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Corporate Taxation and Profit Shifting: Sectoral Differences and the Influence of Intangible Assets among European Multinationals

Master's thesis

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Declaration of Authorship

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Abstract

This study examined the effect of tax rate changes on the pre-tax profits on a dataset of over 125,000 European MNE subsidiaries, focusing on the role of technological development (defined using Eurostat's NACE classification framework), patent box regimes, and intangible assets. Contrary to the initial expectations, not enough evidence was found to conclude that the studied panel of MNEs increases profits by shifting intangible assets to lower-tax jurisdictions. On the other hand, it was shown that high-tech subsidiaries are more likely to effectively allocate intangible assets to jurisdictions with favorable IP regimes to reduce their tax expenditure. However, the magnitude of the positive impact on pre-tax profit was modest, with each additional 1% increase in intangible assets resulting in 0.016% additional profit (at a 10% level of significance). Variations in tax sensitivity depending on the MNE's level of technological development were observed, with high-tech MNEs showing moderate sensitivity to effective tax rates, while low-tech subsidiaries exhibited greater sensitivity to changes in both effective and statutory tax rates. The subset of mid-tech MNEs provided mixed results. These findings highlight the need for continuous monitoring of IP incentives to prevent profit shifting and suggest further research on the long-term impact of specific tax policies, through the use of R&D expenditure metrics and longitudinal data.

JEL Classification	F23, H25, H26
Keywords	profit shifting, intangible assets, multinational corporation, corporate taxation, sectoral analysis, high-tech sectors
Title	Corporate Taxation and Profit Shifting: Sectoral Differences and the Influence of Intangible Assets among European Multinationals

Abstrakt

Tato studie zkoumala vliv změn daňových sazeb na zisk před zdaněním na datovém souboru více než 125,000 evropských dceřiných společností nadnárodních korporací se zaměřením na roli úrovně technologické vyspělosti (definované pomocí NACE klasifikačního rámce poskytovaného institucí Eurostat), režimů patentových schránek a nehmotných aktiv. Navzdory původním odhadům nebyl nalezen dostatek důkazů k prokázání, že zkoumaný panel nadnárodních společností zvyšuje zisky přesouváním nehmotných aktiv do jurisdikcí s nižší daňovou sazbou. Na druhé straně analýza prokázala, že technologicky vyspělé společnosti jsou více nakloněny efektivně alokovat nehmotná aktiva do jurisdikcí s výhodnými režimy duševního vlastnictví, aby tak snížily své daňové výdaje. Velikost pozitivního dopadu na zisk před zdaněním však byla mírná, přičemž každé další 1% zvýšení nehmotných aktiv vedlo k dodatečnému zisku 0,016% (na 10% hladině významnosti). Byly pozorovány rozdíly v daňové citlivosti v závislosti na úrovni technologického rozvoje nadnárodních společností, přičemž technologicky vyspělé nadnárodní společnosti vykazovaly střední citlivost vůči efektivním daňovým sazbám, zatímco dceřiné společnosti s nízkou technologickou vyspělostí vykazovaly větší citlivost na změny efektivních i statutárních daňových sazeb. Podskupina středně technicky vyspělých společností vykazovala smíšené výsledky. Tato zjištění zdůrazňují potřebu nepřetržitého sledování režimů duševního vlastnictví, aby se předešlo přesouvání zisků, a navrhují další výzkum dlouhodobého dopadu konkrétních daňových politik pomocí metrik jako výdaje za R&D a dlouhodobých studií.

Klasifikace JEL	F23, H25, H26
Klíčová slova	přesouvání zisků, nehmotný majetek, nadnárodní podniky, korporátní zdanění, sektorová analýza, high-tech sektory
Název práce	Korporátní zdanění a přesouvání zisků: Sektorové rozdíly a vliv nehmotného majetku mezi evropskými nadnárodními podniky

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Acronyms

BEPS Base Erosion and Profit Shifting

CbCR Country-by-Country Reporting

CIT Corporate Income Tax

EC European Commission

ECB European Central Bank

ETR Effective Tax Rate

EU European Union

EUR Euro

FE Fixed Effects

GDP Gross Domestic Product

GUO Global Ultimate Owner

IP Intellectual Property

KIS Knowledge Intensive Services

LKIS Low Knowledge Intensive Services

MNC Multinational Corporation

MNE Multinational Enterprise

NACE Nomenclature of Economic Activities

OECD Organization for Economic Co-operation and Development

SD Standard Deviation

SE Standard Error

WDI World Development Indicators

Master's Thesis Proposal

Author	Bc. Ivana Krouparová
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Proposed topic	Corporate Taxation and Profit Shifting: Sectoral Differences and the Influence of Intangible Assets among European Multinationals

Motivation

In the context of the modern global economy, multinational enterprises (MNEs) have become an integral part of driving innovative progress, creating job opportunities, and thus contributing to overall economic growth. Nevertheless, it is also the complex nature of their international operations, often spread across multiple jurisdictions, that poses substantial challenges to fair taxation. Oftentimes, profits are not reported in countries where they were originally generated, but rather creatively allocated to jurisdictions where the tax rate is lower. This activity is referred to as profit shifting and as many other forms of tax avoidance, is generally considered unethical. While the practice of profit shifting may not be illegal, it clearly goes against the principles of set tax laws and fair contribution to public finances relative to real economic activity in each country.

Multiple studies (e.g. Beer & Loeprick (2013) or Crotti (2021)) have shown that one of the key mechanisms multinationals employ in profit shifting is the strategic use of intangible assets, such as trademarks, licenses or intellectual property. Unlike fixed assets, the non-physical nature of intangibles allows them to be moved fairly easily from one jurisdiction to another. Moreover, establishing the value of intangible assets, especially in the initial stages of their existence, is essentially subjective. This opens the door for further pricing manipulation. As the share of intangible assets in modern companies continues to increase, the greater the importance of understanding their role in profit shifting.

More technologically advanced sectors, such as the technology or pharmaceutical industry, typically going hand in hand with higher reliance on intangible assets, create a unique context for examining these issues. Compared to less tech-reliant firms, technologically advanced MNEs may have greater opportunities and incentives to engage in profit shifting through the strategic use of intangible assets. This study aims to study and compare the tax behaviors of technology MNEs relative to the non-tech sectors with the hope of identifying any sector-specific patterns in response to tax rate changes and the use of favorable IP regimes.

Hypotheses

The goal of the paper is to examine the following three hypotheses:

1. Hypothesis #1: The effect of intangible assets on pre-tax profits differs between high and low-tax jurisdictions.
2. Hypothesis #2: The effect of intangible assets on pre-tax profits differs between jurisdictions with and without favorable IP regimes.
3. Hypothesis #3: The sensitivity of pre-tax profits to tax rates differs depending on the level of technological development.

Methodology

The dataset for this study will be sourced primarily from the Orbis Europe database. Orbis provides a comprehensive database containing detailed financial information on companies across Europe. The dataset will consist of multinationals' subsidiaries operating on European territory with European global ultimate owners (GUOs). In this case, GUO is defined as an entity owning at least 50.01 % of the subsidiary. A crucial assumption will be made that only profit-making and tax-paying multinationals shift profit.

Following in the steps of the existing literature (e.g. Huizinga & Laeven; Rathke; Viertola), the analysis will employ a fixed effects regression, making use of the Cobb-Douglas function to model the relationship between profits and tax rates. The Cobb-Douglas function helps capture the production capabilities of firms using capital and labor inputs and the resulting equation will be populated by a variety of financial variables such as profit before tax as the dependent variable, and regressors such as operating turnover, employee-related costs, tangible and intangible assets, as well as information on booked tax expenses and debt. These variables should provide a comprehensive view of the financial health and operational scale of the companies in the dataset.

Other than the statutory corporate tax rates, effective tax rates (or ETRs) will be used, as they can provide information on the real tax liability faced by an MNE. Many forms of tax rates, including the logarithmic transformation suggested by Garcia-Bernardo & Jánský, will be included in the analysis to examine the consistency and to better account for the non-linear relationship between tax rates and profit shifting.

The methodology will further include a detailed explanation of the following topics:

- Data segmentation based on NACE codes and European Commission classification criteria into three groups based on the level of technology development and knowledge intensity.
- Effective tax rates calculation and their differences relative to the statutory corporate income tax rates.
- Regression models used to assess the impact of favorable low-tax jurisdictions or favorable IP regimes on profit shifting behavior of each group of MNEs.

Expected Contribution

This study seeks to enhance knowledge of European multinationals' operations with a closer focus on the use of intangible assets tactics in relation to profit shifting. By examining data at the company level from the Orbis Europe database this research delves into how sensitive sectors, particularly those in the technology and non-technology fields, are to potential tax rate changes and to what extent they take advantage of favorable intellectual property regulations.

The main goal is to provide more insight in the following areas:

- **Sectoral Analysis with NACE Segmentation:** The aim of this study is to introduce a rather novel approach by using NACE-code segmentation to analyze profit-shifting behaviors across various sectors, not limited solely to the technology industry. This method allows for a more detailed comparison of high-tech, moderate-tech, and non-tech sectors, providing a comprehensive view that existing research often overlooks.
- **Novelty in Defining Technology Sectors:** Unlike previous literature where the technology sector is generally defined solely by the amount of intangible assets, the plan of this study is to use NACE codes to divide the MNE dataset into three sectors, offering a nuanced view on sector-specific responses to tax rate changes. This approach addresses an existing gap in the literature by providing more information on sectoral differences.
- **Recent Data and Focus on Europe:** Using the most recent firm-level data from the Orbis Europe database, this study aims to update the existing research on profit shifting. The emphasis on European multinationals could bring a further contribution to the existing research due to the diversity of regulatory and tax environments within the European territory, particularly

regarding intellectual property regimes and their potential to attract profit-shifting activities.

This study intends to help address any gaps in the existing literature by offering a detailed, sector-specific analysis of profit shifting among European MNEs, and thus enhance the overall understanding of MNEs profit shifting behavior and aid in the creation of more effective tax policy design.

Outline

1. Introduction
2. Literature Review
3. Data & Summary statistics
4. Methodology & Hypotheses Development
5. Results
6. Conclusion

Core bibliography

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Introduction

In recent years, multinational enterprises (MNEs) have become an integral part of driving innovative progress, creating job opportunities, and thus contributing to overall economic growth. On the other hand, it is the nature of their wide-scale operations that can pose a serious problem in the realm of fair international taxation. One of the pressing issues in this context is profit shifting, a tax avoidance practice where MNEs strategically shift their profits to jurisdictions with a more favorable tax regime rather than reporting them in the country where they were originally generated. These tax-avoidant strategies, though not entirely illegal, are generally considered unethical and going against the principles of fair taxation and contributions to the local economy.

Several economic theories tried to explain the possible motivations behind corporate profit shifting. Among others, the tax competition theory, advanced by Zodrow & Mieszkowski and Wilson, explains that state governments intentionally lower their countries' tax rates to attract foreign direct investment, essentially creating an incentive for MNEs to shift profits to their jurisdiction, leading to an overall declining trend in corporate taxation. An alternative, agency theory, articulated by Meckling & Jensen (1976), states that the issue stems from the intra-firm conflicts of interest between managers and shareholders. By default, management, acting as an agent for the shareholder, works to maximize shareholder value, possibly resorting to tax planning strategies to reduce the company's tax expenses.

Later publications on profit shifting involve theories related to the structuring and financing of MNEs. Existing research explores the mobility and valuation challenges of intangible assets, such as patents, trademarks, or software licensing, with key contributions from economists such as Grubert, Dischinger & Riedel or Crotti. In their research, these authors demonstrated that companies resort to the use of intangible assets to distribute their profits strategically. That is because the non-physical nature of intangible assets makes them easily mobile, while their valuation remains rather subjective, resulting in an ideal tool for transferring profits across borders.

The implementation of intellectual property (IP) regimes such as patent boxes might likely be escalating this issue even further. Patent boxes offer reduced tax rates on income derived from intellectual property, providing companies with an incentive to transfer these assets to such jurisdictions. Studies by Karkinsky

& Riedel (2012) or Griffith *et al.* (2014) explore how companies intentionally position their intellectual property in jurisdictions that would minimize tax liabilities, finding that intellectual property could be an essential element in MNEs' tax planning strategies.

However, there has been limited research on the sectoral differences in profit shifting and sensitivity to tax rates. Studies such as those by Grubert (2003) and Dischinger & Riedel have underscored the importance of intangible assets in profit-shifting strategies, but have not yet fully explored the sectoral nuances of this phenomenon. More recent studies by Beer & Loeprick (2015) or Crotti (2021) explored the effect of intangible assets on profit shifting, focusing on either MNEs' level of complexity or technological development. Beer & Loeprick confirmed the positive relationship between the level of profit shifting and intangible assets, later supported by Crotti, who extended the understanding with a finding that there is no difference in the use of intangible assets for profit-shifting between high-tech and non-tech companies.

This study builds on Crotti's approach, refining[1] the sectoral analysis even further with the use of level 4 NACE classification. Previous analyses generally provide a rather broad split of MNEs into two categories, tech and non-tech. This study will introduce a more nuanced classification by dividing MNEs into three subsets - high, mid, and low-tech groups. This allows for a deeper understanding of how different industries utilize intangible assets for profit shifting and offers enhanced insights into the specific strategies and behaviors across various levels of technological intensity. On top of the additional granularity, MNEs' knowledge intensity is taken into account, particularly those involving patents and intellectual property, as these factors could significantly affect profit-shifting behaviors as well. Moreover, this study explores how the three groups react to tax rate changes, specifically examining the sensitivity to effective tax rates compared to the statutory corporate income tax rates.

This study leverages a comprehensive dataset from Orbis Europe, covering over 500,000 subsidiaries over 11 years from 2013 to 2023. Europe serves as a unique testing ground with its variety of corporate tax systems and sophisticated regulatory frameworks within close proximity. The methodology builds on the principles introduced by Hines & Rice (1994) and further developed by Huizinga & Laeven (2008), Beer & Loeprick (2015), or Garcia-Bernardo

[1]Crotti (2021) defined tech MNEs as those with the NACE codes 26, 47, 49, 58, 61 ,62, 63, 64, 65, or 77.

& Jánský (2024), employing a fixed-effects regression analysis on this extensive dataset to analyze how different sectors respond to tax rate changes and the use of favorable IP regimes. The goal is to enhance the understanding of how different industry sectors react to changes in tax rates to assess the need for tailored policy measures that consider the unique characteristics of various industries to ensure equitable taxation.

Literature Review

3.1 Base Erosion and Profit Shifting

Base erosion and profit shifting (BEPS) is a term used to describe firm tax avoidance strategies that exploit gaps between tax regimes of different jurisdictions to shift profits to the one with more favorable tax policies. The definition provided by the OECD states that BEPS operations' purpose is to ultimately achieve double non-taxation, or at least lower taxation, by shifting profits away from where the profits were generated, resulting in an overall reduction of corporate taxation. The primary actors involved in BEPS are multinational enterprises (MNEs), given they have the necessary tools to undertake sophisticated tax planning thanks to their international presence, various resources, and expertise (Beer & Loeprick 2015).

European multinationals in particular have often been observed engaging in profit shifting, taking advantage of many various tax frameworks concentrated on a relatively small continent. This practice allows the MNEs to effectively reduce their tax expenditure and bolster their competitive advantage, often at the expense of other countries (in the European context, Huizinga & Laeven, 2008, identified Germany as the primary country incurring losses on profits; a 2018 study published by Tørsløv *et al.* mentions both Germany and France).

The economics literature on profit shifting has been growing for over two decades, starting with early contributions from Hines & Rice or Grubert & Mutti, followed by more recent work by other authors (e.g. Weichenrieder), who have greatly advanced the overall understanding in this area, paving the way for further research, as well as policy initiatives. The increasing impacts of globalization and digitalization in the world over the 2010s have brought about a growing need for further exploration of these trends. More recently, important new insights have been provided by researchers like Dharmapala or Clausing, who shed light on the mechanism behind profit shifting, now that business is conducted in a rather integrated global economy.

In 2012, the OECD and G20 developed a coordinated international response in the form of a common Base Erosion and Profit Shifting project (OECD 2015a) with the goal of addressing the challenges posed by profit shifting. The primary objective of this initiative is to address the existing loopholes in international tax regulations enabling the practice of profit shifting. It seeks to establish

a system where profits are subject to taxation in the jurisdictions they were originally generated and value is actually created.

Investigations into BEPS are primarily conducted by international organizations like the OECD, as well as national tax authorities. These investigations focus on identifying and addressing the mechanisms used by MNEs to shift profits, such as transfer pricing, reallocation of intellectual property (IP) rights, and strategic use of debt (Lessambo 2016). Transfer pricing manipulation involves setting prices for transactions between related entities within an MNE to shift profits from high-tax jurisdictions to low-tax ones. The reallocation of IP rights involves transferring ownership of IP to subsidiaries in low-tax jurisdictions, allowing MNEs to allocate substantial profits to these regions through royalties or licensing fees. Thin capitalization, or the strategic use of debt, involves financing subsidiaries in high-tax jurisdictions with debt from subsidiaries in low-tax jurisdictions, enabling interest payments to be deducted from taxable income in the high-tax jurisdiction (Dharmapala 2014a).

Though not always illegal, aggressive tax planning strategies are generally considered unethical and have been increasingly scrutinized by both international and local authorities (Clausing 2016). Investigations into BEPS are mainly carried out by organizations like the OECD or national tax authorities. Their investigations focus on uncovering and tackling the methods MNEs use to shift profits, such as through transfer pricing manipulation (involves effective setting of prices for transactions between subsidiaries aiming to shift profits from high-tax areas to low-tax ones), intellectual property (IP) rights (by transferring their ownership to subsidiaries in low-tax regions and claiming profits through licensing fees or royalties) or thin capitalization and strategic debt shifting, essentially resulting in deduction of interest payments from income in high tax countries.

The economic consequences of BEPS are substantial, often coming at the expense of countries with high corporate tax rates, depriving them of resources needed for local initiatives and services, and undermining the overall people's confidence put in their local tax system. On top of this, research indicates that a notable portion of profits is annually transferred to tax havens resulting in massive losses in tax revenue (Huizinga & Laeven 2008; Tørsløv *et al.* 2018).

3.2 Tax Rates and Profit Shifting

Tax rates are one of the primary factors affecting profit shifting, including high-tech companies. There is now a substantial body of research showing that differences in statutory corporate income tax rates have a significant effect on the firms' decisions related to profit shifting (e.g. Huizinga & Laeven; Hargiasto *et al.*).

More interestingly, a recent report published by Delis *et al.* suggests that tax-motivated profit shifting is more common in jurisdictions with stable corporate tax rates over time. The theory is that when tax rates remain stable, corporations have more time to plan and optimize the structure of their tax liabilities. According to Delis *et al.*, such stability creates an illusion of predictability and consistency, so companies may deem such jurisdictions more suitable for their profit-shifting strategies.

These findings go against the conclusions drawn by a 2004 study by Mintz & Smart, providing an opposite perspective. Mintz & Smart claim that on the contrary, it is the changes in policies and tax reforms that attract a rise in profit-shifting activity, regardless of the stability of local tax rates. Later released studies by Zucman (2014) and Hasegawa (2019) supported these findings, implying that sole stability of tax rates may not be the single factor affecting firms' profit-shifting behavior and that differences in statutory corporate income tax rates significantly affect the extent of profit shifting.

Recent studies have demonstrated that both statutory corporate income tax rates and effective tax rates play vital roles in profit-shifting behavior for multinational corporations. For instance, Crotti used corporate income tax rates to show that higher intangible asset intensity amplifies the negative impact of their increase on reported profits. However, effective corporate income tax rates (ETRs) have also been a subject of investigation in profit-shifting studies, often directly in relation to statutory tax rates. Studies (e.g. Lejour (2021); Đaković *et al.* (2022)) have shown that the calculated effective rate of the corporate income tax can be significantly lower than the statutory rate, exhibiting signs of profit-shifting behavior.

