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Master Thesis Policy Economics

Taxing the Tech Titans
an economic analysis of the firm's behavioural responses to the OECD's Unified Approach under Pillar One

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Abstract

The recent OECD proposal called 'The Unified Approach under Pillar One' (UA) aims to introduce a new, hybrid tax system where separate accounting (SA) is complemented with sales-based formula apportionment. This should eliminate profit shifting through manipulation of the transfer price and ensure a fairer allocation of taxing rights in the digital economy. This thesis finds provides evidence that under the UA the transfer price cannot be used as a meaningful profit shifting device. However, it introduces new ways to shift profits which might be more harmful. Firms with significant market power can minimize the total tax liability by manipulating sales. Therefore, a transition from SA to the UA will likely lead to a shift in investment in capital and sales from high-tax countries towards low-tax countries. This has potential implications for market efficiency, welfare and tax competition. In general the UA is expected to favour low-tax countries over high-tax countries and as such it may strengthen incentives for tax competition.

Keywords: tax policy, OECD, separate accounting, formula apportionment, unified approach

Preface

Dear reader,

In front of you lies my thesis that focuses on the economic effects of the OECD's recent proposal to implement a new tax system for the digital economy. With this I aim to contribute to the discussion about which policies governments can or should implement to tax wealthy corporations. I chose this topic because of my interest in the field of tax policy. I already learned a lot about this topic during the seminar Economic Policy. Writing this master thesis has helped me to further deepen this knowledge. In addition, I learned to conduct theoretical research and I improved my algebra and writing skills.

With this thesis I aim to complete my Master's degree in Policy Economics. This also marks the end of my time as a student of Erasmus University Rotterdam. I am truly grateful for the opportunity to study both economics and tax law at this prestigious university. In the past seven years I worked hard, played even harder but most of all I have met a lot of inspiring teachers and students from whom I have learned a lot.

Of course this thesis would not have existed without the help of others. Therefore I would like to express my gratitude to everyone that has helped me throughout the process. First of all I would like to thank Dirk Schindler, who has been a helpful supervisor. Despite his busy time schedule and the sudden outbreak of the covid-19 pandemic, he always made time to read my chapters. His feedback, insights and ideas have greatly improved my work. Also, his genuine interest and optimism made sure I stayed motivated. Last but not least I would like to thank my family, my boyfriend and my friends who have helped me with their motivational talks, tips and unconditional love and support.

Anouk van den Berg

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Chapter 1 – Introduction

Over the past decades, globalisation and digitalisation have drastically changed the world's economy. Behind the rapid growth of the digital economy are a few big and influential tech firms. As stated by the Chairman of the US House Judiciary Committee: "*companies that once were scrappy, underdog start-ups that challenged the status quo have become the kinds of monopolies we last saw in the era of oil barons and railroad tycoons"* (US Subcommittee on Antitrust, Commercial and Administrative Law, 2020, p. 6). The current covid-19 pandemic and the isolation measures are making society even more dependent on the digital economy, thereby further increasing the dominance of these so-called 'tech titans'.

Even though tech companies have provided many benefits to society, there are also concerns that current regulation is becoming less effective at governing them. After all, the fast pace in which digital firms and markets have developed are making it difficult for regulatory bodies to adapt. These concerns are predominantly arising in the field of competition law. In 2020, a US congressional investigation claimed that companies such as Amazon, Apple, Facebook and Google are in fact becoming a threat to competitors, consumers and democracy itself (US Subcommittee on Antitrust, Commercial and Administrative Law, 2020).

Similar concerns rise in the field of international tax policy. Conventional tax rules are largely dependent on the physical presence of labour or capital within a jurisdiction. They do not seem to match a world in which technological developments allow companies to do business online while having little or no physical presence in the market jurisdiction. This raises the question whether the allocation of taxing rights should change, putting a greater emphasis on the country where consumers are based and value is created.

In addition, there is the concern that the characteristics of the digital economy make it easier for firms to shift large amounts of profits to offshore tax havens. Under the current tax system of Separate Accounting (SA), profits in each country are separately accounted for. To determine the profits of each affiliate correctly, intercompany transactions must be priced. This so-called transfer price should resemble the market price that would prevail between two unrelated parties. However, the transfer price can be subject to manipulation when there is no observable and comparable market transaction. This is often the case with highly mobile intangibles used by digital firms (OECD, 2015a, p. 91, pars. 226 – 229). It is estimated that MNC have shifted 40% of their global profits (600 billion USD) to tax havens in 2015 (Tørsløv et al., 2020). Even though these practices are often not illegal, it is considered very unfair by the public.

A tax system that is often put forward as an alternative is Formula Apportionment (FA). This tax system looks at the global consolidated tax base, which implies that the transfer prices of intercompany transactions are irrelevant. The European Commission advocated an EU-wide introduction of FA in their proposal for a Common Consolidated Corporate Tax Base (CCCTB) in 2011.[1] However, the proposal implies a quite radical change of the tax system and Member States have been reluctant towards implementation. Recently, the OECD has made another attempt to introduce FA, although in a milder form. Their proposal called 'The Unified Approach Under Pillar One' (UA) recommends a hybrid tax system where the current tax rules of SA are complemented with sales-based FA in cases that are most vulnerable to abusive transfer pricing and artificial profit shifting.[2] This proposal should tackle the problem of profit shifting as well as ensuring a fair allocation of taxing rights (OECD, 2019b, p. 5, par. 15).

Before deciding on the implementation of such a proposal, it is important to examine the economic effects of replacing the current tax system of SA by a tax system described in the UA. Most importantly, sales-based FA could also be subject to manipulation when MNCs have sufficient market power to artificially shift sales. The model in this thesis therefore looks at markets that are characterized by imperfect competition. The economic effects are studied by looking at the profit-maximizing behaviour of a multinational corporation (MNC) under both tax systems. The main research question of this thesis is:

"How does a shift in the tax system from Separate Accounting to the Unified Approach affect the behavioural responses of a multinational corporation that operates in the digital economy?"

For this purpose a model is set up in which there is a representative MNC that has three affiliates operating in three different countries. The first two countries each host a productive affiliate that produces output using capital and a fixed common input. The common input is an intangible asset that is licensed by the third affiliate, which is located in a tax haven country. The output produced by the productive affiliates is sold on the domestic market. On these markets the MNC is assumed to operate as a monopolist. This gives the firm sufficient market power to differentiate output and prices on both markets.

[1] European Commission, Proposal for a COUNCIL DIRECTIVE on a Common Consolidated Corporate Tax Base (CCCTB), COM(2011) 121 final – CNS 2011/0058.
[2] OECD. (2019). Public consultation document, Secretariat Proposal for a "Unified Approach" under Pillar One, 9 October 2019 – 12 November 2019.

Given the corporate tax rates of the three countries, the model compares profit maximizing behaviour of the MNC under SA and under the UA. It is of particular interest to see how the MNC makes decisions regarding the optimal license fee, investment in capital and sales.

The results show that a switch from SA to the UA will eliminate paper profit shifting. Instead, taxation under the UA introduces distortions in the allocation of real economic activity. Investment in capital and sales will be restricted in the high-tax country and increased in the low-tax country. This tax induced distortion comes on top of the distortion created by market power, which is present under both tax systems. This thesis finds that under the UA market efficiency and welfare are deteriorated in high-tax countries while improved in low-tax countries. This further increases the incentives for tax competition.

The chapters of this thesis are organized as follows. Chapter 2 explains the properties of SA, which is the most commonly used tax system. Chapter 3 explains the properties of a FA tax system and its (dis)advantages compared to the SA system. Chapter 4 describes how FA is embedded in the OECD proposal. Chapter 5 describes the model used to study the behaviour of the MNC under both tax systems. The results are derived in chapter 6 while chapter 7 discusses these results and implications in greater detail. Finally chapter 8 concludes.

Chapter 2 – Separate Accounting

Following the concern that the current tax system of SA does no longer match the globalization and digitalization of the economy, policymakers now raise the question of whether this system should change and if so, how. Before answering this question it is important to first understand how SA functions. Therefore, this chapter defines SA and discusses the effects of SA found in literature.

2.1 What is Separate Accounting?

Currently, SA is the most commonly used tax principle internationally. Under this system, the tax liability of a MNC in a country is determined based on the profits reported by the affiliate(s) of the MNC in that particular country. Hence, taxable profits are accounted for and taxed separately in each country where the firm is active (Nielsen et al., 2010). This accounting practice requires that when two related affiliates engage in a cross-border transaction, one affiliate must record costs and the other affiliate must record income. This allows the affiliates to maintain separate bookkeeping accounts. The internal price for such goods and services is called the transfer price. It should be determined at arm's length, which means that the transfer price should be similar to the market price that would prevail between two unrelated parties (OECD, 2017, pp. 33 – 34).

2.2 Disadvantages of Separate Accounting: profit shifting and tax competition

Exploiting the fact that there are substantial differences in corporate tax rates between countries, a MNC has the incentive to reduce its reported profits in a high-tax country and instead report them in a low-tax country, a tax planning construction by which it can minimize its overall tax liability (Fuest, 2008). Reviewing the empirical literature, Dharmapala (2014) finds two main channels through which profit shifting often occurs. First, there is a financial channel through which firms strategically replace non tax-deductible equity by tax-deductible inter-company debt. A firm can reduce its tax burden by making sure that the interest payments are taxable in a low-tax affiliate and are tax deductible in a high tax affiliate. Second, there is a much larger non-financial channel through which firms manipulate the transfer price of intra-firm trade. A firm can reduce its tax burden by overpricing trade from high-tax to low-tax affiliates and vice versa.

The same study supports the belief that a considerable share of non-financial profit shifting occurs through the use of intangible assets (see for example Grubert, 2003 and Dischinger and Riedel, 2011). The arm's length transfer price of tangible goods can be determined and controlled relatively easy, especially when there are comparable transactions between independent parties readily available. However, determining and controlling the arm's length price of firm-specific intangible assets (patents, trademarks and licenses) is more difficult since there often is no comparable transaction observed in the market (OECD, 2015a, p. 91, pars. 226–229). In this case MNCs have the possibility to manipulate the transfer price and thus the profits reported in each of its affiliates. Firms can do so by relocating their intangible assets to an affiliate based in a low-tax country where the asset often has not been developed (Dischinger and Riedel, 2011). Consequently, over invoicing the transfer price charged to the other affiliates allows them to shift large amounts of profits from high-tax to low-tax countries. According to an investigation by the US Senate, this strategy allows Apple to "*shift billions of profits away from the US to Ireland, where it pays a corporate tax rate of 2% or less*" (US Senate Subcommittee Memorandum 2013, p. 4).

The result of profit shifting is that high-tax countries lose a substantial part of their corporate tax base to low-tax countries. Consequently, countries will want to undercut each other's corporate tax rate in order to attract more profits. This kind of tax competition is considered to be harmful because it results in inefficiently low corporate tax rates. In this case all countries would be better off if they agreed to set a common higher tax rate, thereby increasing total tax revenue and preventing that public goods will be underprovided (Keen and Konrad, 2013, pp. 267-270). Tax base erosion and tax competition have led to an overall negative view of profit shifting.

However, as pointed out by Dharmapala (2008) and Hong and Smart (2010), not all profit shifting is necessarily bad. The opportunity to shift paper profits out of high-tax countries reduces the disincentive for firms to invest in such countries. This results in less distortions in the location of real investment, which is likely to improve efficiency. Moreover, profit shifting may also weaken tax competition. Especially international firms can lower their effective tax rate on mobile capital by engaging in profit shifting to low-tax countries. Because this makes real investments (immobile capital) less sensitive to tax rate changes, the high-tax country can maintain a higher statutory corporate tax rate.

2.3 Quantifying the profit shifting problem

A substantial amount of empirical research aims to quantify the magnitude of profit shifting and the resulting loss in corporate tax revenue. One way of quantifying profit shifting behaviour of MNCs is by looking at the semi-tax elasticity of reported income. This number tells us how responsive reported income is to changes in the tax rate. Heckemeyer and Overesch (2017) evaluate 27 papers in a meta-analysis and find a consensus estimate of 0.8. This implies that a 1 percentage point decrease in the corporate tax rate causes pre-tax profits to increase by 0.8 percent (i.e. an additional 0.8 percent of profits is shifted into the country). Moreover, the majority of the response to tax rate differentials (≥76%) occurs through the non-financial channel. Further empirical evidence confirms the belief that intangible assets play an important role in the profit shifting process. Firms that invest a lot in R&D are found to have significantly more intercompany transactions (Grubert, 2003). Moreover, tax rate differentials significantly affect both the investment in intangible assets (Dischinger and Riedel, 2011) and the number of patent applications filed (Karkinsky and Riedel, 2012).

Looking at the foregone tax revenue caused by profit shifting, quite large estimates are found by Clausing (2016). She estimates that the US government has lost between 30% ($77 billion) and 45% ($111 billion) of tax revenue in 2012. Such large estimates are disputed by Blouin and Robinson (2019), who claim that the double counting of profits in US data causes profit shifting estimates to be overstated. Adjusting for this issue results in more reasonable estimates of the loss in US corporate tax revenue, which are between 4 and 15% annually. Within this range, Tørsløv et al. (2020) find that the loss in tax revenue in 2015 was 10% globally and 20% for the European Union. These losses vary significantly across member states and depend on their corporate tax rate. By using macroeconomic data to reconstruct the flow of shifted profits, they find that profit shifting severely erodes the tax base non-haven EU countries. These countries are entitled to 35% of the excess profits declared in tax havens. The majority of these profits (80%) are shifted within the EU, mainly to tax havens or conduit countries like Ireland, Luxembourg and the Netherlands.

