grey filled bars) or mixed financing sources (black filled and light grey dashed bars). The common tax base assumes straight-line depreciation of buildings (28 years), machinery (7 years), and intangibles (5 years). Financial assets are not subject to depreciation. For inventories the weighted average cost method is applied.
Source: Own calculation and illustration.

Appendix 26 Interaction of DEBRA and Pillar 2 (CoC)

Country	Status Quo	DEBRA		Pillar 2		Interaction	
	CoC	CoC	Δ in pp.	CoC	Δ in pp.	CoC	Δ in pp.
BG	1.33%	0.88%	-0.45	1.27%	-0.06	1.08%	-0.25
CY	0.95%	0.08%	-0.87	1.22%	0.27	1.31%	0.36
IE	1.56%	0.87%	-0.69	1.52%	-0.04	1.29%	-0.27
MT	0.27%	0.57%	0.30	0.53%	0.26	0.65%	0.38

Notes: The table displays the CoC for the status quo, under application of DEBRA and Pillar 2, and the interaction, i.e., simultaneous application of DEBRA and Pillar 2. For all scenarios 100% new equity financing is assumed to secure comparability. The columns named 'Δ in pp.' show the difference between the countries' CoC of the column-specific scenario and the respective CoC for the status quo.
Source: Own calculation and illustration.

Appendix 27 Interaction of DEBRA, Pillar 2, and BEFIT (CoC)

Country	Status Quo	DEBRA		Pillar 2		Interaction	
	CoC	CoC	Δ in pp.	CoC	Δ in pp.	CoC	Δ in pp.
BG	1.34%	0.89%	-0.45	1.29%	-0.05	1.14%	-0.20
CY	0.90%	0.93%	0.03	1.16%	0.26	1.20%	0.30
IE	1.53%	0.93%	-0.60	1.48%	-0.05	1.25%	-0.28
MT	0.07%	0.37%	0.30	0.33%	0.26	0.45%	0.38

Notes: The table displays the CoC for the status quo, under application of DEBRA and Pillar 2, and the interaction, i.e., simultaneous application of DEBRA and Pillar 2. For all scenarios 100% new equity financing, and the application of a common tax are assumed. The common tax base assumes straight-line depreciation of buildings (28 years), machinery (7 years), and intangibles (5 years). Financial assets are not subject to depreciation. For inventories the weighted average cost method is applied. The columns named 'Δ in pp.' show the difference between the countries' EATR of the column-specific scenario and the respective EATR for the status quo.
Source: Own calculation and illustration.

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