When analyzing profit shifting, both statutory tax rates (or CIT rates) and effective tax rates (ETRs) are often considered. CIT rates serve as informative indicators of the tax environment the multinationals operate in. On the other

hand, ETRs provide a comprehensive view of the actual tax burden MNEs face in reality, already accounting for various deductions and tax incentives (Vržina & Dimitrijević 2020). Comparing statutory CIT rates with ETRs can reveal potential profit-shifting activities (Đaković *et al.* 2022). These findings underscore the need to focus on the differences between statutory and effective tax rates in order to fully understand how corporate tax evasion is carried out.

Specific tax laws play a big part in influencing profit-shifting strategies among multinationals. A study published by Alexander *et al.* (2020) showed that anti-avoidance rules generally prevent MNEs from shifting profits and that these incentives are further reduced by various tax base-broadening measures, such as restrictions on the deductibility of tax losses and group tax reliefs. Another study by Muthitacharoen & Samphantharak (2022) demonstrates that proactive measures such as auditing or transfer-pricing compliance are a more effective form of deterrence than documentation requirements alone, as vigorous monitoring of MNEs' financial practices is more likely to uncover any discrepancies, resulting in hefty penalties. These and many other findings further underscore the importance of specific tax laws in shaping behavior and profit-shifting practices, while at the same time highlighting the need for effective enforcement mechanisms to curtail tax avoidance.

3.3 Role of Technology and Knowledge Intensity

Technology and knowledge-intensive sectors could in theory show a higher propensity to shift profits relative to less technologically developed sectors, primarily due to their reliance on intangible assets such as intellectual property (IP). Grubert has shown that high-tech MNEs are very adept at shifting profits to jurisdictions with lower corporate income taxes in order to reduce their overall tax expenditure. Studies by Beer & Loeprick (2015), Dischinger & Riedel (2011), or Crotti (2021) emphasize how MNEs strategically locate intangible assets across affiliates to optimize profit-shifting opportunities. Thanks to their nature, intangible assets are easier to relocate across borders without the physical constraints that tangible assets face.

A 2021 IMF report highlights significant concerns about the transfer of IP rights to low-tax jurisdictions, particularly during early development stages when valuation is challenging. Empirical evidence shows a substantial negative correlation between effective IP income taxation and intangible assets

like patents, with profit shifting in Europe being considerable due to CIT rate differentials and systematic mispricing of related-party transactions.

Several studies have focused on investigating the propensity for profit shifting in technology-intensive industries. For instance, Barrios & d'Andria (2020) studied the sectoral differences in profit shifting and identified intangible investment as the primary driver. They also showed that sectors that are more likely to engage in profit shifting tend to lower their average cost of capital, attracting more investment to the detriment of others. Additionally, Souilliard (2021) provides evidence of profit-shifting strategies spreading across companies within sectors, with firms replicating the tax avoidance schemes of their peers. Beer & Loeprick's 2013 study delves into the industry-specific variations, showing that subsidiaries with higher intangible asset ratios are more sensitive to corporate income tax rate changes, indicating a higher propensity for profit shifting.

Major tech giants like Apple Inc. or Google have been condemned by European institutions for their tax avoidance strategies[2] (Sullivan 2012; EC 2016), effectively resulting in measures such as the "Google Tax"[3]. Munisami (2018) examines the aggressive tax avoidance strategies used by tech giants like Apple, Facebook, Amazon, and Google detailing complex schemes such as the "Double Irish Dutch Sandwich" technique.

While there is a substantial amount of research on different factors (like intangibles) facilitating profit shifting, the various tax rate change responses of the technology industry have not received widespread empirical attention. Several studies (Beer & Loeprick 2015; Crotti 2021; Glenn *et al.* 2024) investigated whether companies relying more heavily on intangible assets tend to engage in profit-shifting practices, though they all define the technology sector solely by the amount of intangible assets. This narrow focus often generalizes across multinational corporations and neglects a comprehensive comparison of sector-specific behaviors in response to tax rate changes.

[2]The European Commission concluded that Ireland gave Apple preferential tax treatment which amounted to $14.5 billion in unpaid taxes between 2003 and 2014 (see EC, 2016)

[3]For example, in the UK, the Diverted Profits tax, also known as "Google Tax", refers to legislation aimed at preventing tax avoidance by many multinational companies, not only Google, by imposing a tax on profits diverted from higher-tax jurisdictions (Finance Act 2015, c. 11)

3.3.1 Relevance of Intangible Assets

Companies that hold a substantial amount of intangible assets, such as intellectual property (IP), patents, trademarks, or software licenses, have shown themselves to be very adept at shifting profits to jurisdictions with lower corporate income taxes in order to reduce their overall tax expenditure (Grubert 2003; Beer & Loeprick 2013; Dischinger & Riedel 2011; Crotti 2021). For instance, studies conducted by Tudor *et al.* (2014), Kaymaz *et al.* (2019) or Medved *et al.* (2023) found that firms with a higher proportion of intangible assets tend to exhibit better profitability, as these assets contribute to improving their overall company performance. Though the relevance and impact of intangibles could vary across different sectors, influencing the extent and mechanisms of profit shifting.

Particularly in the case of knowledge-based economies, investment in intangible assets such as intellectual property and knowledge capital plays an important role in driving firm profitability (Bagna *et al.* 2021). In technology-driven companies, intangible assets like patents, trademarks, and copyrights are crucial drivers of competitive success and corporate profit (Dischinger & Riedel 2011). These assets enable firms to increase market power and profitability without a corresponding increase in fixed capital investment, widening the profit-investment gap (Orhangazi 2019). The mobility and difficulty in benchmarking the prices of intangible assets make them ideal tools for profit shifting among multinational corporations (Grubert 2003).

In medium-tech sectors, intangible assets could also play a role. Pharmaceutical companies and certain manufacturing industries often rely on patents and R&D, which can be easily transferred across borders to optimize tax liabilities. Orhangazi (2019) confirmed the positive influence of intangible assets on profit in non-financial corporations, focusing on their impact on profitability and investment, particularly in medium-tech sectors such as healthcare and telecommunications. Moreover, the presence of intangible assets like specialized services further emphasizes the reliance on intangible capital in profit shifting within industries like the extractive sector (Beer & Devlin 2021). The positive relationship between intangible assets and long-term debt in young SMEs in medium-high technology sectors highlights the value financial institutions place on intangibles for future benefits (Tong & Serrasqueiro 2020).

In low-tech sectors such as agriculture and traditional manufacturing, intan-

gible assets could still play a role in profit shifting, albeit to a lesser extent compared to high and medium-tech sectors. The widening gap between profitability and real investment in these sectors is influenced by the rising share of intangible assets, leading to higher profits even in the absence of tangible physical investment (Orhangazi 2019). The difficulty in valuing intangible assets derived from R&D makes them important vehicles for shifting of profits in sectors where physical assets may not be as prominent (Grubert 2003). Despite the lower emphasis on intangible assets in these sectors, their role in profit-shifting strategies should not be overlooked, especially in the context of global tax planning and financial management.

While all sectors likely engage in profit shifting to some degree, the existing research hints at high-tech sectors being the most likely candidates for the most aggressive tax planner compared to the other industries. This conclusion appears to be largely driven by the high mobility and valuation challenges associated with intangible assets and the resulting tax planning opportunities.

3.3.2 Role of Intellectual Property Regimes

Intellectual property regimes (also referred to as patent box regimes, or simply IP regimes), offer companies a reduced tax rate on profit derived from ownership of patents or other qualifying IP, such as copyrights or trademarks. A country's motivation behind setting up patent boxes is generally to attract and retain research and development, fostering economic growth and stimulating innovation. Nevertheless, patent boxes may add further intricacy to a tax regime, and certain recent studies have put into question the actual impact of patent boxes on promoting innovation (Griffith *et al.* 2014; Gaessler *et al.* 2021).

Patent box regimes are quite prevalent in Europe, based on the data made available by the Tax Tax Foundation (2024), as of July 2024, 13 out of the 27 EU countries[4] have currently an IP regime in place, with countries like the Netherlands, Belgium, Luxembourg, Ireland or Malta, which currently offers the lowest reduced tax rate of 1.75 %. Evers *et al.* (2015) discuss the varying effective tax rates and policy concerns linked to patent box regimes in Europe. They highlight that even though these systems aim to promote innovation

[4]Tax Tax Foundation (2024) lists a total of 18 European countries, 5 of them outside of the EU, refer to Table B.1 for the complete list.

and economic growth, they also provide chances for companies to move their intellectual property strategically in order to reduce tax liability. Research by Griffith *et al.* (2014) provided evidence of the role of IP regimes in facilitating profit shifting. The study concluded that companies strategically allocate the ownership of their intellectual property to subsidiaries in jurisdictions with such regimes, with significant implications for tax revenues and economic activity within the host countries.

Though the literature on profit shifting through patent box regimes in the general sense is quite extensive, specific research on sectoral differences remains relatively limited. The previously mentioned studies examined the broad impact of patent box regimes on tax revenues, innovation, or their overall effectiveness. However, further insight could be drawn from additional research addressing the differential impacts on various sectors, specifically those highly reliant on technology.

3.4 NACE Classification System

NACE[5] codes present a standard industry classification system of categorization of economic activities developed by Eurostat in collaboration with the national statistical institutes of the EU member states. The NACE framework provides a four-digit classification system designed for collecting and presenting statistical data categorized according to economic activity for a wide variety of domains. This system is widely used in the context of national business statistics and employed as the standard industrial classification framework within the European Union. These codes are essential for compiling statistics related to economic activities in the EU and ensure consistency and comparability across member states. The NACE system is organized hierarchically into four levels of detail:

3.4.1 European Commission Classification Criteria

Eurostat has also developed a classification system that makes use of the NACE framework to sort industries into high-tech and highly knowledge-intensive sectors based on the technological intensity of their economic activity. The focus on high-tech industries aligns with EC's efforts to enhance the performance of

[5]Nomenclature of Economic Activities, comes from the French Nomenclature des Activités Économiques dans la Communauté Européenne

Table 3.1: NACE levels summary table

Level	Count	Contents	Example
1	21 sections	broadest categories, identified by a single letter (A - U)	C - Manufacturing
2	88 divisions	more specific categories within sections, identified by a two-digit code (01 - 99)	32 - Other manufacturing
3	272 groups	further specificity within divisions, identified by a three-digit code (01.1 - 99.0)	32.1 - Manufacture of jewelry, bijouterie and related articles
4	615 classes	most detailed level, identified by a four-digit code (01.11 to 99.00).	32.13 - Manufacture of imitation jewelry and related articles

Source: Eurostat, 2024

these sectors through targeted policies and investments. By promoting high-tech entrepreneurship, fostering research networks, and supporting high-tech manufacturing, the European Commission aims to stimulate economic growth and competitiveness in Europe.

The following section provides a brief overview of Eurostat's aggregation criteria for manufacturing and service sectors based on the level of technological development and knowledge intensity.

Technological Development

Eurostat defines high-tech sectors by substantial investment in R&D, frequent technological innovations, and use of complex technological processes. These industries include sectors such as aerospace, pharmaceutical research, and information technology, which are often at the forefront of technological progress. The high level of R&D in these sectors is a key driver of economic growth and competitiveness in the global market.

Medium-tech sectors engage in moderate levels of R&D investment and can still employ a relatively high level of technological processes, but not to such extent as high-tech industries. Sectors such as automotive manufacturing and certain types of machinery production benefit from technological innovation but do not depend on it as heavily as higher-tech sectors. Their moderate R&D intensity allows them to balance between innovation and cost-efficiency.

Low-tech sectors are defined by very minimal engagement in R&D activities

and investment, but rather a reliance on relatively basic technological processes. Industries including textiles, food processing, and basic metals manufacturing typically focus on production methods that require less technological innovation and investment.

Knowledge Intensity

Knowledge-intensive services (KIS) are sectors characterized by a high level of investment in human capital (based on the share of employees with completed tertiary level of education), as well as R&D activities. These sectors are typically involved in activities that require specialized knowledge and expertise. According to the NACE classification, Knowledge-Intensive Services include telecommunications, computer programming, or financial service-related activities.

Less knowledge-intensive services (LKIS) sectors, on the other hand, do not exhibit a high tendency to invest in technology and innovative processes. These sectors are still quite essential for the economy but do not rely as heavily on specialized knowledge and technologies. According to the NACE classification, Less Knowledge-Intensive Services include sectors related to wholesale, tourism and accommodation services, and transport, or repair of vehicles.

3.5 Hypotheses Development

The following section provides a brief rationale for the hypotheses explored in this analysis by connecting the theoretical perspectives discussed in the literature review to the study's specific aim. Building on previous studies by Grubert (2003), Dischinger & Riedel (2011), and more recent works by Beer & Loeprick (2015) and Crotti (2021), these hypotheses aim to delve deeper into the sectoral differences in profit shifting and tax rate sensitivity. Unlike prior analyses that broadly categorize MNEs into tech and non-tech sectors, this study refines the sectoral analysis with a more nuanced classification by dividing MNEs into high, mid, and low-tech groups. This approach allows for a deeper understanding of how different industries utilize intangible assets for profit shifting and offers enhanced insights into the specific strategies and behaviors across various levels of technological intensity. Additionally, the analysis explores how these sectors react to tax rate changes, specifically examining the sensitivity to specific tax rates.

To systematically investigate these issues, the following three hypotheses will be investigated:

Hypothesis #1: The effect of intangible assets on pre-tax profits differs between high and low-tax jurisdictions.

Beer & Loeprick (2015) and Crotti (2021) have shown how intangible assets provide MNEs with substantial flexibility to shift profits to more favorable tax jurisdictions. Multinationals operating in high-tax jurisdictions have an incentive to reduce their taxable income by transferring intangibles to affiliates in low-tax regions. This hypothesis aims to examine the extent of this behavior and to determine whether the presence of intangible assets exacerbates the discrepancy in pre-tax profits between high and low-tax jurisdictions. The expectation is that MNEs with substantial intangible assets placed in a low-tax jurisdiction will show a greater difference in pre-tax profits between high-tax and low-tax jurisdictions, as they are likely to exploit tax rate differentials more effectively.

Hypothesis #2: The effect of intangible assets on firm profits is different in countries with favorable IP regimes compared to those without.

Griffith *et al.* (2014) have shown that MNEs transfer their intellectual property to countries with favorable IP regimes to reduce their tax liabilities. This analysis will also investigate whether or not high-tech MNEs are more likely to do so, as they could benefit from additional R&D incentives that complement patent box regimes regimes. This study will analyze how IP regimes influence the relationship between intangible assets and firm profits. It is expected that companies will report higher profits in jurisdictions with favorable IP regimes compared to those without, due to the tax advantages associated with these regimes.

Hypothesis #3: The sensitivity of pre-tax profits to tax rates differs depending on the level of technological development.

The technological intensity of a sector can influence its sensitivity to tax rate changes. High-tech multinationals could potentially employ more intricate strategies, taking advantage of R&D-related tax credits or making use of intangible assets, which can act as a buffer to the impact of tax rate increases (Beer & Loeprick 2015). The low-tech sector on the other hand is expected to exhibit a greater sensitivity to statutory tax rate changes, possibly caused by

less advanced tax planning practices. For instance, Dischinger & Riedel (2011) showed that the level of profit shifting is positively impacted by statutory tax rate differentials, suggesting that firms with lower tax planning sophistication may be more affected by these changes. It is hypothesized that high-tech MNEs will exhibit moderate sensitivity to tax rate changes, while low-tech MNEs will show greater sensitivity.

Methodology

4.1 Data

The list of MNEs analyzed in this study was sourced from Orbis Europe (Bureau Bureau van Dijk), a comprehensive database that contains detailed financial information on companies across Europe. The database features information on the companies' ownership structure, corporate linkages, and financial statement items such as reported profits, payroll expenses, operational revenue, etc.

To build a dataset suitable for further analysis, specific filter criteria were applied within the database. The search parameters included a filter for active subsidiaries with global ultimate owners[6] (GUO) different from the country of reported profits, with available information on profit and non-zero tax expenses. A key assumption was made that only profit-making companies shift profit. This approach is often adopted in profit-shifting literature to ensure logarithmic transformation can be applied (Viertola 2023; Bratta *et al.* 2024) and to avoid certain tax incentive measurement errors (Heckemeyer & Overesch 2017). However, it is important to note that profit shifting does not have to be exclusive to profitable companies.

The criteria produced a final list of over 125 thousand unique subsidiaries operating across 39 different European jurisdictions with ultimate owners located in 40 different European countries (see Table 4.1). The observations span over 11 consecutive years, from 2013 to the most recent data published for the financial year of 2023. The dataset contains MNEs operating in 758 unique NACE industry classes[7] which should provide a robust basis for further analysis.

Table 4.1: MNE summary statistics

Variable	Unique values	Most Frequent	Freq	N
id	125,298	DE7330049330	11	565,879
$\text{country}_{\text{op}}$	39	RO	60,177	565,879
$\text{country}_{\text{GUO}}$	40	DE	95,951	565,879
$\text{NACE}_{\text{lvl1}}$	20	G - Wholesale and retail trade; repair of motor vehi...	181,839	565,879
$\text{NACE}_{\text{lvl4}}$	758	46.69 - Wholesale of other machinery and equipment	18,966	565,879

[6] An entity is considered to be a global ultimate owner if it owns at least 50.01 % of the subsidiary's shares.

[7] The amount is greater than the existing 615 classes mentioned in Table 3.1 in Section 3.4. This is caused by the cases where level 4 classification was not available, and rather than excluding these observations, the missing code was replaced by level 3 or level 2 code, depending on availability.

4.2 Variables

The dataset includes a variety of financial and tax-related variables essential for analyzing profit shifting. Key financial variables of interest include reported profit, employee costs, tangible fixed assets, total assets, intangible assets, taxes, and outstanding short-term and long-term debt. These variables were selected to help build a comprehensive overview of the financial health and operational scale of the companies in the dataset. The complete list of all variables used in the analysis can be found in Table B.1 in the Appendix.

Table 4.2: Numeric variable summary statistics

Variable	N	Mean	Std. Dev.	Q1	Median	Q3	Min	Max
profit	565,879	1,751,440	5,635,226	29,979.5	166,840.8	878,292.1	477.05	43,126,732
employee costs	565,879	3,128,765	8,706,268	71,225.5	436,000	2,050,291	450	64,215,954
fixed assets	540,802	7,048,461	95,641,447	7,809.87	80,983.6	914,889.9	0	20,391,109,000
total assets	565,879	20,844,668	72,577,676	322,802.8	1,821,738	9,359,293	6,591.99	568,168,000
intangible assets	537,513	2,397,722	85,348,856	0	0	15,095	0	19,512,150,000
taxes	565,879	624,709.2	13,986,530	4,564.44	31,000	180,174.1	0.01	6,329,664,782
GDP	557,865	27,343.8	17,911.39	13,928.57	23,665.23	36,902.26	1,914.32	118,880.7
debt ratio	565,879	0.08	0.16	0	0	0.06	0	0.79

Note: All amounts are nominal and reported in EUR. GDP per capita in the country of reported profits was obtained from the World Bank's World Development Indicators (WDI) database and converted to EUR with the annual average exchange rate provided by the European Central Bank. Debt ratio has been winsorized at the 1st & 99th percentile to avoid extreme outliers.

Profit before tax, the primary outcome variable of interest in most profit-shifting studies, exhibits a wide range of values, suggesting heterogeneity of performance of the MNEs in the dataset. The difference between the mean and the median appears to be quite substantial, indicative of a right-skewed distribution, likely due to the inclusion of only profit-making companies in the dataset and the presence of a certain amount of high-profit MNEs, or potential outliers. The log transformation applied to the variables later on should reduce the skewness and address potential issues caused by a non-normal distribution.

Employee cost serves as a proxy for labor, with its variability reflecting differences in company sizes and labor intensities. It is expected that labor costs generally indicate higher quantity, as well as quality of employed workers (better-skilled or more productive workers receive higher wages), thus affecting profits positively.