It follows from the empirical literature that estimates of profit shifting differ and are largely dependent on the underlying data and methodology. Nevertheless, we can conclude that profit shifting does occur, that it causes high-tax countries to lose a substantial part of their corporate tax base, and that intangible income is an important channel of profit shifting. Moreover, there is growing public discontent about the very little amount of taxes paid by large and profitable MNCs. Consequently, governments are urged to come up with effective policy solutions to curb profit shifting. According to the OECD (2013), "*what is at stake is the integrity of the corporate income tax"* (p. 8). FA is a tax system which has often been put forward as a solution to the problems arising under SA.

Chapter 3 – Formula Apportionment

FA is a tax system in which taxable profits are consolidated and apportioned among countries by using a commonly agreed formula. While the use in international taxation is scarce, different types of FA systems are implemented on a national level in the United States and Canada to tax multi-state firms. This chapter will explain the basic properties of the FA tax system. As FA is often put forward as an alternative to SA, this chapter also describes several arguments found in the literature that favour one tax system over the other.

3.1 What is Formula Apportionment?

Under FA, the profits of all affiliates of a MNC are consolidated into one measure of global taxable income. This global income is then apportioned to the different countries in which the MNC is active according to a formula based on (a combination of) assets, employment or sales (Nielsen et al., 2010). Instead of the profits reported on the national accounts of the affiliates, FA uses the formula to determine the tax base of each country (Nielsen et al., 2003). The apportionment factors used in the formula make sure that the tax liability in each country is in line with their share of the economic activity of a multinational firm (Gordon and Wilson, 1986). The effective tax rate under FA is a weighted average tax rate across all countries, where the weights are the created by the apportionment factor(s).

3.2 The (dis)advantages of Formula Apportionment

An important distinction is that FA is based on reported *activity* whereas SA is based on reported *profits.* Taxing a firm in line with where their economic activity takes place is often considered to result in a fairer distribution of the global tax base (Devereux and Loretz, 2008). Moreover, the fact that activity is less likely to be misreported compared to profits is one of the reasons why FA is often favoured over SA (Nielsen et al., 2003). Furthermore, it has been claimed that FA substantially reduces or even eliminates profit shifting, which is one of the main problems under SA. As the tax liability is now calculated on a global consolidated base, it does not matter in which affiliate profits are reported. Hence, the MNC does no longer gain from profit shifting by manipulating the transfer price (Becker and Fuest, 2010; Gordon and Wilson, 1986; Nielsen et al.,2003). Indeed, Mintz (2004) provides empirical evidence that taxable income is less sensitive to tax rate changes under FA.

In addition to solving the problem of profit shifting, FA has some positive side effects. For example, consolidating all domestic profits into one global tax base implies that losses which could not be offset within the country under SA, can now be offset across borders. It is estimated that the introduction of cross-border loss offset under FA can reduce the corporate tax base with 4.74% (Oestreicher and Koch, 2011) or even 7.5% (Bettendorf et al., 2010).[3] Initially, this will negatively affect corporate tax revenue. However, the fact that firms will have more resources left to invest can increase tax revenue in the long term.

Another advantage is that FA requires less complex administration compared to SA (Gordon and Wilson, 1986). As pointed out by Fuest (2008), this advantage is not so clear-cut. On one side, SA forces MNCs to incur large costs for advice on transfer pricing and tax planning. Tax authorities spend equal resources trying to comprehend these complex tax planning structures. There is a risk that parties may disagree on the method used to determine the arm's length price, resulting in dispute resolution costs and potentially large fines. Since intercompany transactions are irrelevant for determining the tax base under FA, these administrative costs would disappear. However, a transition of the tax system is also likely to impose large costs both on firms and tax authorities. Also, FA will require global cooperation and communication to determine both the consolidated tax base and the level of economic activity within each country. Here too, conflicts may arise, resulting in increased spending on administrative and legal costs (Fuest, 2008).

Despite its advantages over SA, FA is nowhere near a perfect tax principle. First of all, there is some scepticism as to whether FA will really eliminate profit shifting. For example, Nielsen et al. (2003) find that if the local markets in which the MNC's affiliate operates is characterized by imperfect (oligopolistic) competition, the MNC is incentivized to manipulate the transfer price both for tax reasons and for strategic reasons. The latter means that the firm can adjust its transfer price to undercut competitors in the price of the final good, a strategy by which it can gain market share and increase its profits. Therefore, under imperfect competition abusive transfer pricing will sustain with FA.

[3] The estimates by Oestreicher and Koch (2011) and Bettendorf et al. (2010) do not take into account the behavioural responses by firms and governments. Hence, investments and tax rates are assumed to remain fixed.

Furthermore, even if profit shifting *within* the EU can be reduced by the introduction of FA, profit shifting *outside* the EU will still be possible. Profit shifting outside the zone where FA applies is further encouraged because of the weakened incentive for tax enforcement from countries within the FA-zone. These countries will incur full costs for auditing while only reaping part of the benefits, as the addition to taxable profits is shared with the other countries as well. Once countries underinvest in tax enforcement, the risk to get caught for manipulating the transfer price becomes smaller, and hence profit shifting outside of the FA-zone will increase (Becker and Fuest, 2010). Indeed, empirical evidence confirms that more income is shifted once local tax enforcement of the affiliate is weak (Beuselinck et al., 2015).

Moreover, as long as corporate tax rates are not harmonized, MNCs will still be induced to exploit this tax rate differential to minimize their total tax burden. The type of behavioural response to reach this goal is different under SA and FA. Under SA, firms can shift profits on paper by manipulating the transfer price. This is primarily an accounting practice which has little to no effect on the real economic decisions of the firm. Under FA firms have to manipulate the share of global profits apportioned to each country. This can be done by relocating the factors in the apportionment formula away from high-tax countries towards low-tax countries. This implies that a larger share of global profits will be apportioned to countries where it is taxed at a lower rate. However, this will distort the allocation of factors that enter the apportionment formula: capital, labour and/or sales. Taxes now interfere with the MNCs choice of production factors, resulting in inefficiently high levels of production in low-tax countries, and vice versa. In other words, profit shifting is now replaced by factor shifting (Fuest, 2008; Gordon and Wilson, 1986; Nielsen et al., 2010). This effect is likely to be more damaging than pure profit shifting that is present under SA. Indeed, the model of Altshuler and Grubert (2010) shows that for a capital-based formula, FA is more distortive than SA. The main reason is that FA results in larger cross-country differences in marginal effective tax rates. The marginal effective tax rate determines how much a firm will invest in a country. Under FA, this investment decision is distorted to such extent that FA cannot be favoured over SA, even when it is assumed that almost all profits are shifted under SA.

Empirical evidence for factor shifting can be found for Germany and the US, two countries which already make use of FA on the national level, to allocate corporate profits between communities (Germany) or federal states (US). For Germany, there is evidence which confirms that economic activity is sensitive to differences in tax rates. The German FA system uses an allocation key that is only based on employment.

Consequently, Riedel (2010) finds that the payroll to capital ratio in an affiliate is reduced by 1,9 percent on average once the tax rate in that community is increased with 1 percentage point relative to the other communities.

On the contrary, for the US it is found that little economic activity has been shifted as a response to tax rate differences under FA. However, it must be noted that the federal states in the US already have relatively low corporate tax rates (Clausing, 2016). Also, in the US there is significant variation between states in the formula used to allocate profits under FA. Most states use a double-weighted sales formula while some states include all three factors equally (Weiner, 2005). Lastly, one must be cautious when comparing national FA systems with international systems of FA because it is easier to shift economic activity within a country than between countries. This can be due to, among others, common laws and regulation, better information, greater mobility of capital and labour and the absence of exchange rate fluctuations (Clausing, 2016).

Knowing that MNCs will want to manipulate the formula by relocating economic activity, countries will continue to set their corporate tax rates non-cooperatively in order to capture a larger share of the tax base. In fact, Keen and Konrad (2013, pp. 314-316) find that the type of tax competition under FA is even more intense compared to the competition that would prevail under SA. The reason for this is that governments can gain more from an unilateral tax cut under FA. It is assume that under both regimes an unilateral tax cut results in the relocation of real activity by firms. Under SA, the country's increase in tax revenue is proportional to the marginal increase in domestic profits generated by the additional units of capital that are attracted into the country. Under FA however, the increase in tax revenue is proportional to the increase in the country's share of the firm's global profits. Provided that the average rate of return to capital is larger than the marginal rate of return, governments benefit more from an unilateral tax cut under FA.

Nielsen et. al (2010) make a more comprehensive comparison of tax competition under both regimes in which they take into account that, under SA, firms can undertake costly efforts to shift paper profits between countries. They find that an unilateral tax increase under FA creates two main spillovers on other countries. First, since FA eliminates the possibility to shift paper profits, other countries benefit from the tax increase because of the reallocation of real capital towards countries with a lower tax rate. Second, the firm's effective tax rate, which is a weighted average of all country's individual tax rates, goes up.

This negatively affects investment and tax revenue in all countries. Which of these two effects dominates, depends on the magnitude of pure profits that can be shifted under SA and the costs of profit shifting.

Bettendorf et. al (2010) simulate a computable general equilibrium model for Europe and find that a shift from SA to FA will especially induce low-tax countries to further reduce their tax rates. Under SA, firms decide on the optimal level of profit shifting by trading off the marginal costs and benefits of this action. The marginal benefits are equal to the tax rate differential. Profit shifting costs are convex in the tax rate differential, meaning that the marginal costs of profit shifting increase at an increasing rate. Hence, when a low-tax country further reduces its tax rate, the tax rate differential increases and, due to the convex cost function, the cost of profit shifting for firms rapidly increase. This curbs profit shifting activities by firms. On the contrary, the tax rate differential becomes smaller when a high-tax country reduces its tax rate. The effect on profit shifting costs for firms is thus smaller. In other words, there will be relatively more profit shifting activities when a high-tax country lowers its tax rate. An unilateral tax cut is thus more beneficial to high-tax countries than to low-tax countries under SA, as the positive effect on tax revenue is larger. FA eliminates profit shifting opportunities and creates other effects on tax revenue that are less dependent on the initial tax rates. Hence, it is expected that low-tax countries will find it more beneficial to cut their tax rate compared to SA.

The evidence by Keen and Konrad (2013), Nielsen et al. (2010) and Bettendorf et al. (2010) points towards the direction that tax competition will likely be intensified rather than mitigated under FA.

3.3 Sales-based Formula Apportionment

One of the ideas put forward by the OECD in their proposal on 'The Unified Approach Under Pillar One' is the implementation of a harmonized formula apportionment rule with sales as the only apportionment factor. This section will discuss the sales factor in FA in closer detail.

Proponents claim that sales-based FA minimizes the distortions of factor shifting, as discussed in section 3.2. After all, sales are assumed to be less mobile than the other apportionment factors, especially when compared to capital. As Zucman (2014) explains, a firm cannot move its customers and therefore sales-based FA would give less tax planning opportunities to firms. Since firms have limited options to exploit tax rate differences between countries, sales-based FA could also alleviate harmful tax competition.

Pethig and Wagener (2007) study tax competition under different FA systems. Their model includes three types of allocation keys based purely on capital, payroll or sales. Assuming a Cobb-Douglas production function, they find that the sales share is least elastic with respect to tax rate changes. Therefore, competition in tax rates is expected to be less intense under sales-based FA compared to capital-based and payroll-based FA.

However, an important assumption underlying the conclusions of both Zucman (2014) and Pethig and Wagener (2007) is that markets are characterized by perfect competition and hence firms act as price takers. The impact of sales-based FA is likely to change when there is imperfect competition, where MNCs have some level of market power. Altshuler and Grubert (2010) model the choices of a monopolist and find that sales-based FA will induce firms to adjust the mix of high margin and low margin sales. Thus, while firms with market power might not be able to physically move their customers, they can use their sales margin to manipulate the sales-share of different countries in the apportionment formula. Given that there is a fixed group of customers spread across countries with different tax regimes, the firm will have the incentive to generate high sales margins in low-tax countries and low sales margins in high-tax countries. Consequently, also if the global tax base is apportioned by sales, countries will continue to engage in tax competition to capture a larger share of taxable profits.

In short, while abusive transfer pricing, profit shifting and tax competition under SA is problematic, FA is not likely to be a perfect solution. Even if transfer pricing is eliminated, FA will create new ways to shift profits that might be more distortive to the behaviour of firms and governments. Instead of paper profits, firms will want to relocate economic activity in order to reduce their total tax burden. Consequently, governments will still be induced to lower their corporate tax rates in order to capture a larger share of taxable profits. It is not sure whether an apportionment formula that is purely based on sales can solve these issues.

Chapter 4 – The OECD's Proposal on a Unified Approach Under Pillar One

The newest proposal of the OECD called 'The Unified Approach Under Pillar One' proposes to implement a hybrid system in which the SA principle is used for the taxation of routine profits whilst FA is applied to allocate the tax base consisting of (a market share of) non-routine profits (OECD, 2019b). This proposal is a result of the increasing political pressure to find a global solution to tax the digital economy in a fair and effective way.

4.1 Background: from BEPS to the UA

It all started with the Base Erosion and Profit Shifting (BEPS) project, which included 15 action points to tackle tax planning and tax avoidance by MNCs. The first action point was called "Addressing the Tax Challenges of the Digital Economy", with a final report issued in 2015. Key characteristics of the digital economy were described as high mobility, data dependence, network effects and a significant amount of market power (OECD, 2015a, p.11). The report recognized that some tax challenges were going beyond BEPS and needed a broader perspective. Therefore, the OECD/G20 Inclusive Framework on BEPS (hereafter IF), a collaboration of 138 OECD and non-OECD jurisdictions, decided to work continuously and cooperatively on these issues for the upcoming five years, with a final report planned for 2020 (OECD, 2015a).

The Interim Report issued in 2018 gives a detailed overview of the changing business models of the digital economy and their consequences for the international tax system. It concludes that highly digitalized firms create value, and hence generate profit, in a different way. One of the most important changes is a tendency towards 'scale without mass', which means that digital firms can have a significant economic involvement in a market without necessarily being physically present there (OECD, 2018, p.51, pars. 130-134). This affects the tax presence (nexus) and profit allocation rules of digital firms.

The IF requested the input from external stakeholders (governments, firms and academia), which resulted in three main proposals to better adapt the current tax system to the digital economy. These proposals were then added together and re-grouped into two Pillars. Pillar One is concerned with the reconsideration of fundamental features of the current tax system, such as arm's length pricing and profit allocation rules. Pillar Two is concerned with remaining BEPS issues, such as an effective minimum corporate tax rate (OECD, 2019a).

Under Pillar One, the IF issued their Unified Approach in fall 2019, with a more detailed outline and a timeline to resolve the main policy and technical issues published in early 2020 (OECD, 2019b, 2020a).

4.2 Tax rules proposed by the Unified Approach

The Unified Approach aims to tackle the problem of profit shifting and to ensure a fair allocation of taxing rights that is commensurate with the origin of these profits. Conventional tax rules are largely dependent on the physical presence of labour or capital within a jurisdiction. They do not seem to match a world in which technological developments allow companies to do business online without having any physical entity. For example, Google is able to remotely generate a significant amount of income by selling data from their worldwide users. The Unified Approach therefore introduced a new taxing right based on market presence, where a revenue threshold will determine whether a firm has a significant and sustained involvement in the country where their consumers or users are located (market jurisdictions). Also, a new mechanism is introduced through which multinational's profits are allocated across market jurisdictions. It holds on to transfer pricing mechanisms in cases where this seems to work properly, that is in allocating the routine profits. In cases where transfer pricing often leads to undesirable results, for example in the allocation of non-routine profits from intangibles, it is complemented with partial formula apportionment based on sales (OECD, 2019b).

There are two types of firms that fall under the scope of the Unified Approach: automated digital services and consumer-facing businesses. The first category of firms is those that sell automated digital services while having little to no physical presence in a market jurisdiction. Value is created by the interaction with users and customers and there are powerful network effects. These firms also generate income from using and selling data of their customers. Examples are online search engines (Google), social media platforms (Facebook, Instagram) and digital content streaming services (Netflix). The second category covers a more general group of firms that sell goods or services for personal use to individual consumers. These so-called consumer-facing businesses make use of digital technologies to interact and engage with their customers, which is expected to increase the value of their products. Examples are firms that sell personal computing goods, clothes, food or luxury goods (for example, Apple and Amazon). The automobile industry and franchise models are also considered consumer-facing businesses (OECD, 2020a, pp. 9-11, pars. 15-29).

To alleviate the administrative burden for small and medium sized firms under both categories, however, annual group revenue must exceed a certain threshold. The exact level has not yet been decided, but the IF proposes to apply the same threshold used for country-by-country reporting, which is EUR 750 million (OECD, 2020a, p. 12, par. 35). In addition to the general group revenue threshold, consumer-facing businesses should also have a meaningful interaction with the market. This will be determined by the sales revenue arising within a particular market jurisdiction over a period of multiple years. The sales revenue threshold will be proportionate to the market size, with an absolute minimum to be determined (OECD, 2020a, pp. 12-13, pars. 36-39). Hence, although there is a broad definition of firms that fall under the scope of the Unified Approach, it is clearly targeted towards the well-known tech titans such as Google, Amazon, Facebook and Apple.

Next, there are three types of profits that the Unified Approach aims to reallocate to the market jurisdictions in which they are active (OECD, 2019b, p. 9, par. 30):

1. Amount A - a share of residual profits to be attributed to the market jurisdictions using formula apportionment based on sales

2. Amount B – a fixed compensation for baseline marketing and distribution activities taking place in the market jurisdictions

3. Amount C – any additional profits to be allocated to the market jurisdictions whenever the business functions in that jurisdiction exceed the baseline activity compensated under amount B.

While SA continues to be the main tax principle to allocate amount B and C, sales based FA is introduced for amount A. The firm's total tax base under Amount A is calculated as follows. First, total group profits should be derived from the firm's consolidated financial statements. It is preferred to use Profit Before Tax as profit measure, which is most similar to the profit measure used to levy the corporate income tax. Because firms use different accounting standards, it is likely that minor adjustments need to be made. Once total group profits have been determined, these need to be split in deemed routine profits and deemed residual profits. Lastly, FA is only partially applied to the deemed residual profits, more specifically to a market share of residual profits (OECD, 2020a, pp. 13-14, pars. 42-46). There is no agreement yet on how to determine the share of routine versus residual profits and the share of residual profits that should be allocated to market jurisdictions. To facilitate the discussion and to ensure simplicity the OECD Secretariat proposes to use fixed parameters.

For example, routine profits could be calculated by taking a fixed percentage of the firm's profit margin (OECD, 2019b, p. 14, pars. 54-55). The IF affirms that rules should be simple and promote tax certainty (OECD, 2020a, p. 9, par. 13). The parameters can potentially be varied between industries (OECD, 2019b, p.14, par. 54) and between activities to account for different degrees of digitalisation (OECD, 2020a, p. 14, par. 46). In February 2020 the OECD presented a preliminary economic analysis of their proposal. To study the effect on tax revenue and investment, they assumed both a 10% and 20% share of the profit margin to be routine profits. These numbers are hypothetical and for illustrative purposes only (OECD, 2020b, p. 12). Once the total tax base that falls under amount A has been determined, these profits will be redistributed across eligible market jurisdictions based on their relative share in total sales revenue. The appropriate measure of sales is sales by destination (OECD, 2020a, p. 8 footnote 9). This means that for some digital transactions the final destination of sales needs to be (re)traced, for example by looking at where a particular online advertisement is viewed rather than where it is purchased (OECD, 2020a, p. 14, par. 47).

To conclude, the Unified Approach proposes a new market-based nexus and sales-based FA to tackle the tax challenges of the digital economy. The size of the total tax base that will be subject to sales-based FA is largely dependent both on the split between residual versus routine profits and on the share of residual profits that will be allocated to eligible market jurisdictions. The IF aims to reach political agreement about this at the end of 2020. The short time period might be due to the concern that, in the absence of a cooperative solution, countries will be incentivized to take potentially harmful unilateral tax measures (such as the Digital Service Tax). However, despite the time pressure one should not overlook the economic consequences of the Unified Approach. In this regard, more information about the behavioural responses of MNCs operating in the digital economy can create valuable input for the public policy debate. The next chapter will draft the theoretical framework that can be used to study these responses.

Chapter 5 – The Theoretical Model

This section introduces the model that will be used to study the behavioural responses of a representative MNC under two different tax systems: Separate Accounting and (a simplified version of) the Unified Approach. Subsections 5.1 – 5.3 give a short description of the setting of the model while subsections 5.4 – 5.6 specify the profit equations and tax payments under each tax system. These equations capture the tax incentives that will drive the optimal behavior of the MNC in each setting. The subscripts will denote whether equations apply to the affiliate level (i) or to the consolidated group level (MNC).

5.1 Company structure

Consider a MNC with three affiliates. There are two productive affiliates, one located in high-tax country A and the other located in low-tax country B. Country A and B are assumed to be small, open economies that are identical, except for their statutory corporate tax rate ($t_A > t_B > 0$). There is production and sales in each country. Each affiliate's output is sold on the domestic market. The markets of country A and B are fully separated and segregated, meaning that there is no resale or trade of final goods possible between the two countries. This prevents arbitrage opportunities and ensures that there is sufficient market segmentation so that the MNC can practice price discrimination between the markets of country A and B.[4]

In addition to the two productive affiliates the MNC has set up a third, non-productive affiliate located in tax haven country C. This affiliate acts as a shell company: it does not perform any production or sales operations and it does not own any significant tangible assets or capital. However, it owns a firm-specific intangible asset. One can think of this intangible asset as a form of technology, for example the unique algorithm that Facebook or Google uses. This intangible asset is licensed to the affiliates in country A and B, where it is used as a fixed common input for production ($\bar{X}$). Since there is only one algorithm (or patent, trademark, etc.), the level of common input can be normalized to unity ($\bar{X} = 1$), see Juranek et al., 2018. Furthermore, it is assumed that country C has a very small positive corporate tax rate which is close to zero: ($t_A > t_B >> t_C > 0$).

[4] Price discrimination is unlikely to be successful, even for a firm with significant market power, when consumers can easily resell the product. Similar assumptions are implicitly used by, for example/among others, Schjelderup and Sørgard (1997) and Nielsen et al. (2003).

Country C is assumed to be one of the 138 jurisdictions participating in the IF and, as such, agrees to the common tax rules prescribed by the Unified Approach.[5] Although most tax haven countries are not part of the OECD, many of them are included in the much wider scope of the IF. With this the IF acknowledges that "*globalisation requires that global solutions and a global dialogue be established which go beyond OECD and G20 countries"* (OECD, 2020c, p. 3). To illustrate, out of the 48 jurisdictions identified as tax havens by Dharmapala and Hines (2009), 40 have joined the IF.

This set-up is a simplified yet realistic representation of the company structure used by the big tech firms that would fall under the scope of the UA. It is very likely that Amazon, for example, has sufficient market power to practice price discrimination. The growing digital economy has created circumstances in which almost perfect price discrimination is possible, increasing the concerns of competition and consumer policy makers (OECD, 2018c, p. 5, par. 4). Firms are able to adjust their prices based on large amounts of data they can collect from their consumers through the Internet. One of the early signs of price differentiation showed in 2000, when consumers found out Amazon was charging them different prices for the same DVDs (CNN, 2000). Amazon claimed it was randomly testing prices and refunded the consumers involved. However, recent experimental studies also raise the concern that online retailers in general, and more specifically Amazon, might be engaging in some form of price discrimination. Using real-world accounts and control groups Hannak et al. (2014) show that price inconsistencies were found at the websites of four out of the ten largest e-commerce retailers.[6] These inconsistencies were based, among others, on the type of browser used and consumer history of purchased products. In the case of Amazon, price differences between geographical locations ranging from 21-166% were observed for Kindle e-books (Mikians et al., 2012). Although it is difficult to claim that such differences are purely based on consumer characteristics, it does indicate the use of some type of pricing algorithm. For the remainder of this thesis, Amazon can therefore be used as a credible example of a MNC that falls within the scope of the model.

[5] A complete list of jurisdictions can be consulted at https://www.oecd.org/tax/beps/inclusive-framework-on-beps-composition.pdf.

[6] Amazon is excluded from this study, primarily because its pricing effects are difficult to capture due to the function as a market place for external retailers. It could also be due to the fact that the study was partly funded by an Amazon Web Services in Education grant.

Anecdotal evidence shows that these types of MNCs often relocate the ownership of their intangible assets to a foreign affiliate in a low-tax country. A famous example is the "Double Irish (Dutch) Sandwich" formerly used by Google to avoid paying taxes on their intellectual property.[7] This anecdotal evidence is supported by the empirical analysis from Baumann et al. (2020), who observe that between 1990-2006 the average share of foreign-invented patents is very large (78,5%) for low-tax countries while it is small (6,5%) for high-tax countries, suggesting that patents are moved towards low-tax countries.

5.2 Production

The two productive affiliates in country A and B are symmetric in their production structure. They produce their output according to the common production function $f(K_i, \overline{X})$ using a country-specific level of capital K_i and the fixed common input $\overline{X}$. To simplify, and similar to Nielsen et al. (2010), it is assumed that the financing costs of capital are fully tax deductible. In this model, they are represented by the world interest rate r.

In addition, the tax-haven affiliate in country C charges the productive affiliates a country-specific license fee G_i for the use of the common input. Since the common input is fixed at $\overline{X} = 1$, G_i is essentially a lump sum payment. The true price of the common input is normalized to unity. However, since the common input is firm-specific and not traded with third parties, it is difficult for tax authorities to determine the true, arm's length price (OECD, 2018b, p. 13, par. 16). This gives the MNC the opportunity to overprice the license fee $(G_i > 1)$, a strategy by which it can shift income from the productive affiliates to the tax-haven affiliate.

However, hiding the true arm's length price from the tax authorities comes at a cost. Similar to Kant (1988), it is assumed that these concealment costs represent the risk of getting a fine once the tax authorities detect the abusive transfer pricing practice.[8] These concealment costs are incurred by the productive affiliates and cannot be deducted from their tax base.

[7] As the name suggests, this strategy involves transactions by which profits are shifted first through an Irish affiliate, then through a Dutch affiliate, and finally once more through a second Irish affiliate. See Loomis (2011) for a detailed overview of this tax strategy.

[8] Alternatively, concealment costs represent the labour costs from hiring tax consultants and lawyers to justify the transfer price and hide any deviation from the arm's length price. This type of concealment costs are modelled by Haufler and Schjelderup (2000). As pointed out by both Nielsen et al. (2010) and Juranek et al. (2018), using this type of tax deductible costs does not change the qualitative results of the model. To simplify and without loss of generality, this model ignores labour costs and focuses only on the expected costs of non-tax deductible fines.