Total assets represent the capital input, providing a broader measure of the company's capital stock. Two additional asset components were included to

allow for a more nuanced understanding. Tangible fixed assets, a subset of total capital, represent the physical capital such as equipment, machinery, and buildings. The second component included in the analysis, intangible assets, covers the non-physical aspect of MNE's capital, later investigated in more detail. It has been shown that capital input affects profit positively (e.g. by Huizinga & Laeven; Viertola.

The income tax expense (amount from the taxable income a company is obligated to pay to the tax authorities) variable will be used to calculate effective tax rates to obtain the actual tax burden faced by each MNE. Tax expenditure directly reduces companies' net profit, however, the resulting effect on profitability is a matter of interest in this study.

GDP per capita, a standardized and widely recognized metric used globally, has been selected to proxy a country's productivity or macroeconomic conditions to reflect cross-country differences in available technology. Such advantage is expected to enhance the efficiency and productivity of businesses, in turn increasing the company's profitability.

Debt ratio, calculated as the ratio of long-term and short-term debt over total assets was included to reflect the company's ability to leverage its financial risk. In the European context, interest payments on debt are generally tax deductible, therefore, some companies may be motivated to increase their overall debt to reduce taxable income. Profit is thus expected to be negatively related to financial leverage.

Moreover, table 4.3 shows a general summary of the statutory corporate income tax rates for the countries in the dataset.

Table 4.3: Statutory corporate income tax rates

Tax rate	Mean	Std. Dev.	Q1	Median	Q3	Min	Max
Statutory rates							
CIT_{op}	0.2177	0.0646	0.1800	0.2100	0.2500	0.0850	0.4443
CIT_{GUO}	0.2089	0.0689	0.1583	0.2000	0.2500	0.0850	0.4443

Source: Statutory corporate income tax rates provided by the OECD (2023)

The descriptive statistics for the statutory corporate income tax rates provide insights into the tax landscapes of the operating countries (CIT_{op}) and the global ultimate owner countries (CIT_{GUO}). The means of both rates appear to

be relatively close, with a standard deviation of around 6 or 7 %, indicative of a moderate variation of the tax landscapes in the dataset. These rates will be examined in more detail in section 4.4.

4.3 Methodology for Data Segmentation

In order to enable a comparative analysis of the set of MNEs given their level of technological development or knowledge intensity, a set of criteria for data segmentation was created. Due to the lack of R&D expenditure data in the Orbis Europe database, which could have served as a more direct proxy for MNEs' level technological development, the NACE criteria were utilized instead. Thanks to the fact that the use of NACE is mandatory within the European Statistical System, each unconsolidated MNE has already been allocated with one of the 615 classes, or level 4 NACE code. By adhering to the European Commission guidelines. As indicated in section 3.4, the European Commission's criteria focuses primarily on the manufacturing and services-related industries. In order to have a comprehensive dataset ready for further analysis, a similar approach was adopted, each class not already established by the EC was examined and allocated into a respective group based on its expected reliance on technology or knowledge.

Following this approach, the data was split into three distinct groups, A, B, and C, based on the criteria shown in table 4.4.

Table 4.4: Group segmentation criteria

Group	Description
A	Knowledge-intensive and technologically developed
B	Less Knowledge-intensive and technologically less developed
C	Intermediate in knowledge intensity and technological development

MNEs operating in both knowledge-intensive and technologically advanced industries have been allocated to group A. Firms in group A generally exhibit higher levels of R&D-related activity relative to other groups, substantial technological innovation, and a reliance on professional expertise. To provide some

examples, classes like Central banking, Biotechnology research and development, Computer programming or Manufacture of air and spacecraft and related machinery were allocated into group A.

Industries on the opposite end of the spectrum of the extent of technological development were allocated to group B. Companies in this sector are characterized by lower reliance on specialized knowledge and extent of R&D expenditure, relying more on basic technological processes. Examples in this group include mostly primary industries related to agriculture, forestry, and fishing, wholesale, retail and less technology-reliant manufacturing.

Group C was built from multinationals with intermediate reliance on specialized knowledge or technological development. These companies may still invest in R&D to improve their technological processes, balancing traditional and advanced methods to generate more profit. Examples include certain types of manufacturing or services that do not clearly fall into the high or low categories, such as the Manufacturing of electrical equipment or Manufacturing of basic pharmaceutical products.

Table 4.5 provides a comprehensive summary of the profit distribution across three different groups of economic activities.

Table 4.5: Average profit per MNE per year

Group	N	MNE Count	Total Profit	Avg Profit
A	133,146	31,944	271,686,780,744	1,680,897
B	308,316	65,047	431,112,264,434	1,017,031
C	124,417	28,307	288,304,077,236	1,557,485
Total	**565,879**	**125,298**	**991,103,122,414**	**1,308,378**

Note: All amounts are nominal and reported in EUR. Unlike in Table 4.7, the average for each subsidiary was taken first to prevent companies with more years of observation from skewing the results.

The high-tech group A shows the highest average pre-tax profit per subsidiary, which is generally consistent with the existing literature supporting the positive relationship between technology and firm profitability (Thatcher 2004; Rocha *et al.* 2019; Li 2021). On the other hand, despite containing the largest number of observations, group B shows the lowest average profit per entity, indicative of the group's lower margins. The larger number of entities suggests a wider distribution of profitability across a broader range of industries, which possibly

dilutes the overall profitability, reflecting a mix of high-performing and lower-performing sectors.

Despite having fewer observations compared to the other two groups, group C's average profit per MNE is relatively high, not far from group A. This high profitability per subsidiary can likely be attributed to the presence of the extraction and mining industry within this group, which can leverage control over valuable natural resources and low competition. The differences in the number of observations across the groups highlight the varying sizes of the sectors. Group B's large number of observations might stem from the inclusion of numerous small entities in the technologically less developed group, while the tech sector likely consists of larger, more established entities reporting higher profits. The high number of observations should not negatively impact the analysis, but instead underscore the structural differences between the sectors.

Figure 4.1 presents a geographical distribution of European countries categorized by the dominant group of economic activities based on the average profit per subsidiary. The map indicates a clear pattern in the geographical distribution of economic activities. The economic landscape of Europe is characterized by significant regional variations, with distinct areas specializing in different economic activities. This regional specialization generally aligns with the spread of dominant groups observed in this MNE dataset, which identified the highest average profit per subsidiary per year across different countries.

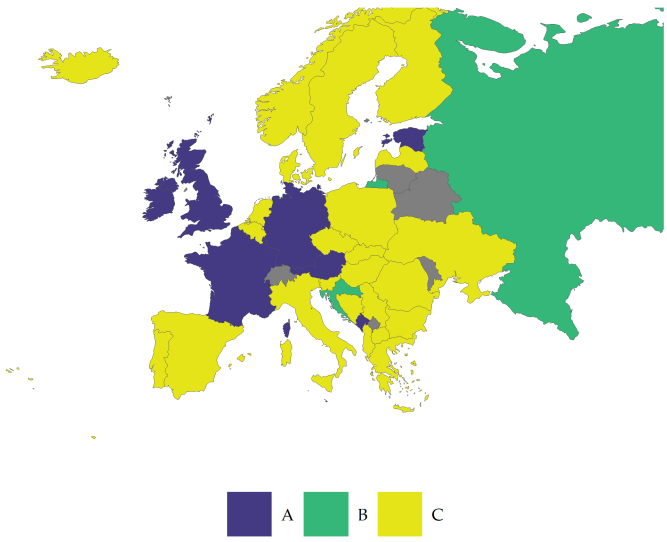


Figure 4.1: Dominant group by average annual profit per subsidiary

Western and Northern Europe, including countries such as the United Kingdom, France, and Germany are well known for their technological advancements and robust financial sectors. These regions exhibit high levels of R&D spending and innovation, particularly in technology hubs like London, Berlin, and Paris. For instance, Germany is noted for its advanced manufacturing sectors, especially in the automotive and machinery industries (Goswami & Daultani 2022). Moreover, Germany (with the ECB residing in Frankfurt), together with other European cities such as Paris, Zurich[8] or London are generally recognized as global financial centers, with strong financial services sectors (OECD, 2019). In addition, Estonia is renowned for its digital economy and e-government initiatives[9] (Tropp *et al.* 2022).

In terms of profit, group B appears to be more prominent among Eastern European countries, possibly due to their strong manufacturing and energy sectors, particularly in Russia, which is the second largest exporter of oil and natural gas in the world (International Energy Agency 2020). Additionally, Croatia is known for being largely dependent on tourism and tourism-related sectors like hospitality and transportation (World Bank 2018), contributing significantly to their GDP.

Countries in Southern, Central, and Northern Europe are classified into group C due to significant contributions from mid-tech industries and the pharmaceutical sector. Southern countries such as Spain, Italy, and Greece have strong industrial bases in the automotive industry, machinery, or electronics, as well as robust pharmaceutical sectors (ITA 2024). Central European countries are characterized by emerging mid-tech sectors such as automotive parts, machinery, and electronics, along with expanding pharmaceutical industries (RSM Global 2024). Northern Europe, including Sweden, Denmark, and Norway, together with the Netherlands contributes significantly through the engineering and automotive sectors, with known companies like Volvo and Scania, as well as large pharmaceutical Norwegian Government (2024) companies (such as Swedish AstraZeneca or Danish Novo Nordisk).

Table 4.6 offers a detailed view of the summary statistics for the dataset, categorized into three distinct groups A, B, and C. This breakdown should help

[8]Switzerland together with Belarus and Moldova were excluded from this analysis for the lack of reliable observations.

[9]According to e-Estonia, an initiative created by the Estonian government to facilitate and promote the country's digital transformation, Estonia is on its way to becoming a leading country in digital innovation.

provide a better understanding of the structural composition and operational dynamics of each group, based on unique values and the frequency of various categorical variables.

Table 4.6: Summary statistics of categorical variables by group

Variable	Unique values	Most Frequent	Freq	N
Group A				
subsidiary ID	31,944	AT9030051478	10	133,146
$\text{country}_{\text{op}}$	36	RO	13,424	133,146
$\text{country}_{\text{GUO}}$	40	DE	18,411	133,146
$\text{NACE}_{\text{lvl1}}$	8	M - Professional, scientific and technical activities	58,506	133,146
$\text{NACE}_{\text{lvl4}}$	131	70.22 - Business and other management consult...	17,353	133,146
Group B				
subsidiary ID	65,047	DE7330049330	11	308,316
$\text{country}_{\text{op}}$	37	RO	35,237	308,316
$\text{country}_{\text{GUO}}$	40	DE	54,513	308,316
$\text{NACE}_{\text{lvl1}}$	14	G - Wholesale and retail trade; repair of motor ve...	181,826	308,316
$\text{NACE}_{\text{lvl4}}$	386	46.69 - Wholesale of other machinery and equipment	18,966	308,316
Group C				
subsidiary ID	28,307	NL76026728	11	124,417
$\text{country}_{\text{op}}$	37	FR	17,293	124,417
$\text{country}_{\text{GUO}}$	40	DE	23,027	124,417
$\text{NACE}_{\text{lvl1}}$	6	C - Manufacturing	74,576	124,417
$\text{NACE}_{\text{lvl4}}$	241	41.20 - Construction of residential and non-residen...	11,378	124,417

Group A shows a high concentration of professional, scientific, and technical activities, further highlighting the knowledge-intensive characteristics of this sector, unlike group B with the frequent appearance of traditional industries. Group C exhibits a balanced mix of manufacturing and other industrial activities. Romania, France, and Germany appear as the most frequent operational and GUO countries among the studied panel of subsidiaries.

Table 4.7 provides detailed summary statistics for various financial and operational variables across the three groups. At first glance, the potential for profit shifting is most notable in group A due to the high value of intangible assets relative to the other groups, while groups B and C present lower amounts of these assets based on their respective financial and operational structures. On top of the highest average profit, group A also exhibits significant investment in its employees, underscoring the importance of highly skilled labor and advanced technological processes. The high levels of intangible assets and profitability suggest that high-tech firms are likely to profit off of profit-shifting strategies involving patent boxes and R&D credits.

Group B, the largest in terms of the number of observations, exhibits the lowest profitability and a lower level of intangible assets relative to the other groups.

Table 4.7: Summary statistics of continuous variables by group

Variable	N	Mean	Std. Dev.	Q1	Median	Q3	Min	Max
Group A								
profit	133,146	2,040,518	6,710,056	26,076.29	132,876.1	752,346.2	477.05	43,126,732
employee costs	133,146	3,834,695	10,409,049	71,226.8	454,624.3	2,294,291	450	64,215,954
fixed assets	124,861	7,392,597	141,552,166	1,894	26,595.8	230,880	0	20,391,109,000
total assets	133,146	25,820,040	91,663,429	199,938.7	1,107,154	7,022,036	6,591.99	568,168,000
intangible assets	124,172	5,462,107	140,177,903	0	0	15,371.28	0	19,512,150,000
taxes	133,146	694,620.2	6,782,290	3,725.94	23,231.5	145,989.8	0.01	1,122,342,915
GDP	131,035	29,582.21	20,952.38	14,020.11	25,762	39,115.66	1,914.32	118,880.7
debt ratio	133,146	0.07	0.16	0	0	0.02	0	0.79
Group B								
profit	308,316	1,398,281	4,609,092	30,721.23	166,075.7	781,693.5	477.05	43,126,732
employee costs	308,316	2,406,184	7,095,117	63,834.52	376,408	1,597,711	450	64,215,954
fixed assets	295,830	5,048,715	56,232,726	10,024.68	87,212.5	792,057.6	0	5,980,662,832
total assets	308,316	16,129,448	57,683,603	403,811.7	1,900,953	8,378,002	6,591.99	568,168,000
intangible assets	293,818	1,152,351	61,255,463	0	0	10,229.3	0	18,256,830,000
taxes	308,316	404,730.5	4,852,137	4,722.97	31,735.06	166,462.8	0.01	1,179,379,000
GDP	303,962	26,543.74	17,240.9	13,761.84	22,665.02	36,161.94	1,914.32	118,880.7
debt ratio	308,316	0.08	0.17	0	0	0.06	0	0.79
Group C								
profit	124,417	2,317,240	6,548,855	33,000	224,404	1,368,750	477.05	43,126,732
employee costs	124,417	4,163,925	10,057,694	93,511.66	659,158	3,290,822	450	64,215,954
fixed assets	120,111	11,616,032	111,971,365	19,069.5	319,157.4	3,401,402	0	9,335,553,839
total assets	124,417	27,204,950	81,232,870	325,549	2,924,194	15,742,968	6,591.99	568,168,000
intangible assets	119,523	2,275,580	55,746,352	0	84.34	31,985.09	0	5,309,000,000
taxes	124,417	1,095,019	27,961,250	5,190	41,053.05	270,541.4	0.01	6,329,664,782
GDP	122,868	26,935.86	15,684.29	14,956.79	26,416.3	36,161.94	1,914.32	118,880.7
debt ratio	124,417	0.08	0.15	0	0	0.09	0	0.79

Note: All amounts are nominal and reported in EUR. GDP per capita in the country of reported profits was obtained from the World Bank's World Development Indicators (WDI) database and converted to EUR with the annual average exchange rate provided by the European Central Bank. Debt ratio has been winsorized at the 1st & 99th percentile to avoid extreme outliers.

Employment costs are also quite low, aligning with the less knowledge-intensive nature of these sectors. The debt level is moderate, reflecting more traditional financing structures. Although the investment in intangibles is lower, reducing the likelihood of profit shifting through intellectual property, profit shifting could still be present in this group through other methods such as transfer pricing. Profit shifting potential exists but is less pronounced compared to group A, given the lower emphasis on intangible assets.

Group C stands out with the highest average profitability among the groups[10], and its total assets are also significant, though not as high as group A. Employment costs are moderate, indicating a blend of traditional and knowledge-intensive activities. The debt level is also moderate, suggesting balanced financing approaches. The variability in intangible assets is high, indicating

[10]The average profit for group C is higher in Table 4.5, where the profit was calculated slightly differently to account for highly profitable MNEs with more years of observations.

diverse levels of investment in innovation across the entities within this group, providing potential opportunities for profit shifting, though to a lesser extent than in the case of group A.

4.4 Effective Tax rates and Profit Shifting

Effective tax rates (ETRs), a key measure for understanding the actual rate at which a company is taxed, offer insights beyond statutory tax rates set by local legislation. ETRs reflect the proportion of profits that MNEs actually pay in taxes, accounting for various tax planning strategies, deductions, credits, and cross-border profit shifting. As such, ETRs are fundamental in evaluating the real tax liability of firms and understanding the impact of tax policies on corporate behavior.

In the context of this study, the calculation of ETRs involved aggregating the income tax expenditure and untaxed profits across all entities to obtain a comprehensive measure of companies' tax burden. This way, two metrics were obtained. Equation 4.1 represents the tax rate in the country of operation (ETR_{op}), calculated as the sum of all taxes paid by multinationals in the country of operation divided by the sum of all profits of these MNEs in the same country. Using the same approach, the effective rates for the countries where the companies' global ultimate owners are located (ETR_{GUO}) were calculated using equation 4.2.

$$\text{ETR}_{op_j} = \frac{\sum_{i=1}^{n} \text{total tax expense}_{ij}}{\sum_{i=1}^{n} \text{profit before tax}_{ij}} \tag{4.1}$$

$$\text{ETR}_{GUO_k} = \frac{\sum_{i=1}^{n} \text{total tax expense}_{ik}}{\sum_{i=1}^{n} \text{profit before tax}_{ik}} \tag{4.2}$$

Both metrics were winsorized at the 1st and 99th percentile to prevent extreme outliers from introducing bias into the analysis, a standard approach used in economic literature (Kennedy *et al.* 1992; Leone *et al.* 2019). Winsorization helps to provide more robust estimates and representation of central tendencies without discarding observations.

Differences in the effective rates between the country where the profits were reported and the country of the global ultimate owner could indicate that there are incentives for MNEs to shift profits to jurisdictions with lower tax burdens.

Such discrepancies could potentially suggest the existence of tax planning and profit-shifting strategies.

Table 4.8 provides summary statistics for both statutory and calculated tax rates across the three groups. The effective tax rates appear to be generally lower and more variable than the statutory tax rates across all groups. This disparity could be taken as a sign of potential tax planning strategies employed by the MNEs in the dataset. The minimum values for ETR are lower than those for CIT, this indicates that there are instances where firms effectively pay very little tax. The maximum values for ETR are slightly higher than those for CIT in some cases, showing that effective rates can sometimes exceed statutory rates, possibly due to adjustments or penalties.

Table 4.8: Tax rate variables summary statistics by group

Tax rate	Mean	Std. Dev.	Q1	Median	Q3	Min	Max
Group A							
Statutory rates							
CIT_{op}	0.2132	0.0624	0.1800	0.2000	0.2500	0.0850	0.4443
CIT_{GUO}	0.2120	0.0708	0.1583	0.2000	0.2500	0.0850	0.4443
Calculated rates							
ETR_{op}	0.1910	0.0675	0.1567	0.1832	0.2296	0.0450	0.4393
ETR_{GUO}	0.1964	0.0795	0.1536	0.1851	0.2472	0.0332	0.5123
Group B							
Statutory rates							
CIT_{op}	0.2168	0.0643	0.1800	0.2100	0.2500	0.0850	0.4443
CIT_{GUO}	0.2086	0.0683	0.1583	0.2060	0.2500	0.0850	0.4443
Calculated rates							
ETR_{op}	0.1963	0.0658	0.1620	0.1854	0.2311	0.0450	0.4393
ETR_{GUO}	0.2034	0.0828	0.1567	0.1927	0.2516	0.0332	0.5123
Group C							
Statutory rates							
CIT_{op}	0.2246	0.0672	0.1900	0.2100	0.2500	0.0850	0.4443
CIT_{GUO}	0.2066	0.0683	0.1583	0.2000	0.2500	0.0850	0.4443
Calculated rates							
ETR_{op}	0.2031	0.0631	0.1685	0.1897	0.2346	0.0450	0.4393
ETR_{GUO}	0.2065	0.0816	0.1567	0.2014	0.2516	0.0332	0.5123

Moreover, group A shows a lower effective tax rate in the country of reported profits (ETR_{op}) relative to the other groups. This could be attributed either to more favorable tax incentives and industry-specific benefits in the respective jurisdictions, or aggressive tax planning strategies.