The exact functional form of the concealment cost function of country i (θ_i) depends on the type of transfer pricing method that is used to determine the arm's length price. In the case of intangibles the OECD prescribes four standard methods: the comparable uncontrolled price (CUP) method, the cost plus (CP) method, the transactional net margin (TNM) method and the transactional profit split (TPS) method.[9] Provided that comparable market transactions can be identified, the OECD promotes the use of the CUP method (OECD, 2015b, p. 100, par. 6.145; Juranek et al., 2018). Since the model considers a simple setting in which the common input $\bar{X}$ is fixed and normalized to unity, the concealment cost functions under the TNM and CP method become equivalent to that under the CUP method (Juranek et al., 2018). Assuming that the MNC uses one of these three standard OECD transfer pricing methods, the concealment costs in country i can be modelled as a convex function of the deviation from the arm's length price: $\theta_i(G_i - 1)$. As there is more divergence from the arm's length price, the probability that the abusive transfer pricing will be detected by the tax authorities increases. Hence, the convex concealment cost function can be explained by the increased risk of getting a fine (Kant, 1988; Juranek et al, 2018).[10]

5.3 Sales

The productive affiliates are assumed to be local monopolists in their respective markets.[11] This assumption seems reasonable for big tech companies such as Google, Amazon, Facebook and Apple. Digital firms are known for the their network effects: the products and services they produce become more valuable once more people use them. Network effects can create a natural source of a persistent monopoly (Frank, 2008, p. 375). The tendency for network effects to create monopolies or oligopolies is an important characteristic of the digital economy (OECD, 2015a, p. 65 and p. 73). Empirically, one could measure market power through mark-ups.

[9] For a detailed description of these transfer pricing methods see OECD (2017).

[10] Similarly, once the deviation from the arm's length price becomes larger, labour costs increase as the firm needs more or better-paid tax consultants and lawyers to conceal their profit shifting activities (Haufler and Schjelderup, 2000).

[11] This assumption is also used by Schjelderup and Weichenrieder (1999) and Altshuler and Grubert (2010). On the contrary, Nielsen et al (2003) argue that many markets are more likely to be characterized by oligopoly rather than monopoly. Comparing SA and FA under oligopolistic competition allows them to study the effects on the firm's strategic incentives as well as their tax planning incentives. For simplicity, the model presented here excludes strategic interactions and focuses on pure monopolies.

A higher mark-up implies that the firm can charge prices that rise far above marginal cost, which is a signal for market power.[12] Firms operating in a digital intensive sector are found to have significantly higher mark-ups than firms in other, less digital sectors. This difference in mark-ups goes up to 43% for the top digital sector (Calligaris et al., 2018).

5.4 Pre-tax profits

The MNC's consolidated pre-tax profits (π_{MNC}) can be defined as the sum of the pre-tax profits of all affiliates ($\sum_{i=1}^{3} \pi_i$). First, the productive affiliates in country A and B earn profit from producing output and selling it on their respective domestic market. The productive affiliate produces its output Q_i according to the production function f, using capital and the fixed common input: $Q_i = f(K_i, \bar{X}) = f(K_i)$. Consequently, the output is sold on the domestic market. Being a local monopolist, the affiliate faces a downward sloping (inverse) demand curve where the price is an endogenous function of the quantity sold in the market, reflecting the market power of the MNC. Consequently, the MNC will choose the profit-maximizing level of output Q_i^* for each affiliate, after which the subsequent market demand determines the price $P_i = P(Q_i)$ (Frank, 2008, pp. 377-387). This implies that, by choosing different levels of output, the MNC is able to charge different prices in the two markets ($P_A \neq P_B$).

Total revenue from sales by the productive affiliates is equal to:

$$S_i = P(Q_i) \cdot Q_i = P(f(K_i)) \cdot f(K_i) \qquad \forall\, i \in \{A, B\} \tag{1}$$

This implies that total sales revenue can also be written as a function of the capital used in production: $S_i = S(K_i)$.

On the cost-side, the productive affiliates incur the financing costs of capital (rK_i) and the license fee for the use of the common input $(G_i\bar{X} = G_i)$. Furthermore, each affiliate takes into account the concealment costs of over-pricing the license fee: $\theta_i(G_i - 1)$.

Total costs of the productive affiliate is defined as:

$$C_i = rK_i + G_i + \theta_i(G_i - 1) \qquad \forall\, i \in \{A, B\} \tag{2}$$

[12] One should be careful however, since higher mark-ups can also reflect other production aspects, for example increased fixed costs.

The pre-tax profit of the productive affiliates is equal to total sales revenue (equation (1)) minus total costs (equation (2)):

$$\pi_i = S_i - rK_i - G_i - \theta_i(G_i - 1) \qquad \forall\, i \in \{A, B\} \tag{3}$$

The non-productive affiliate in tax haven country C earns profit from developing the intangible good and licensing it as a common input for production in country A and B. It derives income from the license fee paid by the productive affiliates: G_A and G_B. Furthermore, it incurs a certain amount of fixed costs F, which represent the sunk cost for developing the intangible.[13] Hence, pre-tax profit of the non-productive affiliate in country C equals:

$$\pi_C = G_A + G_B - F \tag{4}$$

Finally, the consolidated pre-tax profits for the MNC are the sum of the pre-tax profits of all affiliates:

$$\pi_{MNC} = \sum_{i=1}^{3} \pi_i = S_A - rK_A - G_A - \theta_i(G_A - 1) + S_B - rK_B - G_B - \theta_i(G_B - 1) + G_A + G_B - F \tag{5}$$

$$\pi_{MNC} = S - rK - \theta(G - 1) - F \tag{6}$$

where total sales revenue of the MNC is defined by $S = S_A + S_B$, total capital input as $K = K_A + K_B$, and the total concealment costs as $\theta(G - 1) = \theta_A(G_A - 1) + \theta_B(G_B - 1)$.

The MNC aims to maximize consolidated after-tax profits (Π_{MNC}). These profits can be found by subtracting the total tax payments of the MNC from its pre-tax profits. As we will see, the tax payments (and hence also the consolidated after-tax profits) under the SA system are different from those under the tax system of the UA. Under SA, the tax base of a country is determined by the taxable income *arising* in that country. Under the UA, the tax base of a country is (partly) determined by the taxable income that can be *(re-) allocated* to that country. The next subsections will develop these concepts in more detail. Subsection 5.5 will define after-tax profits under SA and subsection 5.6 will define after-tax profits under the UA.

[13] These costs are irrelevant for the MNC's decision about the quantity of output sold in country A and B. See also Juranek et al. (2018), p. 71.

5.5 After-tax profits under Separate Accounting

Under SA, the MNC pays taxes in each country where taxable profits arise. Subtracting this tax payment from the pre-tax profits results in the after-tax profits. The MNC's consolidated after-tax profits (Π_{MNC}) are the sum of the after-tax profits arising in each country/affiliate ($\sum_{i=1}^{3} \Pi_i$).

First, in country A and B profits arise at each of the productive affiliates, see equation (3). Since concealment costs are non-tax deductible, *taxable* profits are represented by sales revenue minus the cost of capital and the license fee. The tax payment of the MNC at the productive affiliates is equal to:

$$T_i^{SA} = t_i(S_i - rK_i - G_i) \qquad \forall\, i \in \{A, B\} \tag{7}$$

After-tax profits arising in country A and B are equal to the pre-tax profits in equation (3) minus the tax payment in equation (7):

$$\Pi_i^{SA} = \pi_i - T_i^{SA} = S_i - rK_i - G_i - \theta_i(G_i - 1) - t_i(S_i - rK_i - G_i) \tag{8}$$

$$\Pi_i^{SA} = (1 - t_i)(S_i - rK_i - G_i) - \theta_i(G_i - 1) \qquad \forall\, i \in \{A, B\} \tag{9}$$

In country C, taxable profits arise from licensing the common input (see equation (4)). The tax payment of the MNC in country C is equal to:

$$T_C^{SA} = t_C(G_A + G_B - F) \tag{10}$$

After-tax profits arising in country C are equal to the pre-tax profits in equation (4) minus the tax payment in equation (10):

$$\Pi_C^{SA} = \pi_C - T_C^{SA} = G_A + G_B - F - t_C(G_A + G_B - F) \tag{11}$$

$$\Pi_C^{SA} = (1 - t_C)(G_A + G_B - F) \tag{12}$$

Finally, the consolidated after-tax profits of the MNC under SA are equal to the sum of all affiliate after-tax profits:

$$\Pi_{MNC}^{SA} = \sum_{i=1}^{3} \Pi_i \tag{13}$$

$$\Pi_{MNC}^{SA} = (1 - t_A)(S_A - rK_A - G_A) - \theta_A(G_A - 1) + (1 - t_B)(S_B - rK_B - G_B) - \theta_B(G_B - 1) + (1 - t_C)(G_A + G_B - F) \tag{14}$$

5.6 After-tax profits under the Unified Approach

Under the UA, the MNC pays taxes in each country where taxable profits can be allocated to. Before turning to the allocation rules, we need to determine the size of taxable profits that can be (re-)allocated. Consolidated *pre-tax profits* are given by equation (6). Again, recall that the concealment costs are non-tax deductible. Consolidated *taxable profits* are equal to:

$$\pi_{MNC,t} = S_A - rK_A + S_B - rK_B - F = S - rK - F \tag{15}$$

Next, the UA prescribes to split these consolidated taxable profits in two tax bases: routine profits and residual profits. As described below, these two tax bases will be allocated differently amongst the countries in which the MNC operates.

5.6.1 Allocation of taxable routine profits

The first tax base are the deemed routine profits. These profits are supposed to be taxed by the country in which they arise (similar to the SA system). The OECD has not yet published clear instructions on which part of the profits can be labelled as deemed routine profits. They do advocate the use of simple, fixed parameters (OECD, 2019b, p. 14, par. 54). In line with this recommendation, this model assumes that the routine profits of country i are determined by applying a fixed mark-up ($\tilde{r}$) to the domestic capital stock (K_i). The same approach is used in an empirical study about general residual profit allocation schemes by Beer et al. (2020). The researchers in this paper claim that routine profit resembles the normal return on real investments. This would imply that $\tilde{r}$ is equal to the financing costs of capital r. However, as Devereux et al. (2019, pp. 22-23) point out, the split between routine and residual profits is not exactly equal to the split in normal and excess return (economic rent). Instead, the normal return represents the profit an independent third party would expect to earn for performing the same activities. This implies that the normal return reflects not only the firm's real investments but also the additional value created in the business process. Therefore, the mark-up to determine routine profits is modelled such that it includes the normal return on investments r plus some small, positive share of the economic rents: $\tilde{r} = r(1 + m)$. This implies that taxable routine profits arising at the productive affiliates are equal to:

$$\pi_{i,t}^{routine} = \tilde{r}K_i \qquad \forall\, i \in \{A, B\} \tag{16}$$

Since the non-productive affiliate does not own any tangible capital stock, no routine profits can be allocated to country C ($\pi_{C,t}^{routine} = 0$). Hence, consolidated taxable routine profits of the MNC are equal to:

$$\pi_{MNC,\,\mathrm{t}}^{routine} = \sum_{i=1}^{3} \pi_{i,t}^{routine} = \tilde{r}K_A + \tilde{r}K_B = \tilde{r}K \tag{17}$$

5.6.2 Allocation of taxable residual profits

The second tax base are the residual profits, which are identified as the remaining part of consolidated taxable profits (equation (15)), after the consolidated taxable *routine* profits (equation (17)) have been deducted:

$$\pi_{MNC,\,\mathrm{t}}^{residual} = \pi_{MNC,t} - \pi_{MNC,\,\mathrm{t}}^{routine} \tag{18}$$

$$\pi_{MNC,t}^{residual} = S - rK - F - \tilde{r}K \tag{19}$$

where total sales revenue of the MNC is defined by $S = S_A + S_B$ and total capital input as $K = K_A + K_B$.

Residual profits are supposed to be taxed by the country to which they can be allocated. Allocation is done by means of sales-based FA, which means that the allocation key reflects the relative share (ω_i) of country i in total sales revenue:

$$\omega_i = \frac{S_i}{S} \tag{20}$$

This implies that taxable residual profits that can be allocated to the productive affiliate in country i are equal to:

$$\pi_{i,\,\mathrm{t}}^{residual} = \omega_i \cdot \pi_{MNC,\,\mathrm{t}}^{residual} \qquad \forall\, i \in \{A, B\} \tag{21}$$

Using equation (19) and (20):

$$\pi_{i,\,\mathrm{t}}^{residual} = \frac{S_i}{S}\left(S - rK - F - \tilde{r}K\right) \tag{22}$$

Due to the lack of sales activity, none of the residual profits can be allocated to country C ($\pi_{C,\,\mathrm{t}}^{residual} = 0$).

Hence, the consolidated taxable residual profits of the MNC are equal to:

$$\pi_{MNC,\,\mathrm{t}}^{residual} = \sum_{i=1}^{3} \pi_{i,t}^{residual} = \frac{S_A}{S}\left(S - rK - F - \tilde{r}K\right) + \frac{S_B}{S}\left(S - rK - F - \tilde{r}K\right) \tag{23}$$

Together, taxable routine profits *arising* at affiliate i and taxable residual profits *allocated* to affiliate i form the total tax base in country/at affiliate i. Subsequently, country i can apply its own statutory tax rate to their local tax base.

The tax payment of the MNC in country i is equal to:

$$T_i^{UA} = t_i(\pi_{i,\,\mathrm{t}}^{routine} + \pi_{i,\,\mathrm{t}}^{residual}) \tag{24}$$

Using equation (16) and (22):

$$T_i^{UA} = t_i\left[\tilde{r}K_i + \frac{S_i}{S}\left(S - rK - F - \tilde{r}K\right)\right] \qquad \forall\, i \in \{A, B\} \tag{25}$$

Total tax payments of the MNC are equal to the sum of taxes paid in each country/at each affiliate i:

$$T_{MNC}^{UA} = \sum_{i=1}^{3} T_i^{UA} = t_A\left[\tilde{r}K_A + \frac{S_A}{S}\left(S - rK - F - \tilde{r}K\right)\right] + t_B\left[\tilde{r}K_B + \frac{S_B}{S}\left(S - rK - F - \tilde{r}K\right)\right] \tag{26}$$

Finally, the MNC's consolidated after-tax profits (Π_{MNC}^{UA}) can be derived by subtracting the total tax payments of the MNC (equation (26)) from consolidated pre-tax profits (equation (6)):

$$\Pi_{MNC}^{UA} = \pi_{MNC} - T_{MNC}^{UA} \tag{27}$$

$$\Pi_{MNC}^{UA} = S - rK - \theta(G-1) - F - t_A\left[\tilde{r}K_A + \frac{S_A}{S}\left(S - rK - F - \tilde{r}K\right)\right] - t_B\left[\tilde{r}K_B + \frac{S_B}{S}\left(S - rK - F - \tilde{r}K\right)\right] \tag{28}$$

Chapter 6 – MNC's behavioural responses: SA versus the UA

This chapter analyses and compares the behavior of the MNC under two tax systems: Separate Accounting and the Unified Approach.[14] Given these tax systems and local tax rates t_A, t_B and t_C, the MNC maximizes the consolidated after-tax profits by choosing the optimal license fee G_i charged and the optimal level of investment in capital stock K_i in each of the countries $i \in \{A, B\}$.

Under the tax system of SA, the profit-maximization problem of the MNC can be defined as:

$$\max_{G_i, K_i} \Pi_{MNC}^{SA} = \sum_{i=1}^{2} [(1 - t_i)(S_i - rK_i - G_i) - \theta_i(G_i - 1)] + (1 - t_C)(G_i - F) \tag{29}$$

Under the tax system of the UA, the profit-maximization problem of the MNC can be defined as:

$$\max_{G_i, K_i} \Pi_{MNC}^{UA} = \sum_{i=1}^{2} \left[S_i - rK_i - \theta_i(G_i - 1) - t_i \left(\tilde{r}K_i + \frac{S_i}{S} \cdot \left(S - rK - F - \tilde{r}K \right) \right) \right] - F \tag{30}$$

6.1 Behaviour of the MNC under Separate Accounting

First, we will identify how the MNC chooses the license fee G_i charged by the tax-haven affiliate in country C to the productive affiliate in country *i*. The first-order condition of after-tax profits with respect to the license fee G_i equals:

$$\frac{\partial \Pi_{MNC}^{SA}}{\partial G_i} = 0 \iff t_i - t_C = \theta'(G_i - 1) \qquad \forall\, i \in \{A, B\} \tag{31}$$

The left-hand side of equation (31) shows the tax rate differential between the productive affiliates in country A or B and the affiliate in tax-haven country C. It represents the marginal tax savings benefits from shifting paper profits by overpricing the license fee. This reduces the taxable profit in country i taxed at a rate t_i while increasing profits in country C, which are taxed at a much lower rate t_C. If tax-haven country C has a tax rate that is equal to the tax rate of one of the productive countries ($t_i = t_C$), there are no tax saving gains from shifting profits and hence the optimal transfer price will be equal to its true value ($G_i = 1$).

[14] Complete derivations of equations used in this chapter can be found in the appendix.

However, since $t_i > t_C$ the MNC will be induced to overprice the license fee $G_i > 1$, thereby shifting paper profits from both country A and B towards tax-haven country C.

As the right-hand side of equation (31) illustrates, profit shifting comes at a cost. The marginal concealment costs from deviating from the arm's length price is represented by the increased risk of getting detected and fined by the local tax authorities. In the optimum, the MNC chooses the optimal license fee G_i by trading off the marginal benefits against the marginal costs of profit shifting. This result is consistent with the results found in the literature both for perfect competition markets (Haufler and Schjelderup, 2001; Nielsen et al., 2010,) and imperfect competition markets (Nielsen et al., 2003). Hence, the market power of the MNC does not affect transfer pricing incentives under SA.

Comparing the first-order condition of country A with that of country B makes clear that in both countries there is a potential tax saving gain from over-invoicing the license fee. Given that $t_A > t_B > t_C$, the constant marginal benefit from tax savings is always larger in country A than in country B. The assumption made about the concealment cost function determines how the optimal license fee of high-tax country A and low-tax country B relate to each other. If it is assumed that the concealment cost functions are identical across countries, then for every license fee G_i the MNC faces the same marginal concealment costs in either country. Since the marginal tax savings are higher when shifting income from country A, it is optimal to charge a higher license fee to the affiliate operating in country A ($G_A^* > G_B^*$).

On the contrary, if it is assumed that the concealment cost function of country A is more convex than that of country B, then for every license fee G_i the marginal risk of getting a fine is larger in country A than in country B. For example, this can occur if tax authorities in country A are much better and faster at detecting abusive transfer pricing practices. Now, both marginal tax savings and marginal concealment costs are higher in country A. Whether G_A^* should be optimally set above or below G_B^* is ambiguous and depends on whether the marginal increase in tax savings of country A relative to country B are larger ($G_A^* > G_B^*$) or smaller ($G_A^* < G_B^*$) than the marginal increase in concealment costs relative to country B.

Next, we will identify how the MNC chooses the optimal level of investment in capital in the productive affiliate located in country i. As capital is the only variable factor of production, the investment in capital in country i will also determine the output produced and sold by the MNC in that country . This, in turn, determines the price charged and the sales revenue earned.

The first-order condition of after-tax profits with respect to the capital stock K_i equals:

$$\frac{\partial \Pi_{MNC}^{SA}}{\partial K_i} = 0 \;\Rightarrow\; (1 - t_i)\left(\frac{\partial S_i}{\partial K_i} - r\right) = 0 \tag{32}$$

$$\frac{\partial S_i}{\partial K_i} = r \qquad \forall\, i \in \{A, B\}$$

The left-hand side of equation (32) shows the marginal product of capital, while the right-hand side shows the marginal cost of using capital. In the optimum, the MNC will use the level of capital input K_i where marginal product equals marginal costs. Since the MNC is able to deduct the full cost of capital from its tax base, the corporation tax captures only the economic profits and not the marginal return from investment. Hence, the optimal outcome is not distorted by taxation. Since the local tax rate is the only parameter that differs between country A and B, the former also implies that the use of capital will be equalized across countries ($K_A^* = K_B^*$). The marginal cost of capital is the same in country A and B, since in each country the MNC faces the same financing costs. Due to the common production function, the gross marginal product is also equal in both countries. Furthermore, the equal use of capital implies that the MNC sells as much output in country A as it does in country B ($Q_A^* = Q_B^*$).

The optimal price will also be the same in both countries, and is determined by the optimal level of output and the inverse demand function. Since the MNC is a monopolist, the price is a downward sloping function of the quantity sold. This implies that the price falls whenever the MNC sells an additional unit of output, not only for the additional unit itself but for all units of output sold. Hence, for every positive output level the marginal revenue is less than the price, as shown formally by equation (33):

$$P\big(f(K_i)\big) > \frac{\partial S_i}{\partial K_i} \qquad \forall\, i \in \{A, B\} \tag{33}$$

Combining equation (33) with equation (32) shows that the MNC sets a price above marginal costs in both countries. This means that the MNC earns a positive economic profit, reflecting its market power. Compared to the equilibrium outcome under perfect competition, the prices are too high and the quantity sold is too low. This is known as the inefficiency from monopoly, resulting in a loss in consumer surplus (Frank et al, 2008, p. 398).

To summarize the effects of MNC behaviour under SA, it is found that the license fee is used as a meaningful profit shifting device in both countries A and B. Investment in capital is not distorted by corporate taxation and both countries will have the same capital stock, output and price. However, this outcome is affected by the market power of the MNC. From an efficiency perspective, the output is restricted and the price charged is too high.

6.2 Behavior of the MNC under the Unified Approach

Again, we will first identify how the MNC chooses the license fee that is charged by the tax-haven affiliate in country C to the productive affiliate in country i. In addition, the outcome for the license fee under the tax system of the UA will be compared to the outcome under the tax system of SA. The first-order condition of after-tax profits with respect to the license fee G_i equals:

$$\frac{\partial \Pi_{MNC}^{UA}}{\partial G_i} = 0 \Leftrightarrow G_i = 1 \qquad \forall\, i \in \{A, B\} \tag{34}$$

Hence, in both countries the MNC optimally sets the transfer price equal to its true value of one.

Because licensing the fixed input is an intercompany transaction, the level of the fee G_i charged is irrelevant for determining total pre-tax profits. Under SA it was shown that the level of the fee G_i does determine the tax payments due in each country. The same license fee G_i is taxed at a significantly lower rate in country C, while it is tax deductible at a higher rate in country A or B, giving rise to a tax saving strategy. However, under the UA the license fee G_i is irrelevant for the total tax payments of the MNC (see equation (26)). Both taxable routine profits *arising in* country i and taxable residual profits *allocated to* country i are independent of G_i. This implies that the license fee cannot be used as a tax saving strategy. Hence, paper profit shifting is not present under the UA. In the literature this is used as a common argument to favour FA tax systems over SA tax systems (Becker and Fuest, 2010; Gordon and Wilson, 1986; Nielsen et al., 2003, 2010). Equation (34) confirms that this argument can also be applied to the UA.

Next, we will identify how the MNC chooses the investment in capital in the productive affiliate located in country i and compare the outcome under the UA to that under SA. The previous paragraph showed that the MNC has no incentive to manipulate the license fee under the UA. However, the new tax system introduces alternative ways to exploit tax rate differences between countries.

Significant market power allows the MNC to adjust quantities sold (and sales price) in each country. Suppose that the MNC raises total sales revenue in low-tax country B by one unit, while simultaneously decreasing total sales revenue in high-tax country A by the same unit. This strategy does not change the total amount of sales revenue earned by the MNC, but it does change the proportion of sales revenue taxed at the lower rate t_B (versus the higher rate t_A). In this model, output (quantity sold) is a function of the capital input used in production. Therefore, optimal capital input in each country (K_A and K_B) is expected to be determined in light of any of such tax rate differences.

To illustrate this, consider the first-order condition of after-tax profits with respect to capital investment in high-tax country A:

$$\frac{\partial \Pi_{MNC}^{UA}}{\partial K_A} = 0 \tag{35}$$

$$\Leftrightarrow \frac{\partial S_A}{\partial K_A} - r - t_A\tilde{r} + t_A\frac{\partial S_A}{\partial K_A}\left(\frac{S_A}{S^2} - \frac{1}{S}\right)\cdot\left(S - rK - F - \tilde{r}K\right) - t_A\frac{S_A}{S}\left(\frac{\partial S_A}{\partial K_A} - r - \tilde{r}\right)$$

$$+ t_B\frac{\partial S_A}{\partial K_A}\cdot\frac{S_B}{S^2}\cdot\left(S - rK - F - \tilde{r}K\right) - t_B\frac{S_B}{S}\left(\frac{\partial S_A}{\partial K_A} - r - \tilde{r}\right) = 0$$

Rewriting gives:

$$(1-t)\left(\frac{\partial S_A}{\partial K_A} - r\right) + (t_B - t_A)\frac{\tilde{r}S_B}{S} + (t_B - t_A)\frac{\partial S_A}{\partial K_A}\frac{S_B}{S^2}\cdot\pi_{MNC,\,\mathrm{t}}^{residual} = 0 \tag{36}$$

Similarly, the first-order condition of after-tax profits with respect to capital investment in low-tax country B is equal to:

$$\frac{\partial \Pi_{MNC}^{UA}}{\partial K_B} = 0 \tag{37}$$

$$\Leftrightarrow \frac{\partial S_B}{\partial K_B} - r - t_B\tilde{r} + t_B\frac{\partial S_B}{\partial K_B}\left(\frac{S_B}{S^2} - \frac{1}{S}\right)\left(S - rK - F - \tilde{r}K\right) - t_B\frac{S_B}{S}\left(\frac{\partial S_B}{\partial K_B} - r - \tilde{r}\right)$$

$$+ t_A\frac{\partial S_B}{\partial K_B}\cdot\frac{S_A}{S^2}\cdot\left(S - rK - F - \tilde{r}K\right) - t_A\frac{S_A}{S}\left(\frac{\partial S_B}{\partial K_B} - r - \tilde{r}\right) = 0$$

Rewriting gives:

$$(1-t)\left(\frac{\partial S_B}{\partial K_B} - r\right) + \left(t_A - t_B\right)\frac{\tilde{r}S_A}{S} + \left(t_A - t_B\right)\frac{\partial S_B}{\partial K_B}\frac{S_A}{S^2}\cdot\pi_{MNC,\,\mathrm{t}}^{residual} = 0 \tag{38}$$

In general:

$$(1-t)\left(\frac{\partial S_i}{\partial K_i}-r\right)+\Delta t\cdot\frac{\tilde{r}S_j}{S}+\Delta t\cdot\frac{\partial S_i}{\partial K_i}\frac{S_j}{S^2}\cdot\pi_{MNC,\,\mathrm{t}}^{residual}=0 \qquad \forall\, i\in\{A,B\} \tag{39}$$

where $\Delta t = t_j - t_i$ is the relative difference between the other country (j) and country i's own tax rate and $t = t_A\frac{S_A}{S} + t_B\frac{S_B}{S}$ is the weighted average tax rate on corporate profits.