The summary Table 4.9 for corporate income tax (CIT) and effective tax rate (ETR) differences across groups A, B, and C provides a further, more detailed, insight into the relative discrepancies in tax burdens and potential profit shifting activities among the studied MNE. The CIT differences, calculated as the statutory tax rate in the operating country minus the statutory tax rate in the GUO country, reveal meaningful patterns.

Table 4.9: Summary of CIT and ETR differences by group

	Min	Q1	Median	Mean	Q3	Max
CIT Δ						
group A	-0.35933	-0.05810	0.00000	0.00122	0.05500	0.35933
group B	-0.35433	-0.05000	0.01000	0.00825	0.06175	0.35933
group C	-0.35433	-0.04408	0.02175	0.01799	0.08000	0.35933
ETR Δ						
group A	-0.46732	-0.06852	0.00000	-0.00542	0.05687	0.40612
group B	-0.46732	-0.07276	-0.00355	-0.00704	0.05758	0.40612
group C	-0.46732	-0.06889	0.00000	-0.00342	0.06291	0.40612

All groups show slight positive mean differences in CIT, with group C having the highest mean difference, indicating that the statutory tax rates are on average lower in the jurisdictions of the subsidiaries' ultimate owner than the country of reported profits. In other words, the studied companies, most prominently those in group C, choose to operate in countries with higher tax rates compared to where their parent companies are located. This finding in itself may appear counterintuitive, though it does not take into account potential intellectual property or tax relief initiatives, which is why effective tax rates are examined to provide another perspective. It is also key to consider the variability and the entire distribution of the differences. The wide range of CIT differences across all groups suggests that this is not the case for all companies in the dataset.

On the other hand, the mean differences in effective tax rates are slightly negative across all groups, indicating a slight tendency of the MNEs within all groups to set up operations in jurisdictions with more favorable tax conditions. Based solely on data from the brief summary provided by Table 4.9, the companies in group C appear to be prioritizing other operational strategies over tax minimization, as they seem to be willing to set up operations in higher tax jurisdictions. They also exhibit the smallest average negative ETR difference relative to the other two groups. In contrast, companies in group B,

with slightly more negative ETR differentials and less positive CIT differences, might potentially be more inclined towards profit shifting. This is also the case for MNEs in group A, though interestingly, the median CIT and ETR differences in group A are 0, suggesting that for a large portion of the studied high-tech MNEs, both CIT and ETR rates are on average the same in both jurisdictions. This would mean that there is no tax advantage or disadvantage for these entities when comparing their operating country to their GUO country.

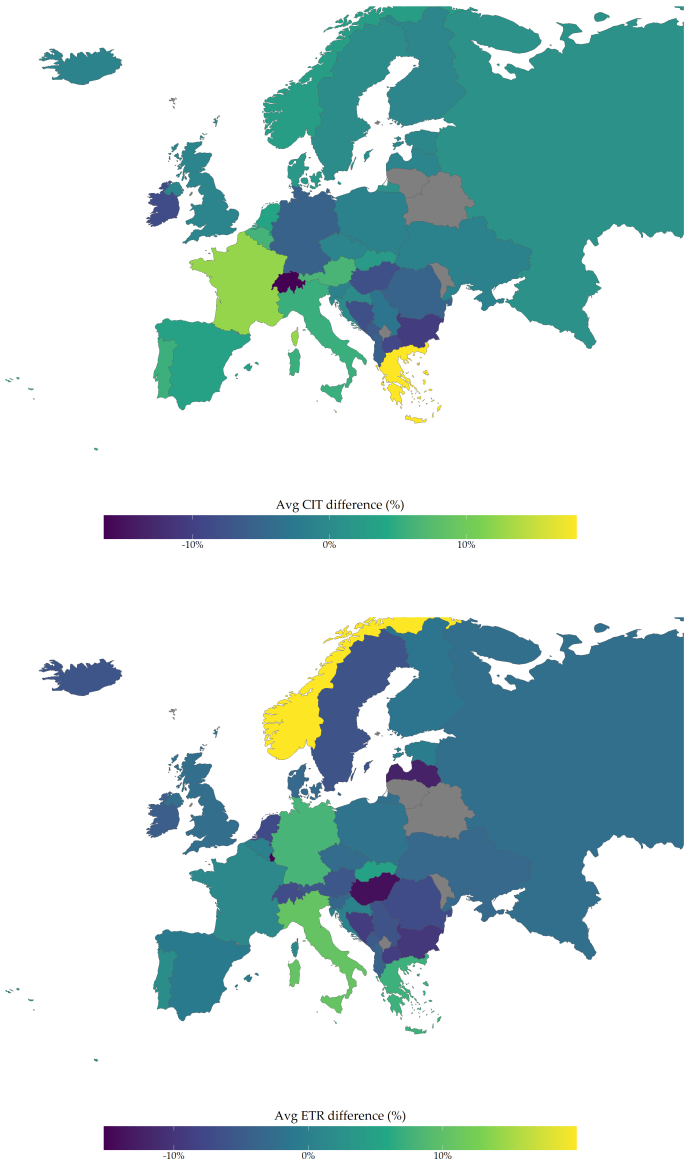


Figure 4.2: Average tax rate differentials exhibited by MNEs by country of operation

Figure 4.2 represents a geographic analysis of the discussed average differences in both tax rates between the country of reported profits and the country of the global ultimate owner for the MNEs operating in the respective European country. These maps were created to help identify which countries are driving the overall positive CIT and negative ETR differences.

MNEs consistently exhibiting negative average CIT and ETR differences tend to operate in countries such as Ireland, Luxembourg, Switzerland, Hungary, and the former Yugoslavian region. This is in line with the findings of Huizinga & Laeven or Garcia-Bernardo & Jánský who identified these regions as possible destinations of shifted profits. These countries are known for their favorable tax regimes with lower statutory corporate tax rates or advantageous tax incentives, such as in the case of Luxembourg.

Conversely, companies with positive statutory tax rate differentials between the country of reported profits and GUO, appear to be most likely to set up operations in countries like Greece, France, Austria, and Italy. This pattern reflects a less aggressive approach to attracting MNEs through tax advantages. Moreover, positive effective tax differentials can be observed in Norway, Germany, Italy, or Greece, countries known for their higher statutory rates and anti-avoidance policies, resulting in reduced incentives for profit shifting. Some countries show mixed patterns. For example, Austria and Italy show positive CIT differences but negative ETR differences. This suggests that while their statutory tax rates are higher, they might still offer certain tax reliefs or incentives that help MNEs reduce their effective tax rates.

4.5 Model Specification

4.5.1 Cobb-Douglas Production Function

The Cobb-Douglas production function, introduced in 1928 by Cobb & Douglas, serves as a valuable analytical tool in economic research, providing insights into profit maximization, cost minimization, productivity analysis, and various other economic assessments. It is widely used in economic modeling due to its ability to represent the relationship between inputs (typically capital and labor) and output in a theoretically sound manner. The function assumes that production can be represented by a multiplicative relationship between inputs, exhibiting constant returns to scale and factor substitutability, which are suit-

able assumptions for many real-world scenarios. The standard form of the Cobb-Douglas production function is expressed as:

$$Y = A \cdot L^{\alpha} \cdot K^{\beta} \tag{4.3}$$

Y represents the total output or production (typically GDP or profit), A stands for total factor productivity, L denotes the labor input, K represents capital input, and α and β are the output elasticities of the labor and capital inputs. These parameters indicate the percentage change in output resulting from a one percent change in labor or capital, holding other factors constant.

Thanks to its flexibility to incorporate various factors influencing profit, the Cobb-Douglas function has also been applied in the context of studying profit shifting (e.g. by Huizinga & Laeven; Rathke; Viertola. The function inputs can be adapted to model the determinants of pre-tax profits reported by multinationals, allowing for a comprehensive examination of how these elements interact with corporate tax policies to affect profit reporting.

4.5.2 Adaptation to the Study of Profit Shifting

The empirical model used in this analysis builds upon the theoretical framework of the Cobb-Douglas function, as well as the methodology used by Hines & Rice (1994) and Dharmapala (2014b). Tax rate and additional control variables are incorporated into the equation to study the effect of tax changes on a company's profit. Hines & Rice (1994) build on the assumption that a subsidiary's pre-tax profit consists of its true profit generated by real activity and the profit shifted in or out.

The model initially introduced by Hines & Rice (1994) did not take into account firm-level data as only country-level information was available at the time. With more granular-level data made accessible every year, their approach has been modified to be applied to panel data (e.g. by Viertola). Using panel datasets should control for potential confounding factors and thus provide more reliable estimations of MNEs' behavior (Dharmapala 2014b). To further enhance the robustness of resulting estimates, a fixed effects model was selected to be applied in the subsequent analysis to control for unobserved heterogeneity across the subsidiaries and time. This way, the model should account for the time-invariant characteristics among the companies that could bias the results

if omitted, providing a more accurate estimation of the effects of tax measures on profits.

The modified form of the Cobb-Douglas function in this study is expressed in a logarithmic form to linearize the relationship between the predictors and the output variable. All modifications made in this study aim to align with already established methodologies used in the economic literature (Hines & Rice 1994; Dharmapala 2014b). The estimation is expressed as equation 4.4 below.

$$\log\pi_{it} = \beta_1\tau_{ct} + \beta_2\log L_{it} + \beta_3\log K_{it} + \beta_4\log A_{ct} + \gamma\mathbf{X}_{it} + \mu_i + \delta_t + u_{it} \quad (4.4)$$

π_{it} represents the reported profit before tax by the subsidiary i in year t. τ_{ct} stands for the tax rate (or tax rate differential) of subsidiary i located in the country c in year t. L_{it} and K_{it} represent the subsidiary's available labor (represented by the employee-related costs) and capital (total assets were used as a proxy in this case), respectively. A_{it} denotes productivity, GDP per capita in the country of operation was used to proxy this variable.

Moreover, $\mathbf{X}_{it}$ represents a vector of additional subsidiary controls, in the context of this study the debt ratio and operating revenue were used as such. Lastly,μ_i represents the MNE's fixed effects which control for the subsidiary i's unobserved characteristics that do not change over time; δ_t stands for the time fixed effects, which control for unobserved factors affecting pretax profits of all subsidiaries in year t, and u_{it} denotes standard errors that are adjusted for subsidiary clusters.

4.5.3 Tax Rate Specifications

To account for the non-linearity in the relationship between tax rates and profit shifting, as well as improve the robustness of the results, this study incorporates different forms of tax rates, using both the statutory corporate income tax rate, effective tax rate, their differentials, as well as logarithmic transformations. The logarithmic approach was inspired by Garcia-Bernardo & Jánský (2024), who demonstrated the superiority of the logarithmic model in capturing the extreme non-linearity of the tax semi-elasticity of profit shifting.

According to Garcia-Bernardo & Jánský, the use of the logarithmic form of tax rates is particularly effective in addressing the diminishing marginal impact of tax rate changes on profit shifting. This specification helps to mitigate the bias

introduced by extreme values and provides a more accurate representation of the relationship between tax rates and profit-shifting behaviors.

The simple form of the corporate income tax rate (CIT) is used to measure the direct impact of statutory tax rates on profit reporting. The same approach is applied using the effective tax rate (ETR), calculated as the ratio of taxes paid to pre-tax profits, to capture the actual tax burden faced by the MNE. Moreover, a logarithmic transformation of both rates is included to address the non-linear relationship between tax rates and profit shifting, capturing the diminishing marginal effects of tax rates on profit allocation decisions (Garcia-Bernardo & Jánský 2024).

On top of that, the differential between both rates in the country of operational and global ultimate owner (CIT/ETR in the country of operation minus CIT/ETR in the country of global ultimate ownership, respectively) was calculated to capture the variations in tax rates experienced by the operating entities compared to their global ultimate owners. The inclusion of this form should shed more light on the tax planning strategies exploiting differences between national tax policies. The logarithmic transformations of these differences further refine the analysis by addressing the non-linear effects, enhancing the understanding of the disparities between operational and global ultimate owner tax burdens. An offset parameter a (in this case set equal to 1) in the logarithmic transformation $\log(\tau+a)$ is included to avoid taking the logarithm of zero or negative values, ensuring the robustness of the model (Garcia-Bernardo & Jánský 2024).

Regression Analysis

5.1 Baseline Fixed Effects Model

The following section studies how different forms of tax variables impact a subsidiary's pre-tax profit, depending on the model specification. All models in this analysis incorporate both ETR and CIT rates as explanatory variables, alongside other relevant control predictors such as employee expenditure (serving as a proxy for labor), total assets (approximating companies' capital), GDP per capita, and debt ratio. White's robust standard errors were used to address the presence of heteroskedasticity in the residuals. The model specification (as per Equation 4.4) and results provide the first insights into how different tax variables affect the profit variable. Table 5.1 below shows the estimated coefficients of the first regression applied on the entire set of subsidiaries before they were split into their respective groups.

Table 5.1: Effect of tax rate changes on profit for the full panel of MNEs

	Dependent variable: log(profit)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ETR	−0.181***							
	(0.052)							
ETR Δ		−0.111***						
		(0.030)						
log(ETR)			−0.027***					
			(0.009)					
log(ETR Δ + a)				−0.094***				
				(0.028)				
CIT					−0.089			
					(0.091)			
CIT Δ						−0.023		
						(0.063)		
log(CIT)							−0.079***	
							(0.024)	
log(CIT Δ + a)								−0.057
								(0.062)
log(empl. costs)	0.104***	0.104***	0.104***	0.104***	0.104***	0.104***	0.104***	0.104***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
log(total assets)	0.721***	0.720***	0.721***	0.720***	0.721***	0.721***	0.721***	0.721***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
log(GDP)	−0.046*	−0.051*	−0.054**	−0.052*	−0.051*	−0.056**	−0.038	−0.054**
	(0.027)	(0.027)	(0.027)	(0.027)	(0.028)	(0.027)	(0.027)	(0.027)
debt ratio	−1.059***	−1.059***	−1.059***	−1.059***	−1.059***	−1.058***	−1.059***	−1.059***
	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)
time FE	✓	✓	✓	✓	✓	✓	✓	✓
firm FE	✓	✓	✓	✓	✓	✓	✓	✓
Observations	557,865	557,865	557,865	557,865	557,865	557,865	557,865	557,865
R^2	0.137	0.137	0.137	0.137	0.137	0.137	0.137	0.137
Note:								*p<0.1; **p<0.05; ***p<0.01
Note II:								a=1

Across all eight model specifications, the coefficients for capital and labor variables remained constant and statistically significant. The direction of the effect is in line with expectations, with both labor and capital having a positive effect on the pre-tax profit, though the magnitude of the effect of capital seems to be somewhat larger compared to the coefficients obtained by Huizinga & Laeven (with elasticity coefficient estimates ranging from to 0.182 to 0.381) or Viertola (with coefficients between 0.037 and 0.058). These differences could stem from several methodological and contextual factors, such as the more broad definition of capital used in this model specification (total assets were used to proxy capital for a broader context instead of fixed tangible assets only), capturing a wider scope of resources available to the firm, resulting in a stronger positive effect on profit.

The coefficient of GDP per capita (denoting factor productivity) is negative and significant in most specifications. Though different from initial expectations, these results align with the findings of Huizinga & Laeven (2008) who theorized that despite potential benefits from advanced technologies available in richer European countries, the dominant effect is that firms require higher expected returns in countries with lower GDP due to less effective property rights and regulations, thus negatively impacting profitability.

Furthermore, the negative and significant coefficients for the debt ratio across all specifications indicate that higher debt levels are associated with lower profits before tax. This finding is also consistent with Huizinga & Laeven (2008) and Viertola (2023), likely due to the interest deductions from debt financing in high-tax countries. These deductions reduce the taxable income, thus aligning with the theoretical expectations and empirical findings of previous studies.

The resulting coefficients for effective tax rates align closely with previous research, showing consistently significant negative effects on pre-tax profit across all four specifications. The magnitude of the ETR semi-elasticity coefficient (-0.181) is relatively smaller compared to other studies like those from Huizinga & Laeven (-1.3) or Saunders-Scott (-0.9), who used similar datasets and methodology (though they did not use the exact method to obtain their effective tax rate), suggesting a more modest impact of tax rate changes on profits among the studied MNEs. Though the consistent negative relationship is indicative of strategic profit shifting, each of the tax rate coefficients requires a different interpretation.

The coefficient for the linear form of ETR suggests that an increase in the tax rate proportionally reduces reported profits, meaning as the ETR rises, reported profits decline in response to the increased tax burden. This semi-elasticity measure reflects the percentage change in profit for a unit change in the effective tax rate. In the case of the second specification, the coefficient for the ETR differential (ETR Δ) indicates how changes in tax rates over time affect a company's profitability, providing more information on the responsiveness of MNEs to tax policy changes. The logarithmic transformation of the effective tax rate serves as an elasticity measure, representing the percentage decrease in profits for a one percent increase in the tax rate. Lastly, the logarithm of the ETR differential (plus a=1 to handle cases where ETR $\Delta < 0$) measures the elasticity of pre-tax profit with respect to the percentage change in the adjusted ETR difference. Specifically, an additional 1 % increase in the difference between the two countries' ETRs (plus 1, due to the shift) would result in a 0.094 % decrease in profit.

A similar approach has been applied to the statutory rates, also yielding consistent negative results, though only the log(CIT) form appears to be statistically significant. This could be explained by Garcia-Bernardo & Jánský's finding that the extreme non-linearity of the relationship between tax rates and profit shifting is better captured by a logarithmic function. The significance of the log(CIT) coefficient suggests that the percentage change in the CIT rate has a proportional impact on the percentage change in pre-tax profit. This aligns with economic theory and empirical evidence that firms adjust their reported profits in response to changes in statutory tax rates to minimize their tax liabilities (e.g. Dischinger & Riedel, 2011).

These results provide the first evidence that effective tax rates significantly influence profit-shifting behavior among MNEs. The negative association between ETR and reported profits suggests that European MNEs actively engage in tax planning strategies to minimize their tax burdens. The significant effect of the ETR difference further supports the notion that tax rate differentials between countries play a critical role in determining where profits are reported. The findings on CIT rates, while not all statistically significant, still indicate that statutory tax rates can impact profit reporting.

5.1.1 Baseline Fixed Effects Model with Group Interaction

In this extended fixed effects model, interaction terms between the MNE group (A, B, or C) and tax rate variables were included to capture the differential impact of tax rates on subsidiary profits across different groups. The interaction term between tax rate and group allows for the tax rate effect to vary depending on the group classification, providing first insights into how tax incentives influence profit-shifting behavior differently across the three groups. The full regression results are available in Table A.2 of the Appendix A.