When comparing the FOC under the UA expressed by equation (39) to the FOC under SA expressed by equation (32), we can identify the additional effects on the MNC's optimal investment in capital and sales in both countries. One should note that these effects are all caused by tax incentives. In the absence of tax rate differences, the outcome under the UA would become equivalent to that under SA (since $t_A = t_B = t$ and $\Delta t = 0$). Again, the MNC decides on the optimal level of sales in both countries by equating marginal revenue to marginal costs. This would imply that country A and B experience the same capital investment, sales and prices under both tax systems. However, the model in this thesis uses a more realistic setting with substantial tax rate differences between countries ($t_A > t_B$).

The first term of equation (39) is similar to the outcome under SA (equation (32)), except that the formula now uses the weighted average tax rate instead of the domestic tax rate. However, since all costs of capital are tax deductible, the first term has a negligible effect on the outcome compared to SA (ceteris paribus). In high-tax country A, where the average tax rate is lower than the domestic tax rate, a switch to the UA will increases the after-tax marginal product and after-tax cost of capital by the same amount. The opposite is true for low-tax country B, where both the after-tax marginal product and the after-tax costs will decrease under the UA.

Furthermore, when switching from SA to the UA, two additional terms emerge. The second term of equation (39) captures the effect of capital investment on the taxes paid on routine profits. For both countries $i = A, B$, increasing investment directly increases the tax base that is labelled as routine profits *arising* and taxed country i. For high-tax country A, the relative tax rate differential with country B is negative ($\Delta t < 0$). Increasing capital investment in country A increases the effective after-tax cost of capital, since more capital is now taxed at a higher rate t_A instead of t_B. For low-tax country B, the relative tax rate differential with country A is positive ($\Delta t > 0$). Increasing capital investment in country B decreases the effective after-tax cost of capital.

The third term of equation (39) captures the effect of capital investment on the taxes paid on residual profits. Increasing investment in country i leads to an increase in output and sales in that country. Ceteris paribus, more sales in country i implies that, from the global tax base labelled as residual profits, a relatively larger share is *allocated* to the domestic tax base of country i while a relatively smaller part is allocated to and taxed in country j. Again, for investment in high-tax country A this implies that a larger part of the global tax base is taxed at the higher rate t_A instead of t_B, increasing the effective after-tax cost of capital. The opposite holds for low-tax country B, where capital investment decreases the effective after-tax cost of capital. In other words, the MNC will want to sell less in high-tax country A and more in low-tax country B, a strategy by which it can manipulate the apportionment formula and minimize the effective tax burden. This tax induced 'factor shifting' is similar to the results found under FA by, among others, Fuest (2008), Gordon and Wilson (1986), and Nielsen et al. (2010).

Contrary to the SA case, international differences in tax rates now distort the optimal investment decision by the MNC. This is caused by the additional tax costs and benefits associated with the investment in capital in country A and country B, respectively. This effect is similar to the classic effect found in the literature about FA (Nielsen et al., 2003, 2010). However, it has not yet been shown for the UA. In the case of the UA the effect works through two channels: routine profits (second term) and residual profits (third term). For high-tax country A, more capital investment comes at the cost of paying relatively higher taxes. Compared to the SA case, marginal revenue from sales in country A is now lower than marginal costs. This gives the MNC the incentive to invest less in capital and sales in country A. According to the downward-sloping inverse demand curve, the price charged to consumers in country A is higher under the UA than under SA. For low-tax country B, more capital investment comes at the benefit of paying relatively lower taxes. Compared to the SA case, marginal revenue from sales in country B is now higher than marginal costs. This gives the MNC the incentive to invest more in capital and sales in country B. According to the downward-sloping inverse demand curve, the price charged to consumers in country B is lower under the UA than under SA.

To summarize the effects of MNC behaviour under the UA, it is found that the license fee can no longer be used to shift paper profits. However, the MNC is expected to engage in factor shifting to maximize total after-tax profits. The UA introduces tax distortions in the optimal investment in capital by the MNC. This has consequences for output and sales in both countries.

In high-tax country A, the MNC is expected to sell less output for a higher price compared to SA. In low-tax country B, the MNC will sell more output against a lower price compared to SA. The next chapter will describe the conditions under which this is likely to be the case, and discusses the possible implications for market efficiency, welfare and tax competition in both countries.

Chapter 7 – Results and implications from a switch from Separate Accounting to the Unified Approach

The previous chapter showed that the MNC will respond to a change in the tax system from SA to the UA by shifting capital investment from the high-tax country towards the low-tax country. By changing the investment in capital, the MNC also changes sales in each country. Since sales is the sole allocation factor used to apportion global residual profits, this minimizes the total tax burden of the MNC under the UA. This chapter will derive the conditions under which this type of factor shifting occurs. Sales shifting has implications for market efficiency, welfare and tax competition incentives, which will be discussed at the end of this chapter.

7.1 SA versus the UA: sales shifting

Sales shifting occurs when output sold under the UA is:

i) *lower* than output sold under SA for high-tax country A; and
ii) *higher* than output sold under SA for low-tax country B.

The equations derived in chapter 6 do not allow us to directly compare output levels under SA and the UA. However, output levels can be compared indirectly by comparing marginal revenue under both tax systems. To do this, the relationship between output and marginal revenue needs to be examined first.

Recall from equation (1) that total revenue from sales is equal to $TR = S = P(Q) \cdot Q$ where it is assumed that $Q = f(K)$ and $P(Q)$ is a linear, downward-sloping demand curve. An expression for marginal revenue is found by taking the first-order condition of total revenue with respect to output:

$$\frac{\partial TR}{\partial Q} = P(Q)' \cdot Q + P(Q) \cdot Q' = P(Q) + P(Q)' \cdot Q \tag{40}$$

The derivative of the function captured by equation (40) will show how marginal revenue responds to a change in output:

$$\frac{\partial MR}{\partial Q} = P(Q)' + P(Q)'' \cdot Q + P(Q)' \cdot Q'$$

linear demand implies that $P(Q)'' = 0$

$$\frac{\partial MR}{\partial Q} = 2P(Q)' \tag{41}$$

Since $P(Q_i)' < 0$, there is a negative relationship between quantity and marginal revenue: $\frac{\partial MR}{\partial Q} < 0$. This means that the MNC can only sell more (less) if marginal revenue decreases (increases).

In other words, sales shifting occurs when marginal revenue under the UA is:

i) *higher* than marginal revenue under SA for high-tax country A; and
ii) *lower* than marginal revenue under SA for low-tax country B.

Under SA, recall from equation (32) that the first-order condition of after-tax profits with respect to the capital stock is equal to:

$$\frac{\partial \Pi_{MNC}^{SA}}{\partial K_i} = 0 \Leftrightarrow (1 - t_i)\left(\frac{\partial S_i}{\partial K_i} - r\right) = 0$$

Rewriting shows that the optimal level of sales in both countries is the level where the marginal revenue from sales is equal to the marginal costs of production:

$$MR_A^{SA} = MR_B^{SA} = r \tag{42}$$

Under the UA, recall from equation (36) and (38) that the first-order condition of after-tax profits with respect to the capital stock is equal to:

$$\frac{\partial \Pi_{MNC}^{UA}}{\partial K_A} = 0 \Leftrightarrow (1 - t)\left(\frac{\partial S_A}{\partial K_A} - r\right) + (t_B - t_A)\frac{\tilde{r} S_B}{S} + (t_B - t_A)\frac{\partial S_A}{\partial K_A}\frac{S_B}{S^2} \cdot \pi_{MNC,\mathrm{t}}^{residual} = 0$$

$$\frac{\partial \Pi_{MNC}^{UA}}{\partial K_B} = 0 \Leftrightarrow (1 - t)\left(\frac{\partial S_B}{\partial K_B} - r\right) + (t_A - t_B)\frac{\tilde{r} S_A}{S} + (t_A - t_B)\frac{\partial S_B}{\partial K_B}\frac{S_A}{S^2} \cdot \pi_{MNC,\mathrm{t}}^{residual} = 0$$

Rewriting shows that the optimal level of sales in country A is the level where the marginal revenue from sales equals the marginal costs of production multiplied by an extra term:

$$MR_A^{UA} = r \cdot \left(\frac{(1 - t) - (1 + m)(t_B - t_A)\frac{S_B}{S}}{(1 - t) + (t_B - t_A)\frac{S_B}{S^2} \cdot \pi_{MNC,\mathrm{t}}^{residual}}\right) \tag{43}$$

A similar result is found for the optimal level of sales in country B:

$$MR_B^{UA} = r \cdot \left(\frac{(1 - t) - (1 + m)(t_A - t_B)\frac{S_A}{S}}{(1 - t) + (t_A - t_B)\frac{S_A}{S^2} \cdot \pi_{MNC,\mathrm{t}}^{residual}}\right) \tag{44}$$

Comparing marginal revenue from equation (42) with marginal revenue from equation (43) will show the conditions under which a switch from SA to the UA will cause the MNC to produce and sell *less* in high-tax country A:

$$MR_A^{UA} > MR_A^{SA} \text{ if } r \cdot \left(\frac{(1-t)-(1+m)(t_B-t_A)\frac{S_B}{S}}{(1-t)+(t_B-t_A)\frac{S_B}{S^2}\cdot\pi_{MNC,\,\mathrm{t}}^{residual}} \right) > r$$

Rewriting gives:

$$-(1+m) < \frac{\pi_{MNC,\,\mathrm{t}}^{residual}}{S} \tag{45}$$

Similarly, comparing equation (42) to equation (44) shows the conditions under which a switch from SA to the UA will cause the MNC to produce and sell *more* in low-tax country B:

$$MR_B^{UA} < MR_B^{SA} \text{ if } r \cdot \left(\frac{(1-t)-(1+m)(t_A-t_B)\frac{S_A}{S}}{(1-t)+(t_A-t_B)\frac{S_A}{S^2}\cdot\pi_{MNC,\,\mathrm{t}}^{residual}} \right) < r$$

Rewriting gives the exact same condition as under (45):

$$-(1+m) < \frac{\pi_{MNC,\,\mathrm{t}}^{residual}}{S} \tag{46}$$

Recall from chapter 5 that m is a small, positive share of economic rents and that $(1+m)$ is the mark-up on the normal return on investment in capital, which determines the amount of routine profits. The left-hand side of equation (45) and (46) shows the negative value of this markup. The right-hand side of equation (45) and (46) can be interpreted as the residual profit margin. This ratio indicates how much residual profit is generated by each unit of sales revenue. Given that the residual profit margin is positive, the condition in equation (45) and (46) holds and the MNC will engage in sales shifting under the UA.

7.2 Implications of sales shifting

Suppose that the optimal level of output and price from the perspective of market efficiency is indicated by Q^* and P^*, respectively. Starting from the initial tax system of SA, we know that outcomes are suboptimal due to the market power of the MNC. In both countries, prices are above marginal costs ($P_A^{SA} = P_B^{SA} > P^*$) and quantity is being restricted ($Q_A^{SA} = Q_B^{SA} < Q^*$). The inefficiency and the resulting loss in consumer surplus are of equal size in both countries.

Implementing the UA creates an additional, tax-induced distortion in the resource allocation. Like market power, taxation places a wedge between the private cost of buying the good and the social cost of producing it. The MNC can minimize the total tax burden by restricting sales in high-tax country A and increasing them in low-tax country B. Hence, the effects on market efficiency are different in both countries. Country A will see an even lower quantity and an even higher price under the UA compared to under SA. This means that the outcomes will deviate even further away from the market efficient outcome: $P_A^{FA} > P_B^{SA} > P^*$ and $Q_A^{FA} < Q_B^{SA} < Q^*$. Hence, implementing the UA will for sure decrease market efficiency for high-tax countries. On the contrary, a switch from SA to the UA will lead to higher quantities and lower prices in country B. Since the initial situation was one with insufficient market coverage, this could point towards the direction that the outcomes are moving closer towards the market efficient outcome: $P_B^{SA} > P_B^{FA} > P^*$ and $Q_A^{SA} < Q_B^{FA} < Q^*$. However, if the tax rate differential is sufficiently large, the tax-induced distortion can induce the MNC to shift so much sales towards country B that it ends up beyond the market efficient outcome: $P_B^{SA} > P^* > P_B^{FA}$ and $Q_A^{SA} < Q^* < Q_B^{FA}$. Hence, the effect of the implementation of the UA on market efficiency in low-tax countries is ambiguous. Table 1 summarizes these results.

	Separate Accounting		**Unified Approach**	
	Output	Price	Output	Price
High-tax country A	$Q^{SA} < Q^*$	$P^{SA} > P^*$	$Q^{UA} < Q^{SA} < Q^*$	$P^{UA} > P^{SA} > P^*$
Low tax country B	$Q^{SA} < Q^*$	$P^{SA} > P^*$	$Q^{UA} > Q^{SA}$ $Q^{UA} \gtreqless Q^*$	$P^{UA} < P^{SA}$ $P^{UA} \gtreqless P^*$

Table 1: Sales in country A and B under SA and the UA.