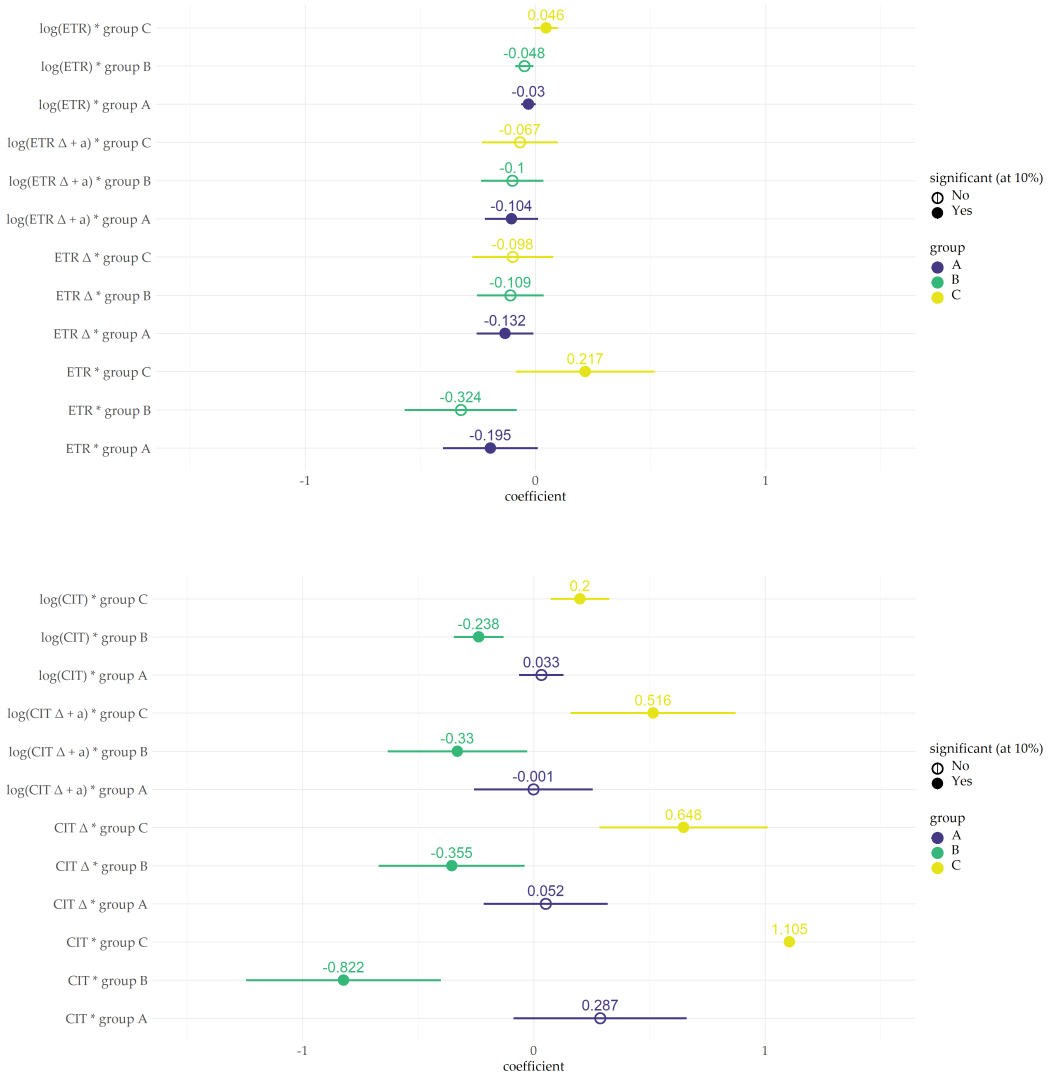


Figure 5.1: Summary of ETR & CIT and group interaction coefficients

Overall, the figure above visibly shows the notable difference in the variability of coefficients between the CIT and ETR estimates. The relatively high

fluctuation of CIT coefficients among the groups indicates that the statutory tax rates may have a less consistent impact on profit-shifting behavior. This could also be t could also be that effective tax rates tend to reflect the nuanced elements of company tax strategies, leading to more consistent estimates.

In the case of MNEs in group B, the interaction coefficients with both ETR and CIT rates indicate profit-shifting behavior with a consistent negative effect, larger in magnitude relative to other groups. However, in terms of ETRs, it is only group A that showed consistently significant results (in this case on a 10% level of significance, refer to Table A.2 in the Appendix A for more detail). Group C exhibits a different pattern. The positive interaction coefficients, particularly for the statutory tax variables, indicate that these subsidiaries are less likely to engage in profit shifting relative to the other groups. Instead, they might report higher profits even in higher-tax jurisdictions, possibly due to operational constraints or strategic decisions that outweigh the benefits of tax avoidance.

The technologically more developed MNEs in group A appear to be more sensitive to changes in the effective rather than the statutory tax rate. This would support the theory that high-tech firms often benefit from various tax incentives, like R&D credits, making them less sensitive to CIT rate changes. On the other hand, non-tech MNEs in group B seem to be more responsive to the statutory tax rates instead. This could be because low-tech firms typically rely more on tangible assets, and thus could have fewer opportunities for tax relief incentives.

The results for group C do not indicate aggressive profit-shifting behavior, instead, the companies in this group might maintain or even increase their reported profits in response to higher statutory tax rates. The positive coefficients suggest that mid-tech firms could be balancing between operational efficiency and profit-shifting, resulting in a less aggressive response to changes in tax rates. The results for this group may not be as telling since the MNEs in this group are more heterogeneous compared to the other two groups, or they may employ other operational strategies that offset the increase in statutory rates.

The coefficients of the other predictors such as labor, capital, or productivity remained consistent following the addition of the interaction, supporting the consistency in their effects on profit before tax (see Table A.2).

5.2 Baseline Fixed Effects Model Split by Group

To study the differential impact of tax variables on subsidiary profits, the dataset was split into three separate group subsets based on the criteria defined in Section 4.3. The hope is that this approach will help uncover more information about the specific responses of each sector to tax rate changes and control for potential heterogeneity that might not be obvious from the pooled dataset. Running separate regressions for each group allows a direct comparison of the magnitude and significance of coefficients across groups, highlighting how each of them responds to changes in tax incentives and statutory income tax rates.

Figure 5.2 provides a visualization of the estimated tax coefficients for each of the four specifications and MNE groups. The significance of the estimates in the figure is reported at a 10% significance level, refer to Tables A.3, A.4 and A.5 in this paper's Appendix A for detailed regression results.

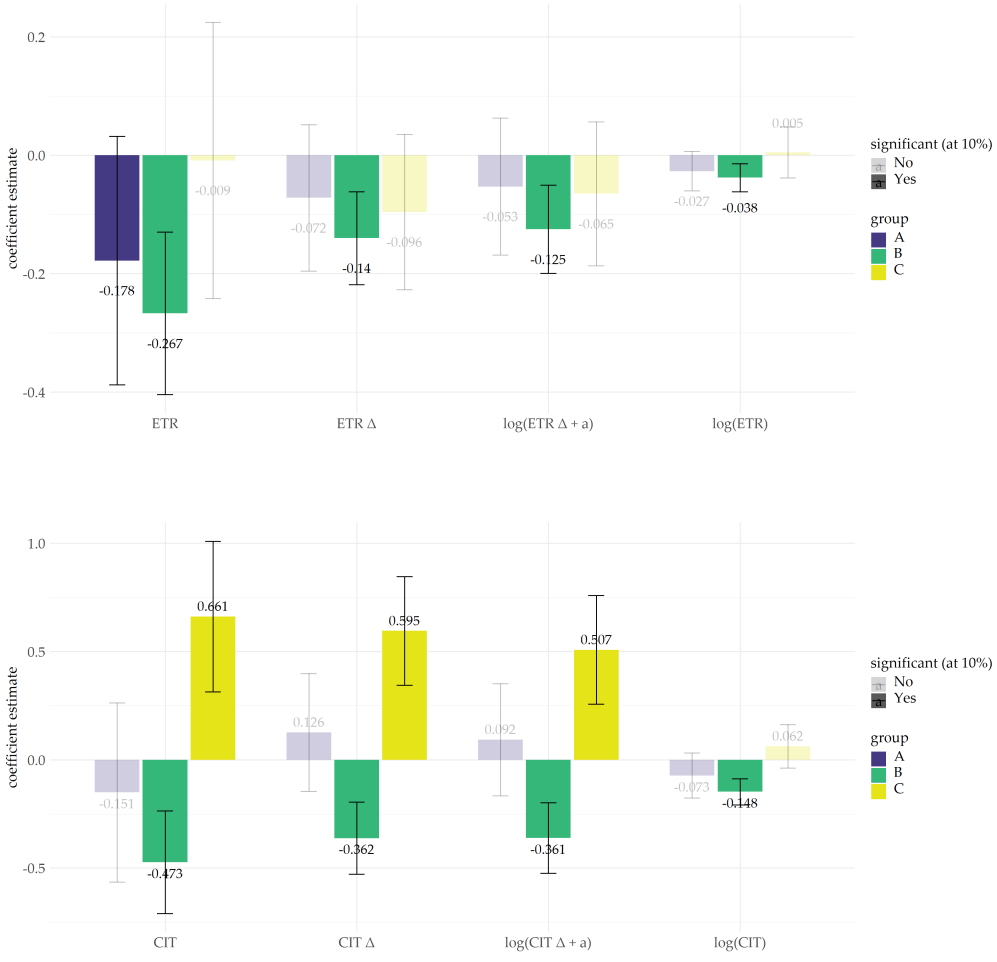


Figure 5.2: Effects of tax rate changes on profit before tax by group

For group A, the estimates for effective tax rates remain consistently negative across all specifications, albeit lower in magnitude and confidence level compared to the undivided MNE dataset. This finding is consistent with the earlier results and supports the notion that MNEs in group A tend to respond negatively to any increase in the real tax burden they face. Similarly to the previous results, the estimates of statutory rates do not show significant effects across all transformations, further supporting the notion that statutory tax rates may indeed not be a critical deciding factor for technology-focused MNEs in shaping their profit-shifting strategy.

For group B, the results show a significant negative effect of both ETR and CIT variables on profit, the highest in magnitude among the three industry groups. The effect of an increase in ETR on profit is more negative compared to group A, possibly because high-tech firms can better utilize IP regimes, lowering the overall impact of ETR changes. Interestingly, low-tech firms in group B also appear to be greatly sensitive to changes in statutory CIT rates, showing a significant reduction in reported profits with an increase in CIT rates. This indicates that while group B is impacted by both ETR and CIT changes, the sensitivity to CIT changes is particularly strong. This further supports the notion that low-tech firms typically rely less on intangible assets, making these firms less likely to benefit from various tax incentives, such as R&D credits and IP regimes, which can significantly lower their effective tax rate. Hence, they are more sensitive to the direct effects of statutory tax rates.

The regression results for group C display a slightly different pattern, though consistent with the previous findings in Figure 5.1. Once again, the ETRs do not seem to have any significant effect on profits, indicating that middle-tech MNEs are not as sensitive to changes in effective tax rates as groups A and B. However, they do seem to respond positively to an increase in statutory rates. This is indicative of other incentives or strategic investments that potentially help them maintain or even increase their profitability despite higher tax rates. These firms could be leveraging economies of scale, superior management practices, or a competitive edge in their industry, which could potentially help them absorb the increased tax expenditure without a significant negative impact on their reported profits.

Overall, the coefficients for labor and capital have not changed significantly compared to the previous regression results (see Tables A.3, A.4 & A.5). These

variables continue to have a substantial impact on profits, reinforcing their importance in determining subsidiary profitability. The GDP per capita variable, however, does not show significant effects in most specifications for group B, suggesting that low-tech firms might not be as sensitive to the income levels of the country they operate in. The debt ratio remains significantly negative, indicating that higher debt levels are associated with lower profits, supporting the previous results.

Comparing these group-specific results to the pooled dataset with added group interaction terms provides an alternative perspective on the groups' behavior. Companies in group A seem to be primarily sensitive to changes in effective tax rates, while low-tech firms in group B respond to both ETR and CIT rate changes. Mid-tech companies in group C on the other hand, appear to respond positively to increases in statutory rates, indicating varied profit-shifting strategies across the three groups.

5.3 Profit Shifting and Intangible Assets

The initial analysis used total assets as a single measure to provide broader insights into the role of capital in determining profitability across the three sectors. However, this aggregation might mask certain differences in how different types of assets, especially intangibles, affect profit. To gain a more granular view of the capital structure, the analysis was extended by substituting total assets with two components, tangible fixed assets (to serve as a new proxy for capital, similar to Huizinga & Laeven, 2008) and intangible assets which are of particular interest in this study. Table 5.2 shows the estimated coefficients of both types of assets following this adjustment.

Table 5.2: Effect of two forms of capital on pre-tax profit for each group

Group	**Fixed Assets**	**SE**	**Intangible Assets**	**SE**
group A	0.055***	0.009	0.008*	-0.004
group B	0.061***	0.005	-0.004*	-0.003
group C	0.071***	0.011	-0.004	-0.004

Note: The significance levels are denoted as follows: *p < 0.1, **p < 0.05, ***p < 0.01. Both forms of capital were log-transformed. For detailed regression output, refer to Tables A.6, A.7 & A.8

The results for intangible assets highlight their strategic importance in high-

tech firms. The positive coefficient, although not largely significant (in contrast with e.g. Crotti, 2021), hints at the importance of intangible assets in driving profitability. However, the magnitude of the effect does not appear to be as pronounced (similarly to Beer & Loeprick, 2015, and Crotti, 2021), possibly due to intangible investments requiring more time to be reflected in profits.

Low-tech companies in group B show a negative correlation between a potential increase in intangibles and reported profit. Low-tech firms may lack the expertise or infrastructure to effectively utilize intangible assets, leading to misalignment with core competencies and diversion of resources from value-generating activities, ultimately resulting in inefficiencies and negative impacts on profitability. Group C does not show significant results, likely due to its heterogeneous nature compared to the other groups.

The results also imply that while intangible assets may have a positive impact on profit for high-tech firms, fixed assets remain a fundamental component of profitability across all groups of analyzed MNEs, particularly in mid and low-tech firms where the dependence on physical capital is the most pronounced.

Figures 5.3 and 5.4 present the estimated coefficients for both tax variables after including intangible and tangible assets.

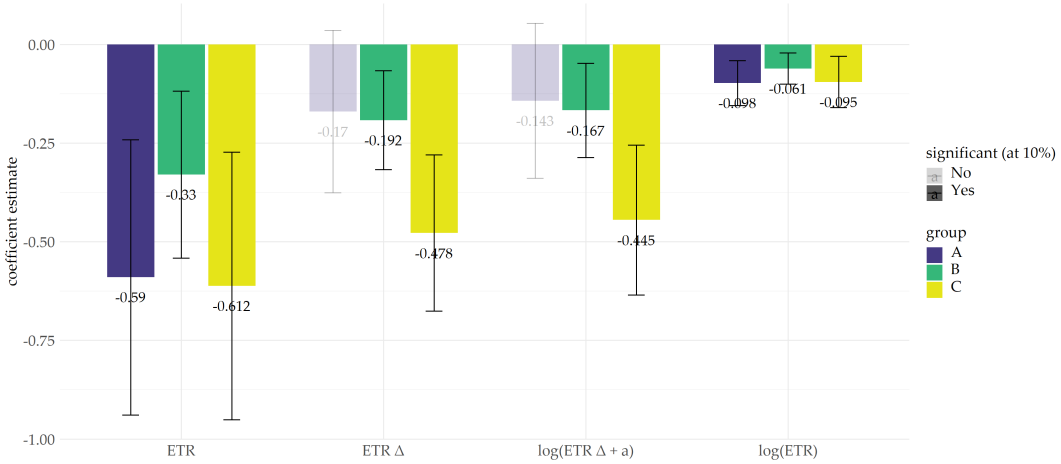


Figure 5.3: Effect of ETR rate changes on profit before tax by group (after adding intangible asset variable)

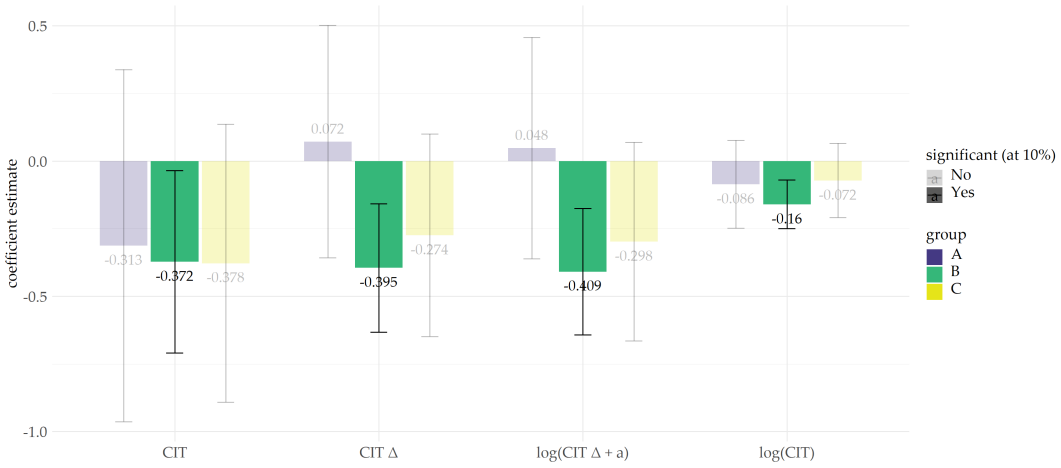


Figure 5.4: Effect of CIT rate changes on profit before tax by group (after adding intangible asset variable)

Looking at what the adjusted model revealed about sensitivity to tax rate changes, the ETR coefficient for group A has become more significant and larger in magnitude compared to the previous specification, indicating a stronger sensitivity to changes in effective tax rates. The fact that the coefficient for ETR in group A is once again significant only when the ETR is taken into account directly, but not the differential, meaning that high-tech firms prioritize managing their tax burdens in their immediate environment over leveraging tax rate differences between countries. However, the CIT coefficients remain insignificant, reinforcing the notion that statutory rates are less impactful on these firms.

In contrast, group B continues to show significant sensitivity to both ETR and CIT, with a slight increase in magnitude for ETR compared to the previous results, emphasizing that low-tech firms are heavily influenced by both effective and statutory tax rates. The stronger response to CIT changes reflects the limited use of intangible assets and greater reliance on tangible assets, making these firms more exposed to statutory tax rates.

For group C, the positive sensitivity to CIT rates has changed to negative, though without sufficient statistical significance. Moreover, unlike in the original specification, the ETR coefficients become significantly negative. These two changes suggest that the tax planning strategies across the mid-tech sector may be more complex and varied compared to high-tech and low-tech firms. The significant negative ETR estimate and the shift to a negative CIT coeffi-

cient suggest that middle-tech firms are responsive to both their effective and statutory tax burdens once their asset utilization is accurately accounted for.

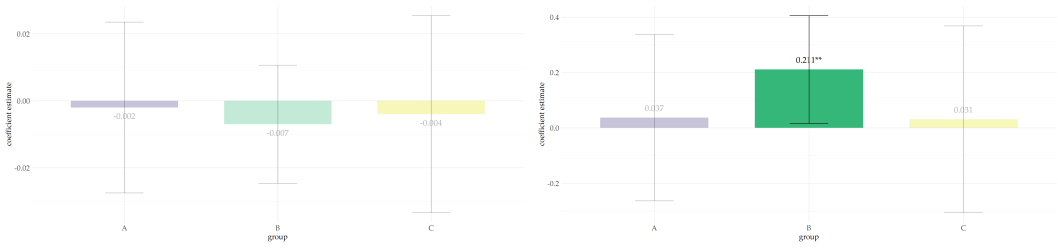
5.3.1 Adding Low Tax Jurisdiction Interaction

To gain a direct comparison of how each group uses intangible assets in low-tax jurisdiction, an interaction term was included between a dummy variable indicating low-tax jurisdiction and intangible assets. The goal is to see if the negative impact of intangible assets on profit is different in low-tax jurisdictions compared to those where taxes are higher.

The three analyzed groups may employ different strategies with their intangible assets, some might aggressively shift intangibles to low-tax countries, while others may not. This interaction term can help isolate these effects. If MNEs were shifting profits to low-tax jurisdictions using intangible assets, the interaction's coefficient would show a significant and positive relationship with profits, implying that they are effectively locating their intangible assets to shift profits to lower-tax areas, thus saving on taxes.

Low tax jurisdiction was defined as a dummy equal to 1 for countries with corporate income tax rates of 15 % or lower. The threshold of 15% for defining low tax jurisdictions was set following the recent global tax policy initiatives, particularly the OECD's proposed global minimum tax rate under Pillar II of the BEPS 2.0 project. Additionally, countries like Cyprus, Malta, Luxembourg, Switzerland, the Netherlands, and Estonia were included, as they are generally recognized for their lenient tax incentives, making them attractive destinations for MNEs seeking tax efficiencies.

The results of the adjusted regression are summarized in figure 5.5.