The implications on welfare are more difficult to pin down. This thesis does not aim to give a definition of welfare. However, just looking at market efficiency would result in a narrow view of welfare. One could also take into account the development of tax revenue, for example. Under SA, both country A and B lose a part of their tax base due to the profit shifting activities of the MCN towards tax haven country C. This will induce countries to cut their tax rate in order to compete over these paper profits. Under the UA, the MNC can no longer manipulate the transfer price to shift paper profits towards tax havens. This initially has a positive effect on tax revenue in country A and B. However, the tax base in these countries is now affected by sales shifting.

In this model, sales are shifted from high-tax country A towards low-tax country B. This implies that high-tax country A will see a loss in tax revenue also under the UA. Whether this loss in tax revenue smaller or larger than the loss under SA is ambiguous. Low-tax country B gains in tax base under the UA. This is an improvement compared to SA, where country B lost part of its tax base to the tax haven country. To summarize, in high-tax country A the UA worsens market efficiency while the los in tax revenue can be either larger or smaller. In low-tax country B, the effect on market efficiency is ambiguous while tax revenue is larger. Hence, it is questionable whether the UA will improve welfare in each of these countries.

Moreover, tax competition is not eliminated under the UA. While competition over paper profits disappears, authorities will now compete over investment and real, economic profits. Theory suggests that the incentive to engage in tax competition is most likely stronger under the UA than under SA. This is because the benefits of a unilateral tax cut are larger under FA systems than under SA (Keen and Konrad, 2013, pp. 314-316). This argument also applies to the UA, which is a sales based FA system. A unilateral tax cut attracts more capital into the country, generating additional profit. Under SA, the subsequent increase in tax revenue is proportional to the marginal domestic profits. Under FA however, the increase in tax revenue is proportional to the increase in the country's share of the firm's global profits. Provided that the average rate of return to capital is larger than the marginal rate of return, governments can gain more from an unilateral tax cut under FA.

Chapter 8 - Conclusion

This thesis attempts to analyse how firms will respond to a change in the tax system from SA to the UA. The UA is a recent tax policy proposal from the OECD that prescribes to complement SA with sales-based FA. This should eliminate the main problem of SA: artificial profit shifting by manipulating the transfer price of intra-firm transactions. Instead, sales-based FA should be resistant to profit shifting incentives because sales is relatively immobile: a firm cannot move its customers.

The results in this thesis are brought forth using a theoretical framework in which there is a MNC that has two productive affiliates based in two countries with a substantial difference in tax rates. In addition there is a tax-haven affiliate which licenses an intangible asset that is used as a common input for production. Similar to the tech titans that are subject to the scope of the UA, the MNC is assumed to have sufficient market power to act as a quasi-monopolist.

The analysis finds that profit shifting incentives will not disappear under the UA. Indeed, the transfer price cannot be used as a device to shift profits to the tax-haven affiliate. However, that does not imply that profit shifting is fully eliminated. While customers cannot be moved, sufficient market power allows the MNC to adjust sales revenue by changing quantities and prices in both markets. Under sales-based FA, this manipulates the apportionment of global profits and minimizes the total tax burden. Hence, under the UA profit shifting will occur through manipulation of sales instead of manipulation of the transfer price. This type of profit shifting distorts the optimal allocation of resources and as such it might be more harmful than the type of profit shifting that is present under SA.

Finally, the UA is likely to favor low-tax countries over high-tax countries. Under the UA, firms will have the incentive to shift sales away from high-tax countries towards low-tax countries. As a result, high-tax countries will see higher prices and lower quantities. This intensifies the distortions caused by market power. In addition, tax base erosion does not disappear under the UA. On the other hand, low-tax countries will see lower prices and higher quantities compared to SA. This mitigates the insufficient market coverage caused by the market power of the firm, thereby potentially improving market efficiency. Considered that an implementation of the UA improves tax revenue in low-tax countries, and that a country gains more from an unilateral tax cut, tax competition incentives will become stronger.

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Appendix

6.1 Behavior of the MNC under Separate Accounting

$$\Pi_{MNC}^{SA} = \sum_{i=1}^{2}\Big[(1-t_i)\big(S_i - rK_i - G_i\big) - \theta_i(G_i - 1)\Big] + (1-t_C)(G_i - F)$$

$$= \sum_{i=1}^{2} S_i - rK_i - G_i - t_i S_i + t_i rK_i + t_i G_i - \theta_i(G_i - 1) + G_i - F - t_C G_i + t_C F$$

$$= \sum_{i=1}^{2} S_i - rK_i - t_i S_i + t_i rK_i + t_i G_i - \theta_i(G_i - 1) - F - t_C G_i + t_C F$$

Equation (31) – optimal license fee

taking the first order condition w.r.t. G_A gives:

$$\frac{\partial \Pi_{MNC}^{SA}}{\partial G_A} = 0$$

$$t_A - \theta'(G_A - 1) - t_C = 0$$

similarly for the first order condition w.r.t. G_B :

$$\frac{\partial \Pi_{MNC}^{SA}}{\partial G_B} = 0$$

$$t_B - \theta'(G_B - 1) - t_C = 0$$

in general:

$$\frac{\partial \Pi_{MNC}^{SA}}{\partial G_i} = 0$$

$$t_i - \theta'(G_i - 1) - t_C = 0$$

$$(t_i - t_C) = \theta'(G_i - 1) \qquad \forall\ i \in \{\ A\ ,\ B\ \} \quad \Rightarrow \text{ see equation (31)}$$

Equation (32) – optimal capital stock

recall that $S_i = S\big(K_i\big)$

taking the first order condition w.r.t. K_A gives:

$$\frac{\partial \Pi_{MNC}^{SA}}{\partial K_A} = 0$$

$$(1-t_A)\left(\frac{\partial S_A}{\partial K_A} - r\right) = 0$$

similarly for the first order condition w.r.t. K_B :

$$\frac{\partial \Pi_{MNC}^{SA}}{\partial K_B} = 0$$

$$(1-t_B)\left(\frac{\partial S_B}{\partial K_B} - r\right) = 0$$

in general:

$$\frac{\partial \Pi_{MNC}^{SA}}{\partial K_i} = 0 \quad \Leftrightarrow$$

$$(1-t_i)\left(\frac{\partial S_i}{\partial K_i} - r\right) = 0$$

$$(1-t_i)\frac{\partial S_i}{\partial K_i} = (1-t_i)r$$

$$\frac{\partial S_i}{\partial K_i} = r \qquad \forall\ i \in \{\ A\ ,\ B\ \} \quad \Rightarrow \text{ see equation (32)}$$

Equation (33) – proof that the MNC sets a price above marginal costs

$$S_i(K_i) = P\left(f(K_i)\right) \cdot f(K_i) \qquad \Rightarrow \text{see equation (1)}$$

$$\frac{\partial S_i}{\partial K_i} = P'\left(f(K_i)\right) \cdot f(K_i) + P\left(f(K_i)\right) \cdot f'(K_i)$$

$$f'(K_i) = 1$$

$$\frac{\partial S_i}{\partial K_i} = P\left(f(K_i)\right) + P'\left(f(K_i)\right) \cdot f(K_i)$$

downward sloping inverse demand function $\rightarrow\ P'\left(f(K_i)\right) < 0$

furthermore, we assume that $f(K_i) > 0$

$$P'\left(f(K_i)\right) \cdot f(K_i) < 0$$

$$P\left(f(K_i)\right) > \frac{\partial S_i}{\partial K_i} \qquad \Rightarrow \text{see equation (33)}$$

6.2 Behavior of the MNC under the Unified Approach

$$\Pi_{MNC}^{UA} = \sum_{i=1}^{2}\left[S_i - rK_i - \theta_i(G_i - 1) - t_i\left(\tilde{r}\, K_i + \frac{S_i}{S}\cdot\left(S - rK - F - \tilde{r}\, K \right)\right)\right] - F$$

$$= S_A - rK_A - \theta_A(G_A - 1) - t_A \tilde{r}\, K_A - t_A \frac{S_A}{S}\left(S - rK - F - \tilde{r}\, K \right)$$

$$+ S_B - rK_B - \theta_B(G_B - 1) - t_B \tilde{r}\, K_B - t_B \frac{S_B}{S}\left(S - rK - F - \tilde{r}\, K \right) - F$$

Equation (34) – optimal license fee

taking the first order condition w.r.t. G_A gives:

$$\frac{\partial \Pi_{MNC}^{UA}}{\partial G_A} = 0$$

$$-\theta'(G_A - 1) = 0$$

similarly for the first order condition w.r.t. G_B:

$$\frac{\partial \Pi_{MNC}^{UA}}{\partial G_B} = 0$$

$$-\theta'(G_B - 1) = 0$$

in general:

$$\frac{\partial \Pi_{MNC}^{UA}}{\partial G_i} = 0$$

$$-\theta'(G_i - 1) = 0$$

$$G_i - 1 = 0$$

$$G_i = 1 \qquad \forall\ i \in \{ A\ ,\ B \} \quad \Rightarrow \text{ see equation (34)}$$

Equation (35) and (36) – optimal capital stock in high-tax country A

recall that $S_i = S(K_i),\ S = S_A + S_B$ and $K = K_A + K_B$

rewriting after-tax profits:

$$\Pi_{MNC}^{UA} = S_A - rK_A - \theta_A(G_A - 1) - t_A \tilde{r}\, K_A + [X]\cdot[Y]$$

$$+ S_B - rK_B - \theta_B(G_B - 1) - t_B \tilde{r}\, K_B + [Z]\cdot[Y] - F$$

where

$$[X] = -t_A \frac{S_A}{S}$$

$$[Y] = S - rK - F - \tilde{r}K$$

$$[Z] = -t_B \frac{S_B}{S}$$

taking the first order condition w.r.t. K_A gives:

$$\frac{\partial \Pi_{MNC}^{UA}}{\partial K_A} = 0$$

$$\frac{\partial S_A}{\partial K_A} - r - t_A \tilde{r} + \frac{\partial [X]}{\partial K_A} \cdot [Y] + [X] \cdot \frac{\partial [Y]}{\partial K_A} + \frac{\partial [Z]}{\partial K_A} \cdot [Y] + [Z] \cdot \frac{\partial [Y]}{\partial K_A} = 0$$

$$\rightarrow \quad \frac{\partial [X]}{\partial K_A} = -t_A \cdot \frac{\partial S_A}{\partial K_A} \cdot (S)^{-1} - t_A S_A \cdot -(S)^{-2} \cdot \frac{\partial S_A}{\partial K_A}$$

$$= -t_A \cdot \frac{\partial S_A}{\partial K_A} \cdot \frac{1}{S} + t_A \cdot \frac{\partial S_A}{\partial K_A} \cdot \frac{S_A}{S^2}$$

$$= t_A \frac{\partial S_A}{\partial K_A} \left(\frac{S_A}{S^2} - \frac{1}{S} \right)$$

$$\rightarrow \quad \frac{\partial [Y]}{\partial K_A} = \frac{\partial S_A}{\partial K_A} - r - \tilde{r}$$

$$\rightarrow \quad \frac{\partial [Z]}{\partial K_A} = t_B S_B (S)^{-2} \cdot \frac{\partial S_A}{\partial K_A}$$

$$= t_B \frac{\partial S_A}{\partial K_A} \cdot \frac{S_B}{S^2}$$

$$[X] = -t_A \frac{S_A}{S}$$

$$\frac{\partial [X]}{\partial K_A} = t_A \frac{\partial S_A}{\partial K_A}\left(\frac{S_A}{S^2} - \frac{1}{S}\right)$$

$$[Y] = S - rK - F - \tilde{r}K$$

$$\frac{\partial [Y]}{\partial K_A} = \frac{\partial S_A}{\partial K_A} - r - \tilde{r}$$

$$[Z] = -t_B \frac{S_B}{S}$$

$$\frac{\partial [Z]}{\partial K_A} = t_B \frac{\partial S_A}{\partial K_A} \cdot \frac{S_B}{S^2}$$

Plugging $[X]$, $\frac{\partial [X]}{\partial K_A}$, $[Y]$, $\frac{\partial [Y]}{\partial K_A}$, $[Z]$ and $\frac{\partial [Z]}{\partial K_A}$

back into the FOC: $\frac{\partial S_A}{\partial K_A} - r - t_A \tilde{r} + \frac{\partial [X]}{\partial K_A} \cdot [Y] + [X] \cdot \frac{\partial [Y]}{\partial K_A} + \frac{\partial [Z]}{\partial K_A} \cdot [Y] + [Z] \cdot \frac{\partial [Y]}{\partial K_A} = 0$

gives:

$$\frac{\partial S_A}{\partial K_A} - r - t_A \tilde{r} + t_A \frac{\partial S_A}{\partial K_A}\left(\frac{S_A}{S^2} - \frac{1}{S}\right) \cdot \left(S - rK - F - \tilde{r}K\right) - t_A \frac{S_A}{S}\left(\frac{\partial S_A}{\partial K_A} - r - \tilde{r}\right)$$

$$+ t_B \frac{\partial S_A}{\partial K_A} \cdot \frac{S_B}{S^2} \cdot \left(S - rK - F - \tilde{r}K\right) - t_B \frac{S_B}{S}\left(\frac{\partial S_A}{\partial K_A} - r - \tilde{r}\right) = 0 \qquad \Rightarrow \text{see equation (35)}$$