(a) Intangibles and low tax jurisdiction interaction

(b) Low tax jurisdiction only

Figure 5.5: Low tax jurisdiction estimates

The interactions between intangible assets and low-tax jurisdictions did not yield any significant conclusions for any of the groups, indicating that the

benefits of intangible assets do not significantly change when firms operate in low-tax jurisdictions. Interestingly, the previously significant coefficient for the statutory tax rate in group B (see Table A.10) became less prominent with the inclusion of the low-tax jurisdiction dummy, implying it may have captured some of the variability previously attributed to statutory tax rates. The positive significant coefficient for the low-tax jurisdiction variable indicates that low-tech firms generally tend to benefit from operating in low-tax jurisdictions, even though the interaction with intangible assets remains insignificant. This finding suggests that these firms may employ simpler tax planning strategies not heavily reliant on intangibles.

In the context of group A, another reason for a non-significant result could be that high-tech firms often capitalize on tax incentives and R&D credits, such as patent box regimes, to avoid higher taxes without the need to shift profits to a subsidiary in a lower-tax country. This raises a question of the importance of favorable IP regimes in strategic tax planning.

5.3.2 Adding IP Regime Jurisdiction Interaction

While the previous analysis of the interaction between intangible assets and low-tax jurisdictions did not yield significant results, this section takes an alternative approach by examining the impact of favorable IP regimes on profit-shifting behaviors. IP regimes refer to tax policies that provide preferential tax treatment to income derived from intellectual property (IP), such as patent boxes and similar incentives. The low tax jurisdiction variable is replaced with a new dummy, set to 1 for subsidiaries operating in jurisdictions with favorable IP regimes and 0 otherwise. The new interaction term should help isolate the impact of favorable IP regimes on the pre-tax profits of firms with significant intangible assets.

This adjustment aims to capture the specific impact of favorable IP regimes on profit before tax, isolating the effects of jurisdictions that provide tax incentives explicitly tailored for intellectual property (IP) income. Favorable IP regimes were identified based on the criteria set forth by the OECD and other international tax bodies. These criteria include specific tax benefits for IP income, such as Patent Box regimes, R&D tax credits, and other preferential treatments.

Favorable IP regimes are designed to attract and retain IP-related business

activities by offering reduced tax rates on income derived from IP, creating an incentive for MNEs to locate their intangible assets in these jurisdictions. The full list of countries with favorable IP regimes, sourced from the Tax Foundation's comprehensive overview of European patent box regimes, is available in Table B.1.

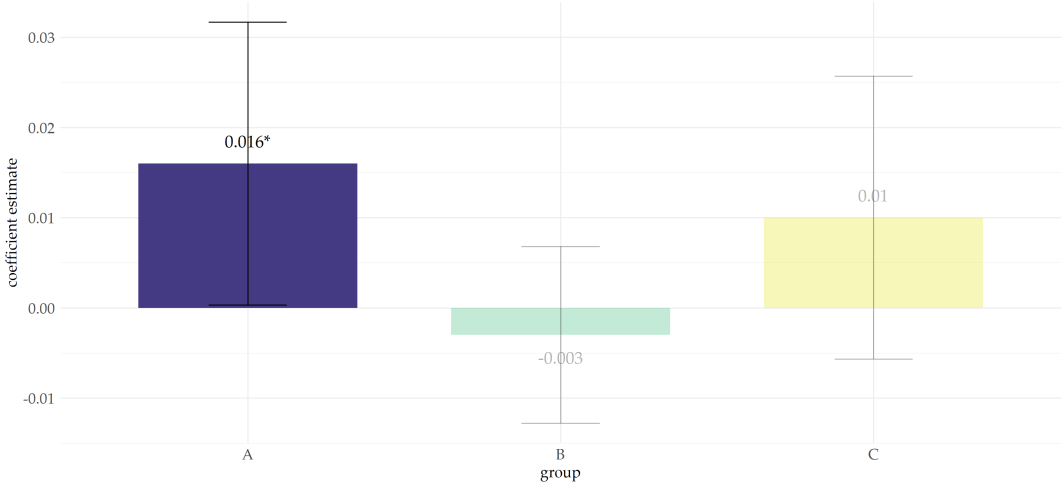


Figure 5.6: IP regime interaction estimates

For group A, the interaction coefficient is slightly positive and significant, indicating that firms in this group benefit from locating their intangible assets in countries that have adopted patent box regimes. This suggests that high-tech firms are indeed effectively utilizing IP regimes to their advantage to lower their tax liabilities, which aligns with the strategic importance of intangible assets in driving profitability for these firms found by both Beer & Loeprick (2015) and Crotti (2021). The consistent significance of the ETR variable across the different specifications reinforces the theory that high-tech companies engage in sophisticated tax planning strategies to optimize their overall tax burden.

In groups B and C, the interaction term between intangible assets and favorable IP regimes is not significant, indicating that firms in these groups may not be leveraging IP regimes as effectively as high-tech firms in group A. The significant negative coefficients for the ETR and ETR difference variables in both groups imply a strong sensitivity to tax rates, indicating that these sectors do not rely on IP-related strategies. Additionally, the robustness of other variables, such as fixed assets and employee costs, remains consistent, highlighting that these predictors continue to be significant determinants of profitability across both groups.

5.4 Summary of Tax Rate Coefficients Across Model Specifications

The three figures below provide a comprehensive overview of how various model specifications impacted the tax coefficients for each sector of MNEs. The plots visualize the behavior of both tax variables and their 4 specifications across the 6 different model specifications discussed above.

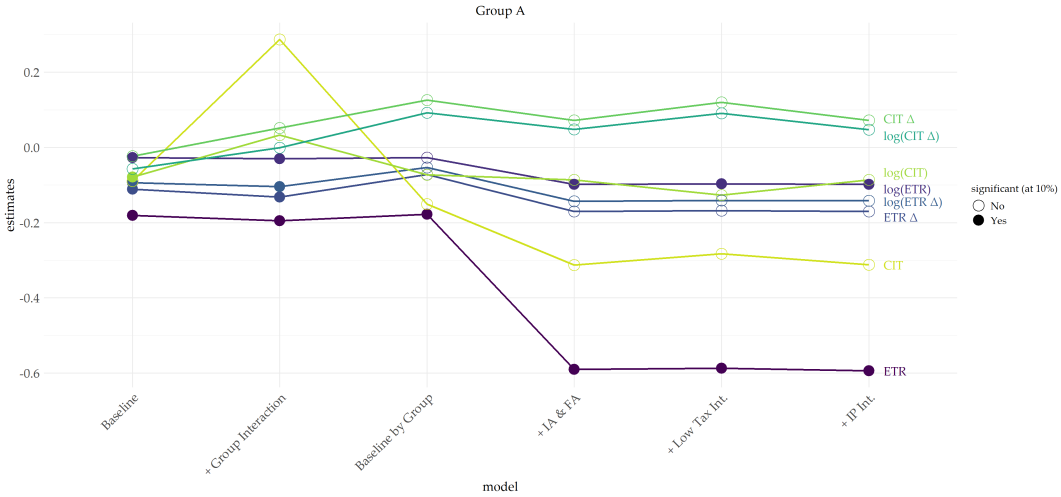


Figure 5.7: Summary of tax rate coefficient changes across model specifications (group A)

Baseline model refers to the initial general regression on the entire panel of MNEs; Group Interaction denotes the baseline with group interaction; Baseline by Group stands for the initial model specification ran separately on each subset divided by group; + IA and FA shows the tax rate estimates after the division of capital into intangible and fixed assets; + Low Tax Int. refers to the previous model but after the inclusion of low-tax interaction; + IP Int. denotes the last model with IP interaction.

Figure 5.7 summarizes the output for group A, where the results of the first model produced a significant negative coefficient for all effective rate tax rate forms, indicating that higher effective tax rates consistently affect profits negatively. The negative trend remains across all specifications, suggesting a robust negative relationship between ETR and pre-tax profit for this group. However, the differential specifications of ETR do not show a consistently significant effect on pre-tax profit. This could be because rather than the absolute level, they capture changes in the tax rate which can be more volatile and subject to short-term fluctuations. Therefore their relationship with profits might be less stable, and hence less likely to exhibit consistent significance. Nevertheless,

they seem to follow the same trend with the changing model specifications as the other ETR forms.

When the split between intangible and fixed assets is included in the model, the negative coefficient of ETR drops even lower (most prominently in the direct application of the ETR rate), potentially indicative of intangible assets increasing the tax sensitivity (supported by Beer & Loeprick, 2015). To investigate this relationship further, an interaction between intangible assets and low-tax jurisdiction was included in the model to help isolate the relationship between these two variables and its impact on profits.

The CIT coefficient, on the other hand, shows no significant impact on profit. This could be explained by high-tech MNEs' strategies being more focused on favorable IP regimes offering various deductions, credits, or other incentives that would curb the negative impact of potential increases in statutory CIT rates. This was later supported by the finding that firms with higher intangible assets benefit more in jurisdictions with favorable IP regimes in the previous section, aligning with the hypothesis that intangible assets have a different impact on pre-tax profits in jurisdictions with favorable IP regimes (for high-tech companies at least).

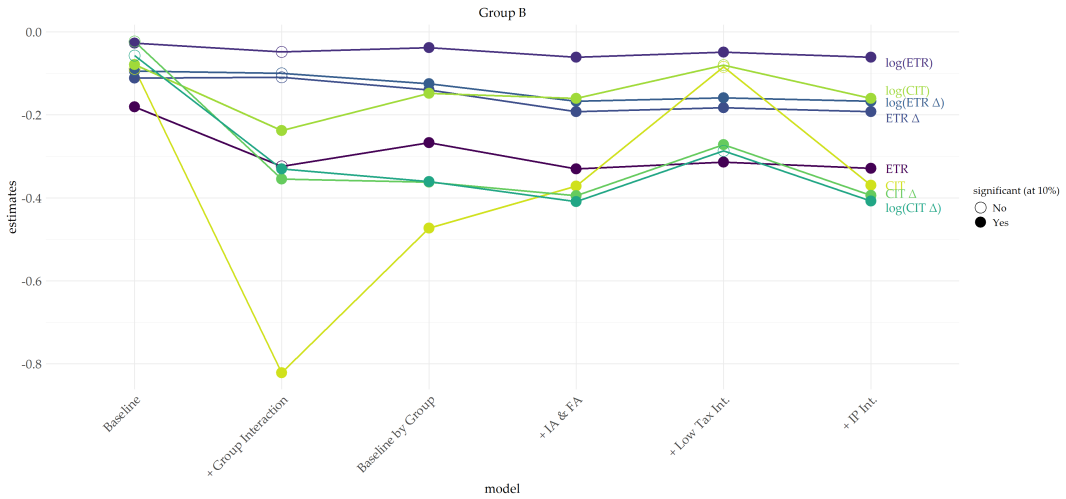


Figure 5.8: Summary of tax rate coefficient changes across model specifications (group B)

Baseline model refers to the initial general regression on the entire panel of MNEs; Group Interaction denotes the baseline with group interaction; Baseline by Group stands for the initial model specification ran separately on each subset divided by group; + IA and FA shows the tax rate estimates after the division of capital into intangible and fixed assets; + Low Tax Int. refers to the previous model but after the inclusion of low-tax interaction; + IP Int. denotes the last model with IP interaction.

Overall, the regression results for the non-tech group B (Figure 5.8) show its sensitivity to both effective and statutory tax rates. Similarly to group A, there is almost constant and significant sensitivity to ETR, but with a higher magnitude of the impact on profit, indicating a stronger response to changes in ETR.

Unlike in group A, incorporating fixed and intangible assets into the model did not substantially change the size of any of the tax rate estimates. The higher sensitivity in Group B aligns with the notion that firms with fewer intangible assets may be less adept at leveraging tax planning strategies (similar to Beer & Loeprick, 2015), making them more vulnerable to tax rate changes. Moreover, non-tech MNEs' profits seem to be substantially impacted by the higher statutory tax rates, unlike in the case of group A where CIT rates did not show a significant impact. Non-tech companies in group B rely less upon intangibles and related tax planning strategies and can thus face greater challenges in mitigating the impact of CIT increases.

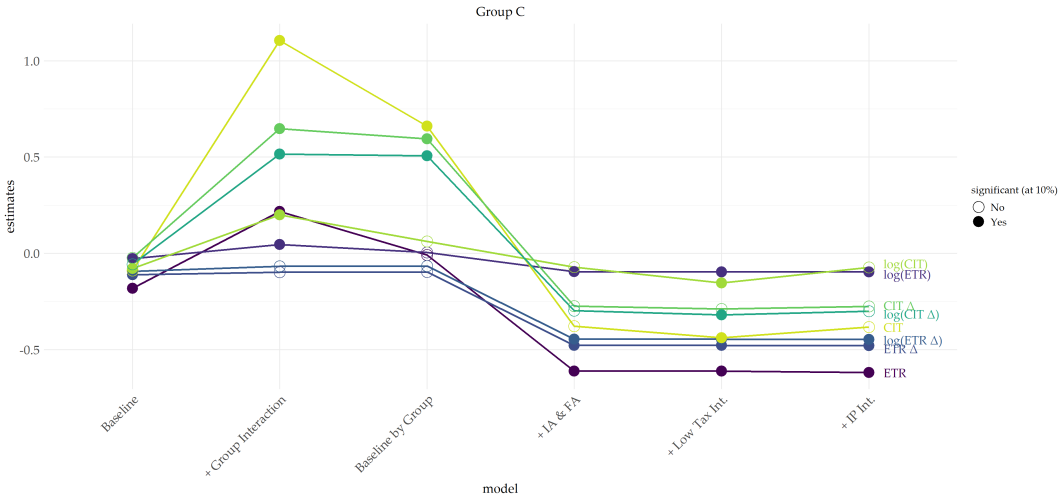


Figure 5.9: Summary of tax rate coefficient changes across model specifications (group C)

Baseline model refers to the initial general regression on the entire panel of MNEs; Group Interaction denotes the baseline with group interaction; Baseline by Group stands for the initial model specification ran separately on each subset divided by group; + IA and FA shows the tax rate estimates after the division of capital into intangible and fixed assets; + Low Tax Int. refers to the previous model but after the inclusion of low-tax interaction; + IP Int. denotes the last model with IP interaction.

For group C (Figure 5.9), the regression results were somewhat mixed, reflecting the heterogeneous and not-so-clearly defined structure of this sector. In the initial pooled model with group interaction, all tax coefficients indicated a slight

positive relationship with profit, however, this changed with the introduction of fixed and intangible assets into the group subset. These assets might interact differently with tax rates compared to the pooled analysis, potentially masking its effect on profit when not isolated. In later model specifications, both tax variables' coefficients seemed to stabilize and their effect remained negative following the inclusion of additional variables and interactions, revealing the importance of considering a proper split of capital and inclusion of intangible assets to capture the true tax effects on profit.

The analysis of tax rate coefficients across different model specifications reveals that the three MNE groups tend to respond differently to tax rate changes. High-tech companies consistently showed a significant negative effect of effective tax rates on profits, likely influenced by the substantial reliance on intangible assets within these firms. Non-tech MNEs demonstrated greater sensitivity to effective tax rates, but often an even larger negative profit response to changes in statutory rates. This could be explained by group B's less IP regime-reliant tax planning capabilities, as they are more affected by changes in CIT rates. In contrast, the mid-tech MNEs in group C showed a less clear combination of outcomes underscoring the complexities within this diverse sector, indicating that a more nuanced approach is necessary to consider the multitude of factors involved.

Conclusion

This study extends the important research of Hines & Rice (1994), Huizinga & Laeven (2008), followed up by more recent publications Beer & Loeprick (2015), Crotti (2021) and others to examine the impact of tax rate changes on the pre-tax profits reported by European MNEs. Special focus was given to comparing the profit-shifting behavior across different sectors, focusing on the role of intangible assets, the level of technological development, and adopted patent box regimes. The goal of this study was to understand how these factors influence the pre-tax profits of MNEs and to identify sector-specific strategies used by these enterprises to manage their tax liabilities.

There was not sufficient evidence found to confirm the hypothesis that MNEs are more likely to increase profit by shifting their intangible assets to a lower tax jurisdiction. The regression analysis did not reveal a significant relationship between profits and interaction between intangible assets and a low-tax jurisdiction dummy for in of the three studied groups, suggesting that the relationship between the two factors may not be as strong as initially anticipated (e.g. by Dischinger & Riedel, 2011), at least not in the European context.

The analysis confirmed that firms with higher levels of technological development effectively use patent regimes to decrease their tax expenditure, uncovering the likely strategic use of intangible assets. The inclusion of interaction terms between intangible assets and an IP regime dummy variable showed a significant positive coefficient across all specifications for the high-tech group, unlike the other sectors where no significant effect was shown. However, it should be said that this result was found significant only at a 10% level of significance and the magnitude of the effect is relatively small. The results of the empirical analysis suggest that thanks to the presence of a patent box regime, a 1% increase in intangible assets is associated with a 0.016% rise in pre-tax profits for a high-tech subsidiary, on top of any direct effects on intangible assets or IP regime itself.

Nevertheless, the positive coefficient implies that high-tech MNEs indeed benefit from allocating their intangible assets to countries that have adopted IP regimes, showing that the effect of intangible assets on pre-tax profits differs significantly between jurisdictions with and without favorable IP regimes, at least for this group in particular. There was no evidence found to support this hypothesis for the middle and low-level technology-reliant groups, indicating

that these firms do not use IP regimes for profit shifting to the same extent as the technologically developed companies. While the increase in profitability is modest, this strategy is part of broader tax optimization efforts employed by multinational enterprises, demonstrating how tax incentives for intellectual property can influence corporate behavior.

The analysis revealed significant variations in the effect of tax rate changes on pre-tax profit across the three studied MNE groups. The analysis uncovered the varying tax sensitivity of pre-tax profits of each sector depending on the form of tax rate used. The high-tech group of MNEs consistently displayed a moderate negative relationship between effective tax rates and profits indicative of its sensitivity to tax change, with more pronounced sensitivity to the direct effective tax rate in the current country rather than the differential between the operating country and the global ultimate owner country. The low-tech MNE group displayed a greater negative response to increases in the effective tax rate compared to the high-tech group. This goes against the findings of Beer & Loeprick (2015) who found there to be a greater negative effect on profit following a tax rate increase for subsidiaries with above median intangible endowment when defining the technology development by the level of intangible assets. More interestingly, the low-tech subsidiaries showed an even greater negative sensitivity to changes in statutory rates, indicative of less sophisticated tax planning. For the mid-technology level group of companies, the overall response to tax rate changes varied, showing a quite volatile effect of both ETR and CIT changes on profits relative to the other two more homogeneously defined groups. The varied reactions within these sectors highlight the importance of considering firm-specific attributes, such as their capital composition, when assessing the impact of tax rate changes.

These findings confirm that there are differences in the way the three selected groups react to changes in tax rates, both effective and statutory, supporting the initial hypothesis. High-technology MNEs showed an overall moderate and rather stable negative response to both ETR and CIT changes, indicative of a more predictable tax behavior, possibly due to effective tax planning strategies and effective use of patent box regimes. The low-tech group displayed the most pronounced sensitivity to effective tax rates, but an even greater response to statutory rate changes, indicating that they may be more likely to shift profits to low-tax jurisdictions (reporting approximately 16.6% to 21.8% higher profits) or even tax havens. The results were the least conclusive for the moderate

technology group, with the greatest variability in the effect of both ETR and CIT changes, underscoring the group's complexity and varied nature.

These findings shed more light on the complexity of profit shifting among European multinationals, establishing a link between the level of technological development, the adoption of patent regimes, and the MNEs' tax planning behavior. While IP incentives aim to promote innovation and stimulate investment, they may also facilitate profit shifting if not closely monitored. As technology continues to evolve even further, its impact on tax planning and profit shifting warrants continuous investigation. Future studies could incorporate other reliable metrics to define the level of MNE's technological development, such as R&D expenditure for a more precise definition. There is also a need for research on the long-term effects of recently passed tax laws and policies on MNE behavior to assess the effectiveness and sustainability of these policies.

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Appendix A - Regression Outputs

Table A.1: Effect of tax rate changes on profit for the full panel of MNEs

	Dependent variable: log(profit)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ETR	−0.181***							
	(0.052)							
ETR Δ		−0.111***						
		(0.030)						
log(ETR)			−0.027***					
			(0.009)					
log(ETR Δ + a)				−0.094***				
				(0.028)				
CIT					−0.089			
					(0.091)			
CIT Δ						−0.023		
						(0.063)		
log(CIT)							−0.079***	
							(0.024)	
log(CIT Δ + a)								−0.057
								(0.062)
log(empl. costs)	0.104***	0.104***	0.104***	0.104***	0.104***	0.104***	0.104***	0.104***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
log(total assets)	0.721***	0.720***	0.721***	0.720***	0.721***	0.721***	0.721***	0.721***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
log(GDP)	−0.046*	−0.051*	−0.054**	−0.052*	−0.051*	−0.056**	−0.038	−0.054**
	(0.027)	(0.027)	(0.027)	(0.027)	(0.028)	(0.027)	(0.027)	(0.027)
debt ratio	−1.059***	−1.059***	−1.059***	−1.059***	−1.059***	−1.058***	−1.059***	−1.059***
	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)
time FE	✓	✓	✓	✓	✓	✓	✓	✓
firm FE	✓	✓	✓	✓	✓	✓	✓	✓
Observations	557,865	557,865	557,865	557,865	557,865	557,865	557,865	557,865
R^2	0.137	0.137	0.137	0.137	0.137	0.137	0.137	0.137
Note:								*p<0.1; **p<0.05; ***p<0.01
Note II:								a=1

Table A.2: Effect of tax rate changes on profit + group interaction

	Dependent variable: log(profit)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ETR	−0.195*							
	(0.105)							
ETR Δ		−0.132**						
		(0.063)						
log(ETR)			−0.030*					
			(0.016)					
log(ETR Δ + a)				−0.104*				
				(0.059)				
CIT					0.287			
					(0.191)			
CIT Δ						0.052		
						(0.137)		
log(CIT)							0.033	
							(0.049)	
log(CIT Δ + a)								−0.001
								(0.131)
log(employee costs)	0.104***	0.104***	0.104***	0.104***	0.104***	0.104***	0.104***	0.104***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
log(total assets)	0.721***	0.720***	0.721***	0.720***	0.721***	0.721***	0.721***	0.721***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
log(GDP)	−0.048*	−0.051*	−0.056**	−0.052*	−0.050*	−0.058**	−0.042	−0.056**
	(0.027)	(0.027)	(0.027)	(0.027)	(0.028)	(0.027)	(0.027)	(0.027)
debt ratio	−1.059***	−1.059***	−1.058***	−1.059***	−1.057***	−1.057***	−1.058***	−1.058***
	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)
ETR * group B	−0.129							
	(0.124)							
ETR * group C	0.412***							
	(0.154)							
ETR Δ * group B		0.023						
		(0.074)						
ETR Δ * group C		0.034						
		(0.090)						
log(ETR) * group B			−0.018					
			(0.020)					
log(ETR) * group C			0.076***					
			(0.027)					
log(ETR Δ + a) * group B				0.004				
				(0.069)				
log(ETR Δ + a) * group C				0.037				
				(0.084)				
CIT * group B					−1.109***			
					(0.215)			
CIT * group C					0.818***			
					(0.242)			
CIT Δ * group B						−0.407**		
						(0.161)		
CIT Δ * group C						0.596***		
						(0.186)		
log(CIT) * group B							−0.271***	
							(0.055)	
log(CIT) * group C							0.167***	
							(0.065)	
log(CIT Δ + a) * group B								−0.329**
								(0.154)
log(CIT Δ + a) * group C								0.517***
								(0.182)
time FE	✓	✓	✓	✓	✓	✓	✓	✓
firm FE	✓	✓	✓	✓	✓	✓	✓	✓
Observations	557,865	557,865	557,865	557,865	557,865	557,865	557,865	557,865
R^2	0.137	0.137	0.137	0.137	0.137	0.137	0.137	0.137

Note: *p<0.1; **p<0.05; ***p<0.01
Note II: a=1

Table A.3: Effect of tax rate changes on profit before tax (group A)

	Group A Dependent variable: log(profit)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ETR	−0.178*							
	(0.107)							
ETR Δ		−0.072						
		(0.063)						
log(ETR)			−0.027					
			(0.017)					
log(ETR Δ + a)				−0.053				
				(0.059)				
CIT					−0.151			
					(0.211)			
CIT Δ						0.126		
						(0.139)		
log(CIT)							−0.073	
							(0.053)	
log(CIT Δ + a)								0.092
								(0.132)
log(employee costs)	0.107***	0.107***	0.107***	0.107***	0.107***	0.107***	0.107***	0.107***
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
log(total assets)	0.758***	0.758***	0.758***	0.758***	0.758***	0.758***	0.758***	0.758***
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
log(GDP)	−0.171***	−0.177***	−0.178***	−0.178***	−0.171***	−0.189***	−0.165***	−0.187***
	(0.055)	(0.055)	(0.055)	(0.055)	(0.056)	(0.055)	(0.056)	(0.055)
debt ratio	−0.987***	−0.987***	−0.987***	−0.987***	−0.987***	−0.987***	−0.987***	−0.987***
	(0.044)	(0.044)	(0.044)	(0.044)	(0.044)	(0.044)	(0.044)	(0.044)
time FE	✓	✓	✓	✓	✓	✓	✓	✓
firm FE	✓	✓	✓	✓	✓	✓	✓	✓
Observations	131,035	131,035	131,035	131,035	131,035	131,035	131,035	131,035
R^2	0.179	0.179	0.179	0.178	0.178	0.179	0.179	0.178
Note:								*p<0.1; **p<0.05; ***p<0.01
Note II:								a=1

Table A.4: Effect of tax rate changes on profit before tax (group B)

	Group B Dependent variable: log(profit)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ETR	-0.267^{***} (0.070)							
ETR Δ		-0.140^{***} (0.040)						
log(ETR)			-0.038^{***} (0.012)					
log(ETR Δ + a)				-0.125^{***} (0.038)				
CIT					-0.473^{***} (0.121)			
CIT Δ						-0.362^{***} (0.085)		
log(CIT)							-0.148^{***} (0.031)	
log(CIT Δ + a)								-0.361^{***} (0.083)
log(employee cost)	0.099^{***} (0.006)	0.100^{***} (0.006)	0.100^{***} (0.006)	0.100^{***} (0.006)	0.100^{***} (0.006)	0.100^{***} (0.006)	0.100^{***} (0.006)	0.100^{***} (0.006)
log(total assets)	0.699^{***} (0.007)	0.698^{***} (0.007)	0.699^{***} (0.007)	0.699^{***} (0.007)	0.699^{***} (0.007)	0.699^{***} (0.007)	0.699^{***} (0.007)	0.699^{***} (0.007)
log(GDP)	0.046 (0.036)	0.037 (0.036)	0.035 (0.036)	0.036 (0.036)	0.067^{*} (0.037)	0.055 (0.036)	0.065^{*} (0.037)	0.054 (0.036)
debt ratio	-1.004^{***} (0.028)	-1.004^{***} (0.028)	-1.004^{***} (0.028)	-1.004^{***} (0.028)	-1.005^{***} (0.028)	-1.004^{***} (0.028)	-1.005^{***} (0.028)	-1.004^{***} (0.028)
time FE	✓	✓	✓	✓	✓	✓	✓	✓
firm FE	✓	✓	✓	✓	✓	✓	✓	✓
Observations	303,962	303,962	303,962	303,962	303,962	303,962	303,962	303,962
R^2	0.119	0.119	0.119	0.119	0.119	0.119	0.119	0.119

Note: *p<0.1; **p<0.05; ***p<0.01
Note II: a=1

Table A.5: Effect of tax rate changes on profit before tax (group C)

	Group C							
	Dependent variable: log(profit)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ETR	−0.009							
	(0.119)							
ETR Δ		−0.096						
		(0.067)						
log(ETR)			0.005					
			(0.022)					
log(ETR Δ + a)				−0.065				
				(0.062)				
CIT					0.661***			
					(0.177)			
CIT Δ						0.595***		
						(0.128)		
log(CIT)							0.062	
							(0.051)	
log(CIT Δ + a)								0.507***
								(0.128)
log(employee costs)	0.113***	0.113***	0.113***	0.113***	0.114***	0.114***	0.113***	0.114***
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
log(total assets)	0.733***	0.733***	0.733***	0.733***	0.733***	0.734***	0.733***	0.734***
	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)
log(GDP)	−0.187***	−0.177***	−0.189***	−0.181***	−0.251***	−0.247***	−0.205***	−0.236***
	(0.061)	(0.060)	(0.060)	(0.060)	(0.062)	(0.061)	(0.062)	(0.061)
debt ratio	−1.273***	−1.273***	−1.272***	−1.273***	−1.267***	−1.267***	−1.271***	−1.269***
	(0.047)	(0.047)	(0.047)	(0.047)	(0.047)	(0.047)	(0.047)	(0.047)
time FE	✓	✓	✓	✓	✓	✓	✓	✓
firm FE	✓	✓	✓	✓	✓	✓	✓	✓
Observations	122,868	122,868	122,868	122,868	122,868	122,868	122,868	122,868
R^2	0.138	0.139	0.138	0.138	0.139	0.139	0.139	0.139

Note: *p<0.1; **p<0.05; ***p<0.01

Note II: a=1

Table A.6: Effect of tax rate changes on profit before tax with intangible assets (group A)

	Group A Dependent variable: log(profit)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ETR	−0.590***							
	(0.178)							
ETR Δ		−0.170						
		(0.105)						
log(ETR)			−0.098***					
			(0.029)					
log(ETR Δ + a)				−0.143				
				(0.100)				
CIT					−0.313			
					(0.332)			
CIT Δ						0.072		
						(0.219)		
log(CIT)							−0.086	
							(0.083)	
log(CIT Δ + a)								0.048
								(0.209)
log(employee costs)	0.420***	0.421***	0.421***	0.421***	0.422***	0.422***	0.422***	0.422***
	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)
log(fixed assets)	0.055***	0.055***	0.055***	0.055***	0.055***	0.055***	0.055***	0.055***
	(0.009)	(0.009)	(0.008)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
log(intangible assets)	0.008*	0.008*	0.008*	0.008*	0.008*	0.008*	0.008*	0.008*
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
log(GDP)	0.127	0.094	0.099	0.091	0.101	0.076	0.096	0.077
	(0.096)	(0.095)	(0.095)	(0.095)	(0.097)	(0.095)	(0.096)	(0.095)
debt ratio	−0.869***	−0.868***	−0.869***	−0.868***	−0.868***	−0.868***	−0.868***	−0.868***
	(0.072)	(0.072)	(0.072)	(0.072)	(0.072)	(0.072)	(0.072)	(0.072)
time FE	✓	✓	✓	✓	✓	✓	✓	✓
firm FE	✓	✓	✓	✓	✓	✓	✓	✓
Observations	50,099	50,099	50,099	50,099	50,099	50,099	50,099	50,099
R^2	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.059
Note:								*p<0.1; **p<0.05; ***p<0.01
Note II:								a=1

Table A.7: Effect of tax rate changes on profit before tax with intangible assets (group B)

	Group B Dependent variable: log(profit)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ETR	−0.330***							
	(0.108)							
ETR Δ		−0.192***						
		(0.064)						
log(ETR)			−0.061***					
			(0.020)					
log(ETR Δ + a)				−0.167***				
				(0.061)				
CIT					−0.372**			
					(0.172)			
CIT Δ						−0.395***		
						(0.121)		
log(CIT)							−0.160***	
							(0.046)	
log(CIT Δ + a)								−0.409***
								(0.119)
log(employee costs)	0.370***	0.370***	0.370***	0.370***	0.371***	0.371***	0.371***	0.371***
	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)
log(fixed assets)	0.061***	0.061***	0.061***	0.061***	0.062***	0.062***	0.062***	0.062***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
log(intangible assets)	−0.004*	−0.004*	−0.004*	−0.004*	−0.004*	−0.004*	−0.004*	−0.004*
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
log(GDP)	0.108*	0.096*	0.094	0.093	0.108*	0.107*	0.113**	0.106*
	(0.058)	(0.057)	(0.057)	(0.057)	(0.058)	(0.057)	(0.058)	(0.057)
debt ratio	−0.787***	−0.787***	−0.787***	−0.787***	−0.788***	−0.788***	−0.789***	−0.788***
	(0.043)	(0.043)	(0.043)	(0.043)	(0.043)	(0.043)	(0.043)	(0.043)
time FE	✓	✓	✓	✓	✓	✓	✓	✓
firm FE	✓	✓	✓	✓	✓	✓	✓	✓
Observations	124,086	124,086	124,086	124,086	124,086	124,086	124,086	124,086
R^2	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040

Note: *p<0.1; **p<0.05; ***p<0.01
Note II: a=1

Table A.8: Effect of tax rate changes on profit before tax with intangible assets (group C)

	Group C Dependent variable: log(profit)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ETR	−0.612***							
	(0.173)							
ETR Δ		−0.478***						
		(0.101)						
log(ETR)			−0.095***					
			(0.033)					
log(ETR Δ + a)				−0.445***				
				(0.097)				
CIT					−0.378			
					(0.262)			
CIT Δ						−0.274		
						(0.191)		
log(CIT)							−0.072	
							(0.070)	
log(CIT Δ + a)								−0.298
								(0.187)
log(employee costs)	0.469***	0.467***	0.469***	0.467***	0.469***	0.468***	0.469***	0.468***
	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)
log(fixed assets)	0.071***	0.071***	0.071***	0.071***	0.071***	0.071***	0.071***	0.071***
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
log(intangible assets)	−0.004	−0.004	−0.004	−0.004	−0.004	−0.004	−0.004	−0.004
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
log(GDP)	−0.448***	−0.451***	−0.477***	−0.455***	−0.470***	−0.479***	−0.484***	−0.478***
	(0.087)	(0.087)	(0.086)	(0.087)	(0.089)	(0.087)	(0.088)	(0.087)
debt ratio	−1.073***	−1.074***	−1.072***	−1.074***	−1.073***	−1.072***	−1.072***	−1.072***
	(0.069)	(0.069)	(0.069)	(0.069)	(0.069)	(0.069)	(0.069)	(0.069)
time FE	✓	✓	✓	✓	✓	✓	✓	✓
firm FE	✓	✓	✓	✓	✓	✓	✓	✓
Observations	59,560	59,560	59,560	59,560	59,560	59,560	59,560	59,560
R^2	0.051	0.051	0.051	0.051	0.051	0.051	0.051	0.051

Note: *p<0.1; **p<0.05; ***p<0.01
Note II: a=1

Table A.9: Effect of tax rate changes on profit before tax in group A + low tax jurisdiction interaction

	Group A Dependent variable: log(profit)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ETR	−0.587***							
	(0.178)							
ETR Δ		−0.168						
		(0.105)						
log(ETR)			−0.097***					
			(0.029)					
log(ETR Δ + a)				−0.141				
				(0.100)				
CIT					−0.283			
					(0.348)			
CIT Δ						0.120		
						(0.225)		
log(CIT)							−0.127	
							(0.111)	
log(CIT Δ + a)								0.091
								(0.214)
log(employee costs)	0.420***	0.422***	0.421***	0.422***	0.422***	0.422***	0.422***	0.422***
	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)
log(fixed assets)	0.055***	0.055***	0.055***	0.055***	0.055***	0.055***	0.056***	0.055***
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
log(intangible assets)	0.008*	0.008*	0.008*	0.008*	0.008*	0.008*	0.008*	0.008*
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
low tax jurisdiction	0.056	0.062	0.037	0.062	0.039	0.076	−0.025	0.074
	(0.153)	(0.153)	(0.153)	(0.153)	(0.156)	(0.154)	(0.172)	(0.154)
log(GDP)	0.122	0.089	0.096	0.086	0.097	0.066	0.112	0.068
	(0.096)	(0.096)	(0.095)	(0.096)	(0.098)	(0.096)	(0.099)	(0.096)
debt ratio	−0.869***	−0.868***	−0.869***	−0.868***	−0.868***	−0.868***	−0.868***	−0.868***
	(0.072)	(0.072)	(0.072)	(0.072)	(0.072)	(0.072)	(0.072)	(0.072)
log(intangible assets) * low tax jurisdiction	−0.002	−0.002	−0.002	−0.002	−0.003	−0.003	−0.002	−0.003
	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)
time FE	✓	✓	✓	✓	✓	✓	✓	✓
firm FE	✓	✓	✓	✓	✓	✓	✓	✓
Observations	50,099	50,099	50,099	50,099	50,099	50,099	50,099	50,099
R^2	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.059

Note: *p<0.1; **p<0.05; ***p<0.01
Note II: a=1

Table A.10: Effect of tax rate changes on profit before tax in group B + low tax jurisdiction interaction

	Group B Dependent variable: log(profit)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ETR	−0.314***							
	(0.109)							
ETR Δ		−0.183***						
		(0.064)						
log(ETR)			−0.049**					
			(0.020)					
log(ETR Δ + a)				−0.159***				
				(0.061)				
CIT					−0.084			
					(0.177)			
CIT Δ						−0.272**		
						(0.124)		
log(CIT)							−0.080	
							(0.059)	
log(CIT Δ + a)								−0.287**
								(0.122)
log(employee costs)	0.371***	0.371***	0.371***	0.371***	0.371***	0.371***	0.371***	0.371***
	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)
log(fixed assets)	0.061***	0.061***	0.061***	0.061***	0.062***	0.062***	0.062***	0.062***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
log(intangible assets)	−0.004	−0.004	−0.004	−0.004	−0.004	−0.004	−0.004	−0.004
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
low tax jurisdiction	0.218**	0.219**	0.211**	0.219**	0.215**	0.197**	0.166	0.194*
	(0.098)	(0.098)	(0.099)	(0.098)	(0.100)	(0.099)	(0.107)	(0.099)
log(GDP)	0.083	0.072	0.068	0.069	0.062	0.078	0.080	0.078
	(0.058)	(0.057)	(0.057)	(0.057)	(0.059)	(0.058)	(0.059)	(0.058)
debt ratio	−0.788***	−0.788***	−0.788***	−0.788***	−0.787***	−0.788***	−0.788***	−0.788***
	(0.043)	(0.043)	(0.043)	(0.043)	(0.043)	(0.043)	(0.043)	(0.043)
log(intangible assets) * low tax jurisdiction	−0.007	−0.007	−0.007	−0.007	−0.007	−0.007	−0.007	−0.007
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
time FE	✓	✓	✓	✓	✓	✓	✓	✓
firm FE	✓	✓	✓	✓	✓	✓	✓	✓
Observations	124,086	124,086	124,086	124,086	124,086	124,086	124,086	124,086
R^2	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041

Note: *p<0.1; **p<0.05; ***p<0.01
Note II: a=1

Table A.11: Effect of tax rate changes on profit before tax in group C + low tax jurisdiction interaction

	Group C Dependent variable: log(profit)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ETR	−0.611***							
	(0.173)							
ETR Δ		−0.478***						
		(0.101)						
log(ETR)			−0.096***					
			(0.033)					
log(ETR Δ + a)				−0.445***				
				(0.097)				
CIT					−0.439*			
					(0.266)			
CIT Δ						−0.289		
						(0.194)		
log(CIT)							−0.153*	
							(0.088)	
log(CIT Δ + a)								−0.320*
								(0.190)
log(employee costs)	0.469***	0.467***	0.469***	0.467***	0.469***	0.468***	0.469***	0.468***
	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)
log(fixed assets)	0.071***	0.071***	0.071***	0.071***	0.071***	0.071***	0.071***	0.071***
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
log(intangible assets)	−0.004	−0.004	−0.004	−0.004	−0.004	−0.004	−0.004	−0.004
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
low tax jurisdiction	0.047	0.044	0.031	0.045	0.012	0.025	−0.056	0.020
	(0.172)	(0.171)	(0.172)	(0.171)	(0.174)	(0.172)	(0.184)	(0.173)
log(GDP)	−0.449***	−0.452***	−0.475***	−0.456***	−0.460***	−0.475***	−0.451***	−0.473***
	(0.087)	(0.087)	(0.087)	(0.087)	(0.090)	(0.088)	(0.090)	(0.088)
debt ratio	−1.073***	−1.074***	−1.072***	−1.074***	−1.074***	−1.072***	−1.074***	−1.072***
	(0.068)	(0.069)	(0.069)	(0.069)	(0.069)	(0.069)	(0.069)	(0.069)
log(intangible assets) * low tax jurisdiction	−0.004	−0.004	−0.004	−0.004	−0.004	−0.004	−0.004	−0.004
	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)
time FE	✓	✓	✓	✓	✓	✓	✓	✓
firm FE	✓	✓	✓	✓	✓	✓	✓	✓
Observations	59,560	59,560	59,560	59,560	59,560	59,560	59,560	59,560
R^2	0.051	0.051	0.051	0.051	0.051	0.051	0.051	0.051

Note: *p<0.1; **p<0.05; ***p<0.01
Note II: a=1

Table A.12: Effect of tax rate changes on profit before tax in group A + IP regime jurisdiction interaction

	Group A Dependent variable: log(profit)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ETR	−0.594***							
	(0.178)							
ETR Δ		−0.170						
		(0.105)						
log(ETR)			−0.098***					
			(0.029)					
log(ETR Δ + a)				−0.142				
				(0.100)				
CIT					−0.312			
					(0.331)			
CIT Δ						0.072		
						(0.219)		
log(CIT)							−0.086	
							(0.083)	
log(CIT Δ + a)								0.047
								(0.209)
log(employee costs)	0.421***	0.422***	0.421***	0.422***	0.422***	0.422***	0.422***	0.422***
	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)
log(fixed assets)	0.056***	0.056***	0.056***	0.056***	0.056***	0.056***	0.056***	0.056***
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
log(intangible assets)	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
log(GDP)	0.127	0.094	0.099	0.091	0.101	0.076	0.096	0.077
	(0.096)	(0.095)	(0.095)	(0.095)	(0.097)	(0.095)	(0.096)	(0.095)
debt ratio	−0.871***	−0.870***	−0.870***	−0.870***	−0.870***	−0.869***	−0.870***	−0.869***
	(0.072)	(0.072)	(0.072)	(0.072)	(0.072)	(0.072)	(0.072)	(0.072)
log(intangible assets) * IP regime	0.016*	0.016*	0.016*	0.016*	0.016*	0.016*	0.016*	0.016*
	(0.009)	(0.008)	(0.008)	(0.008)	(0.008)	(0.009)	(0.008)	(0.009)
time FE	✓	✓	✓	✓	✓	✓	✓	✓
firm FE	✓	✓	✓	✓	✓	✓	✓	✓
Observations	50,099	50,099	50,099	50,099	50,099	50,099	50,099	50,099
R^2	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.059

Note: *p<0.1; **p<0.05; ***p<0.01
Note II: a=1

Table A.13: Effect of tax rate changes on profit before tax in group B + IP regime jurisdiction interaction

	Group B Dependent variable: log(profit)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ETR	−0.329***							
	(0.108)							
ETR Δ		−0.192***						
		(0.064)						
log(ETR)			−0.061***					
			(0.020)					
log(ETR Δ + a)				−0.167***				
				(0.061)				
CIT					−0.370**			
					(0.172)			
CIT Δ						−0.394***		
						(0.121)		
log(CIT)							−0.160***	
							(0.046)	
log(CIT Δ + a)								−0.408***
								(0.119)
log(employee costs)	0.370***	0.370***	0.370***	0.370***	0.371***	0.371***	0.371***	0.371***
	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)
log(fixed assets)	0.061***	0.061***	0.061***	0.061***	0.062***	0.061***	0.062***	0.061***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
log(intangible assets)	−0.003	−0.003	−0.003	−0.003	−0.003	−0.003	−0.003	−0.003
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
log(GDP)	0.108*	0.096*	0.093	0.093	0.107*	0.106*	0.112*	0.106*
	(0.058)	(0.057)	(0.057)	(0.057)	(0.058)	(0.057)	(0.058)	(0.057)
debt ratio	−0.787***	−0.787***	−0.787***	−0.787***	−0.787***	−0.787***	−0.789***	−0.787***
	(0.043)	(0.043)	(0.043)	(0.043)	(0.043)	(0.043)	(0.043)	(0.043)
log(intangible assets) * IP regime	−0.003	−0.003	−0.003	−0.003	−0.003	−0.003	−0.003	−0.003
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
time FE	✓	✓	✓	✓	✓	✓	✓	✓
firm FE	✓	✓	✓	✓	✓	✓	✓	✓
Observations	124,086	124,086	124,086	124,086	124,086	124,086	124,086	124,086
R^2	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040

Note: *p<0.1; **p<0.05; ***p<0.01
Note II: a=1

Table A.14: Effect of tax rate changes on profit before tax in group C + IP regime jurisdiction interaction

	Group C Dependent variable: log(profit)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ETR	−0.619***							
	(0.173)							
ETR Δ		−0.480***						
		(0.101)						
log(ETR)			−0.096***					
			(0.033)					
log(ETR Δ + a)				−0.447***				
				(0.097)				
CIT					−0.383			
					(0.262)			
CIT Δ						−0.276		
						(0.191)		
log(CIT)							−0.073	
							(0.070)	
log(CIT Δ + a)								−0.300
								(0.186)
log(employee costs)	0.469***	0.468***	0.469***	0.468***	0.469***	0.469***	0.469***	0.469***
	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)
log(fixed assets)	0.071***	0.071***	0.071***	0.071***	0.071***	0.071***	0.071***	0.071***
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
log(intangible assets)	−0.009	−0.009	−0.009	−0.009	−0.008	−0.008	−0.008	−0.008
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
log(GDP)	−0.446***	−0.450***	−0.476***	−0.454***	−0.468***	−0.478***	−0.483***	−0.477***
	(0.087)	(0.087)	(0.086)	(0.087)	(0.089)	(0.087)	(0.088)	(0.087)
debt ratio	−1.073***	−1.074***	−1.072***	−1.074***	−1.073***	−1.072***	−1.072***	−1.072***
	(0.069)	(0.069)	(0.069)	(0.069)	(0.069)	(0.069)	(0.069)	(0.069)
log(intangible assets) * IP regime	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
time FE	✓	✓	✓	✓	✓	✓	✓	✓
firm FE	✓	✓	✓	✓	✓	✓	✓	✓
Observations	59,560	59,560	59,560	59,560	59,560	59,560	59,560	59,560
R^2	0.051	0.051	0.051	0.051	0.051	0.051	0.051	0.051

Note: *p<0.1; **p<0.05; ***p<0.01
Note II: a=1

Appendix B - Summary Tables & Figures

Table B.1: Variable definitions and data sources

Variable	Definition	Source
Tax variables		
taxes	income tax expenses	Orbis Europe
CIT	statutory corporate income tax rates	OECD
ETR	calculated as a ratio of tax expenses over profit before tax	Orbis Europe
Pre-tax profit		
profit	profit before tax	Orbis Europe
Labor		
employee costs	all employees costs of the company (including pension costs)	Orbis Europe
Capital		
tangible fixed assets	reported tangible fixed assets	Orbis Europe
intangible assets	reported intangible assets	Orbis Europe
Productivity		
GDP	GDP per capita in the country of reported profits (operation), , converted with the average annual exchange rate provided by the European Central Bank	World Bank Development Indicators
Financial leverage		
debt ratio	calculated as a ratio of total debt (long-term debt + loans & short-term debt) over total assets	Orbis Europe
Sector		
$NACE_{lvl1}$	assigned NACE sections category	Orbis Europe
$NACE_{lvl4}$	assigned NACE class category	Orbis Europe

Table B.2: Corporate income tax rates (%)

ISO	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Low Tax	IP
AL	10.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00		✓
AT	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	24.00		
BA	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	✓	
BE	33.00	33.00	33.00	33.00	33.00	29.00	29.00	25.00	25.00	25.00	25.00		✓
BG	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	✓	
CH	8.50	8.50	8.50	8.50	8.50	8.50	8.50	8.50	8.50	8.50	8.50	✓	✓
CY	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	✓	✓
CZ	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00		
DE	15.83	15.83	15.83	15.83	15.83	15.83	15.83	15.83	15.83	15.83	15.83		
DK	25.00	24.50	23.50	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00		
EE	21.00	21.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	✓	
ES	30.00	30.00	28.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00		✓
FI	24.50	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00		
FR	38.00	38.00	38.00	34.43	44.43	34.43	34.43	32.02	28.41	25.83	25.83		✓
GB	23.00	21.00	20.00	20.00	19.00	19.00	19.00	19.00	19.00	19.00	25.00		✓
GR	26.00	26.00	29.00	29.00	29.00	29.00	24.00	24.00	22.00	22.00	22.00		
HR	20.00	20.00	20.00	20.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00		
HU	19.00	19.00	19.00	19.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	✓	✓
IE	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	✓	✓
IS	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00		
IT	27.50	27.50	27.50	27.50	24.00	24.00	24.00	24.00	24.00	24.00	24.00		
KV	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	✓	
LI	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50		
LU	22.47	22.47	22.47	22.47	20.33	19.26	18.19	18.19	18.19	18.19	18.19	✓	✓
LV	15.00	15.00	15.00	15.00	15.00	20.00	20.00	20.00	20.00	20.00	20.00		
ME	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	15.00	15.00	✓	
MK	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	✓	
MT	35.00	35.00	35.00	35.00	35.00	35.00	35.00	35.00	35.00	35.00	35.00	✓	✓
NL	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.80	25.80	✓	✓
NO	28.00	27.00	27.00	25.00	24.00	23.00	22.00	22.00	22.00	22.00	22.00		
PL	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00		✓
PT	30.00	30.00	28.00	28.00	28.00	30.00	30.00	30.00	30.00	30.00	30.00		✓
RO	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00		
RS	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00		✓
RU	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00		
SE	22.00	22.00	22.00	22.00	22.00	22.00	21.40	21.40	20.60	20.60	20.60		
SI	17.00	17.00	17.00	17.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00		
SK	23.00	22.00	22.00	22.00	21.00	21.00	21.00	21.00	21.00	21.00	21.00		✓
TR	20.00	20.00	20.00	20.00	20.00	22.00	22.00	22.00	25.00	23.00	25.00		
UA	19.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00		

source: OECD, 2023

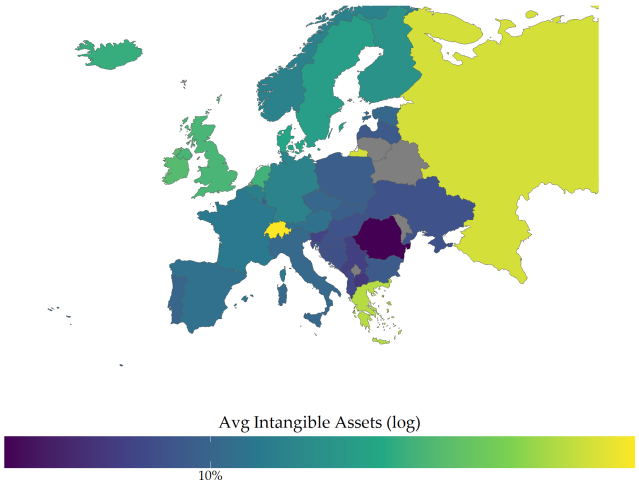

Figure B.1: Average intangible assets reported in each country (log)

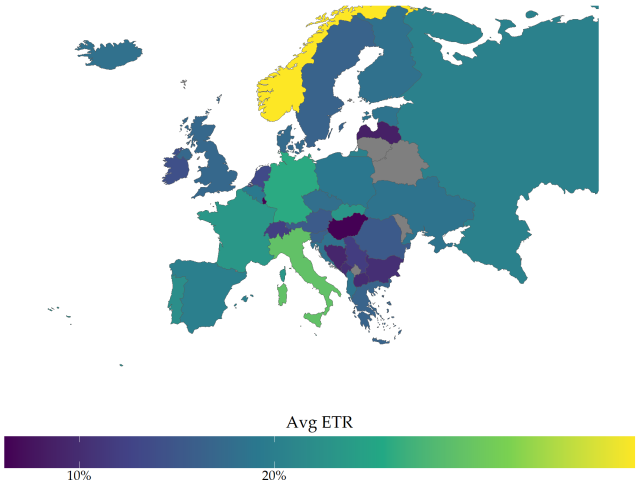

Figure B.2: Average effective tax rate in each country

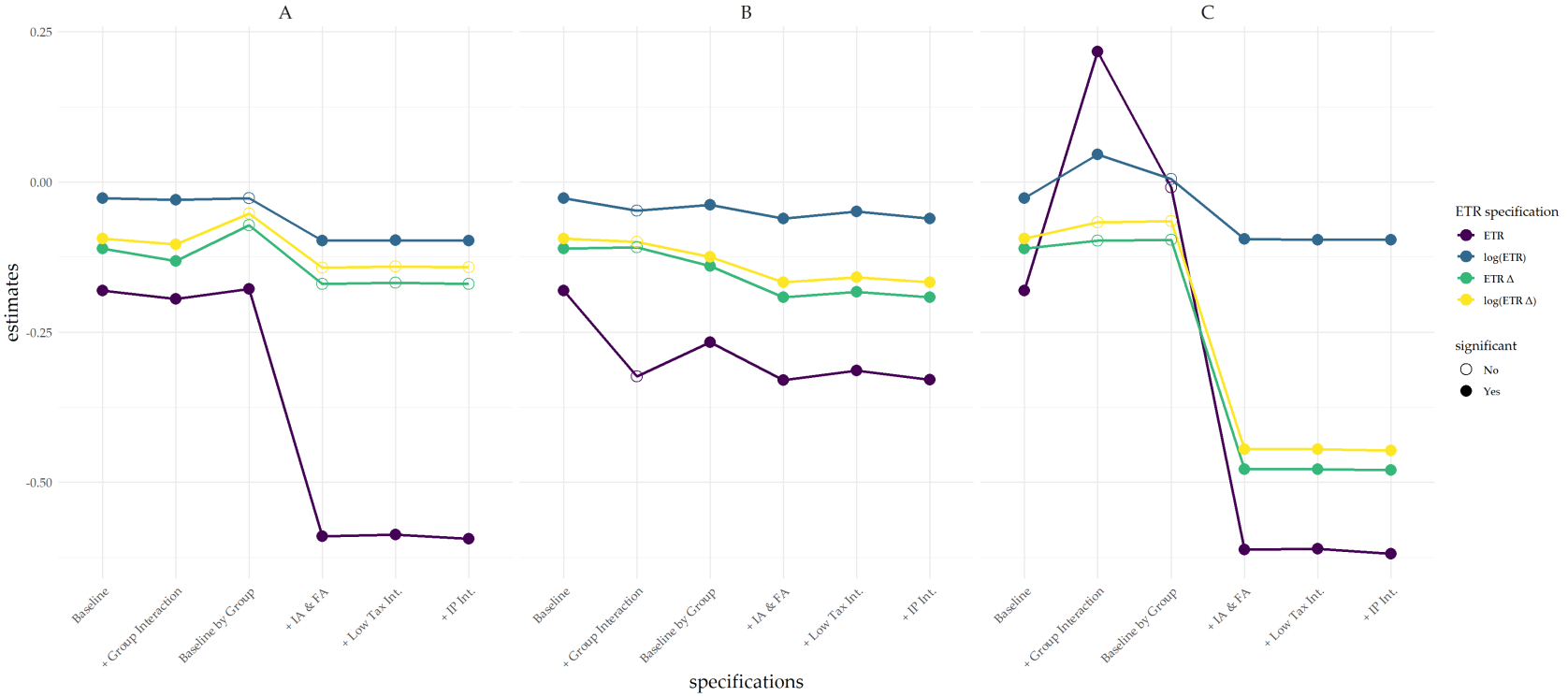

Figure B.3: Summary of ETR coefficients across all model specifications

Baseline model refers to the initial general regression on the entire panel of MNEs; Group Interaction denotes the baseline with group interaction; Baseline by Group stands for the initial model specification ran separately on each subset divided by group; + IA and FA shows the tax rate estimates after the division of capital into intangible and fixed assets; + Low Tax Int. refers to the previous model but after the inclusion of low-tax interaction; + IP Int. denotes the last model with IP interaction.

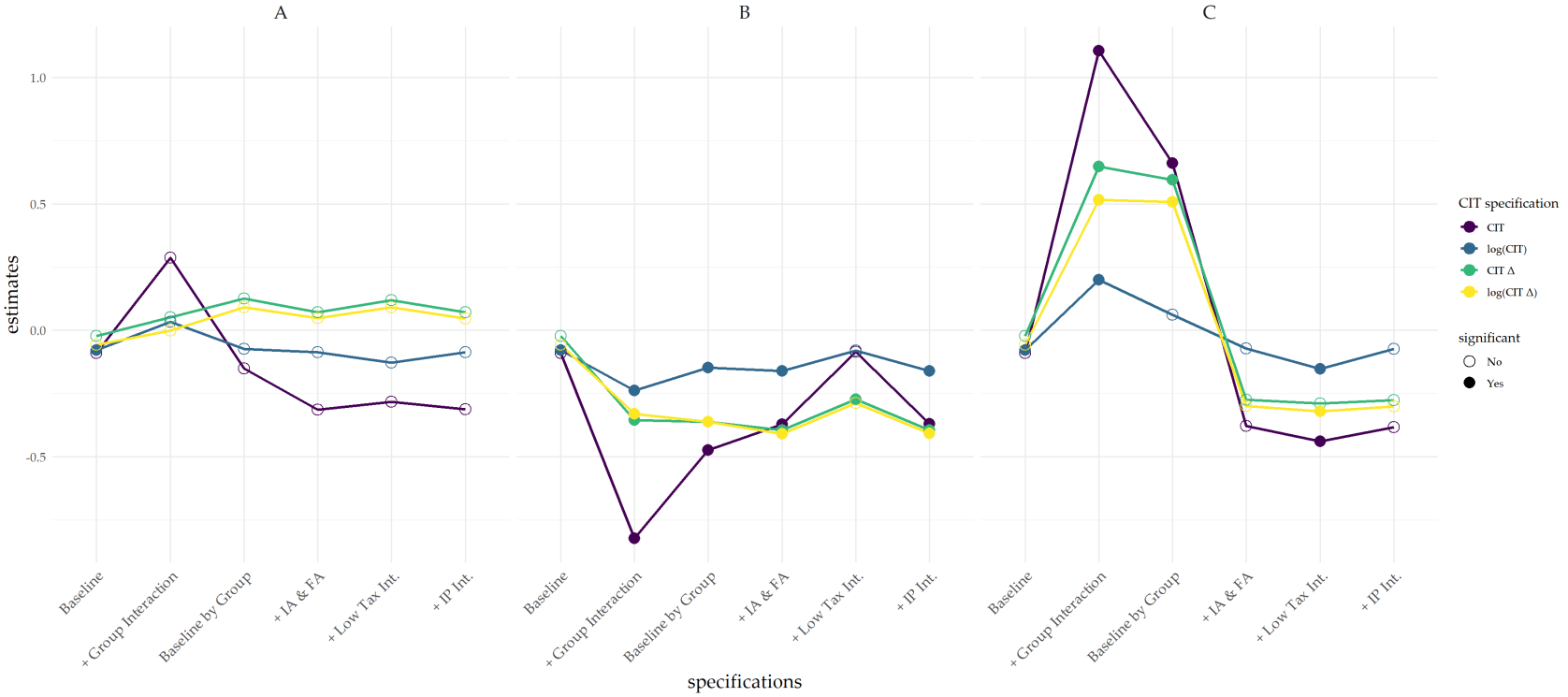

Figure B.4: Summary of CIT coefficients across all model specifications

Baseline model refers to the initial general regression on the entire panel of MNEs; Group Interaction denotes the baseline with group interaction; Baseline by Group stands for the initial model specification ran separately on each subset divided by group; + IA and FA shows the tax rate estimates after the division of capital into intangible and fixed assets; + Low Tax Int. refers to the previous model but after the inclusion of low-tax interaction; + IP Int. denotes the last model with IP interaction.