Rewriting $S - rK - F - \tilde{r}K = \pi^{residual}_{MNC,\,t}$

using equation (19)

$$\frac{\partial S_A}{\partial K_A} - r - t_A \tilde{r} + t_A \frac{\partial S_A}{\partial K_A}\left(\frac{S_A}{S^2} - \frac{1}{S}\right) \cdot \pi^{residual}_{MNC,\,t} - t_A \frac{S_A}{S}\left(\frac{\partial S_A}{\partial K_A} - r - \tilde{r}\right) + t_B \frac{\partial S_A}{\partial K_A} \cdot \frac{S_B}{S^2} \cdot \pi^{residual}_{MNC,\,t} - t_B \frac{S_B}{S}\left(\frac{\partial S_A}{\partial K_A} - r - \tilde{r}\right) = 0$$

$$\frac{\partial S_A}{\partial K_A} - r - t_A \tilde{r} - t_A \frac{S_A}{S}\left(\frac{\partial S_A}{\partial K_A} - r - \tilde{r}\right) - t_B \frac{S_B}{S}\left(\frac{\partial S_A}{\partial K_A} - r - \tilde{r}\right) + t_A \frac{\partial S_A}{\partial K_A}\left(\frac{S_A}{S^2} - \frac{1}{S}\right) \cdot \pi^{residual}_{MNC,\,t} + t_B \frac{\partial S_A}{\partial K_A} \cdot \frac{S_B}{S^2} \cdot \pi^{residual}_{MNC,\,t} = 0$$

Rewriting $-t_A \frac{S_A}{S}\left(\frac{\partial S_A}{\partial K_A} - r - \tilde{r}\right) - t_B \frac{S_B}{S}\left(\frac{\partial S_A}{\partial K_A} - r - \tilde{r}\right)$

using the weighted average tax rate: $t = t_A \frac{S_A}{S} + t_B \frac{S_B}{S}$

$$-t_A \frac{S_A}{S}\left(\frac{\partial S_A}{\partial K_A} - r - \tilde{r}\right) - t_B \frac{S_B}{S}\left(\frac{\partial S_A}{\partial K_A} - r - \tilde{r}\right) = -t\left(\frac{\partial S_A}{\partial K_A} - r - \tilde{r}\right) = tr + t\tilde{r} - t\left(\frac{\partial S_A}{\partial K_A}\right)$$

Plugging back into the FOC:

$$\frac{\partial S_A}{\partial K_A} - r - t_A \tilde{r} + tr + t\tilde{r} - t\left(\frac{\partial S_A}{\partial K_A}\right) + t_A \frac{\partial S_A}{\partial K_A}\left(\frac{S_A}{S^2} - \frac{1}{S}\right) \cdot \pi^{residual}_{MNC,\,t} + t_B \frac{\partial S_A}{\partial K_A} \cdot \frac{S_B}{S^2} \cdot \pi^{residual}_{MNC,\,t} = 0$$

$$(1-t)\left(\frac{\partial S_A}{\partial K_A} - r\right) + \tilde{r}(t - t_A) + t_A \frac{\partial S_A}{\partial K_A}\left(\frac{S_A}{S^2} - \frac{1}{S}\right) \cdot \pi^{residual}_{MNC,\,t} + t_B \frac{\partial S_A}{\partial K_A} \cdot \frac{S_B}{S^2} \cdot \pi^{residual}_{MNC,\,t} = 0$$

Rewriting $\tilde{r}(t - t_A)$

using the weighted average tax rate: $t = t_A \frac{S_A}{S} + t_B \frac{S_B}{S}$

$$\tilde{r}(t - t_A) = \tilde{r}\left(t_A \frac{S_A}{S} + t_B \frac{S_B}{S} - t_A \frac{S}{S}\right)$$

$$= \tilde{r}\left(t_B \frac{S_B}{S} - t_A\left(\frac{S}{S} - \frac{S_A}{S}\right)\right)$$

$$= \tilde{r}\left(t_B \frac{S_B}{S} - t_A \frac{S_B}{S}\right)$$

$$= \tilde{r}(t_B - t_A)\frac{S_B}{S}$$

Plugging back into the FOC:

$$(1-t)\left(\frac{\partial S_A}{\partial K_A} - r\right) + (t_B - t_A)\frac{\tilde{r} \cdot S_B}{S} + t_A \frac{\partial S_A}{\partial K_A}\left(\frac{S_A}{S^2} - \frac{1}{S}\right) \cdot \pi^{residual}_{MNC,\,t} + t_B \frac{\partial S_A}{\partial K_A} \cdot \frac{S_B}{S^2} \cdot \pi^{residual}_{MNC,\,t} = 0$$

Rewriting $t_A \frac{\partial S_A}{\partial K_A}\left(\frac{S_A}{S^2}-\frac{1}{S}\right)\cdot \pi_{MNC,\,t}^{residual}$

$$= t_A \frac{\partial S_A}{\partial K_A}\left(\frac{S_A}{S^2}-\frac{S}{S^2}\right)\cdot \pi_{MNC,\,t}^{residual}$$

$$= -t_A \frac{\partial S_A}{\partial K_A}\left(\frac{S}{S^2}-\frac{S_A}{S^2}\right)\cdot \pi_{MNC,\,t}^{residual}$$

$$= -t_A \frac{\partial S_A}{\partial K_A}\frac{S_B}{S^2}\cdot \pi_{MNC,\,t}^{residual}$$

Plugging back into the FOC:

$$(1-t)\left(\frac{\partial S_A}{\partial K_A}-r\right)+(t_B-t_A)\frac{\tilde{r}\,S_B}{S}-t_A\frac{\partial S_A}{\partial K_A}\frac{S_B}{S^2}\cdot\pi_{MNC,\,t}^{residual}+t_B\frac{\partial S_A}{\partial K_A}\cdot\frac{S_B}{S^2}\cdot\pi_{MNC,\,t}^{residual}=0$$

$$(1-t)\left(\frac{\partial S_A}{\partial K_A}-r\right)+(t_B-t_A)\frac{\tilde{r}\,S_B}{S}+(t_B-t_A)\frac{\partial S_A}{\partial K_A}\frac{S_B}{S^2}\cdot\pi_{MNC,\,t}^{residual}=0 \quad \Rightarrow \text{ see equation (36)}$$

<u>Equation (37) and (38) – optimal capital stock in low-tax country B</u>

recall that $S_i = S(K_i)$, $S = S_A + S_B$ and $K = K_A + K_B$

rewriting after-tax profits:

$$\Pi_{MNC}^{UA} = S_A - rK_A - \theta_A(G_A-1) - t_A\tilde{r}K_A + [X]\cdot[Y]$$

$$+S_B - rK_B - \theta_B(G_B-1) - t_B\tilde{r}K_B + [Z]\cdot[Y] - F$$

where

$$[X] = -t_A\frac{S_A}{S}$$

$$[Y] = S - rK - F - \tilde{r}K$$

$$[Z] = -t_B\frac{S_B}{S}$$

taking the first order condition w.r.t. K_B gives:

$$\frac{\partial \Pi_{MNC}^{UA}}{\partial K_B} = 0$$

$$\frac{\partial S_B}{\partial K_B} - r - t_B \tilde{r} + \frac{\partial [Z]}{\partial K_B} \cdot [Y] + [Z] \cdot \frac{\partial [Y]}{\partial K_B} + \frac{\partial [X]}{\partial K_B} \cdot [Y] + [X] \cdot \frac{\partial [Y]}{\partial K_B} = 0$$

$$\rightarrow \quad \frac{\partial [X]}{\partial K_B} = t_A S_A (S)^{-2} \cdot \frac{\partial S_B}{\partial K_B}$$
$$= t_A \frac{\partial S_B}{\partial K_B} \cdot \frac{S_A}{S^2}$$

$$\rightarrow \quad \frac{\partial [Y]}{\partial K_B} = \frac{\partial S_B}{\partial K_B} - r - \tilde{r}$$

$$\rightarrow \quad \frac{\partial [Z]}{\partial K_B} = -t_B \cdot \frac{\partial S_B}{\partial K_B} \cdot (S)^{-1} - t_B S_B \cdot -(S)^{-2} \cdot \frac{\partial S_B}{\partial K_B}$$
$$= -t_B \cdot \frac{\partial S_B}{\partial K_B} \cdot \frac{1}{S} + t_B \cdot \frac{\partial S_B}{\partial K_B} \cdot \frac{S_B}{S^2}$$
$$= t_B \frac{\partial S_B}{\partial K_B} \left(\frac{S_B}{S^2} - \frac{1}{S} \right)$$

Plugging $[X]$, $\frac{\partial [X]}{\partial K_B}$, $[Y]$, $\frac{\partial [Y]}{\partial K_B}$, $[Z]$ and $\frac{\partial [Z]}{\partial K_B}$ back into the FOC $\frac{\partial \Pi_{MNC}^{UA}}{\partial K_B} = 0$ gives:

$$\frac{\partial S_B}{\partial K_B} - r - t_B \tilde{r} + t_B \frac{\partial S_B}{\partial K_B} \left(\frac{S_B}{S^2} - \frac{1}{S} \right) \cdot \left(S - rK - F - \tilde{r} K \right) - t_B \frac{S_B}{S} \left(\frac{\partial S_B}{\partial K_B} - r - \tilde{r} \right)$$
$$+ t_A \frac{\partial S_B}{\partial K_B} \cdot \frac{S_A}{S^2} \cdot \left(S - rK - F - \tilde{r} K \right) - t_A \frac{S_A}{S} \left(\frac{\partial S_B}{\partial K_B} - r - \tilde{r} \right) = 0 \qquad \Rightarrow \text{see equation } (37)$$

Rewriting $S - rK - F - \tilde{r}K = \pi_{MNC,\,t}^{residual}$

using equation (19)

$$\frac{\partial S_B}{\partial K_B} - r - t_B\tilde{r} + t_B\frac{\partial S_B}{\partial K_B}\left(\frac{S_B}{S^2} - \frac{1}{S}\right)\cdot\pi_{MNC,\,t}^{residual} - t_B\frac{S_B}{S}\left(\frac{\partial S_B}{\partial K_B} - r - \tilde{r}\right) + t_A\frac{\partial S_B}{\partial K_B}\cdot\frac{S_A}{S^2}\cdot\pi_{MNC,\,t}^{residual} - t_A\frac{S_A}{S}\left(\frac{\partial S_B}{\partial K_B} - r - \tilde{r}\right) = 0$$

$$\frac{\partial S_B}{\partial K_B} - r - t_B\tilde{r} - t_A\frac{S_A}{S}\left(\frac{\partial S_B}{\partial K_B} - r - \tilde{r}\right) - t_B\frac{S_B}{S}\left(\frac{\partial S_B}{\partial K_B} - r - \tilde{r}\right) + t_B\frac{\partial S_B}{\partial K_B}\left(\frac{S_B}{S^2} - \frac{1}{S}\right)\cdot\pi_{MNC,\,t}^{residual} + t_A\frac{\partial S_B}{\partial K_B}\cdot\frac{S_A}{S^2}\cdot\pi_{MNC,\,t}^{residual} = 0$$

Rewriting $-t_A\frac{S_A}{S}\left(\frac{\partial S_B}{\partial K_B} - r - \tilde{r}\right) - t_B\frac{S_B}{S}\left(\frac{\partial S_B}{\partial K_B} - r - \tilde{r}\right)$

using the weighted average tax rate: $t = t_A\frac{S_A}{S} + t_B\frac{S_B}{S}$

$$-t_A\frac{S_A}{S}\left(\frac{\partial S_B}{\partial K_B} - r - \tilde{r}\right) - t_B\frac{S_B}{S}\left(\frac{\partial S_B}{\partial K_B} - r - \tilde{r}\right) = -t\left(\frac{\partial S_B}{\partial K_B} - r - \tilde{r}\right) = tr + t\tilde{r} - t\frac{\partial S_B}{\partial K_B}$$

Plugging back into the FOC:

$$\frac{\partial S_B}{\partial K_B} - r - t_B\tilde{r} + tr + t\tilde{r} - t\frac{\partial S_B}{\partial K_B} + t_B\frac{\partial S_B}{\partial K_B}\left(\frac{S_B}{S^2} - \frac{1}{S}\right)\cdot\pi_{MNC,\,t}^{residual} + t_A\frac{\partial S_B}{\partial K_B}\cdot\frac{S_A}{S^2}\cdot\pi_{MNC,\,t}^{residual} = 0$$

$$(1-t)\left(\frac{\partial S_B}{\partial K_B} - r\right) + \tilde{r}(t - t_B) + t_B\frac{\partial S_B}{\partial K_B}\left(\frac{S_B}{S^2} - \frac{1}{S}\right)\cdot\pi_{MNC,\,t}^{residual} + t_A\frac{\partial S_B}{\partial K_B}\cdot\frac{S_A}{S^2}\cdot\pi_{MNC,\,t}^{residual} = 0$$

Rewriting $\tilde{r}(t - t_B)$

using the weighted average tax rate: $t = t_A\frac{S_A}{S} + t_B\frac{S_B}{S}$

$$\tilde{r}(t - t_B) = \tilde{r}\left(t_A\frac{S_A}{S} + t_B\frac{S_B}{S} - t_B\frac{S}{S}\right)$$

$$= \tilde{r}\left(t_A\frac{S_A}{S} - t_B\left(\frac{S}{S} - \frac{S_B}{S}\right)\right)$$

$$= \tilde{r}\left(t_A\frac{S_A}{S} - t_B\frac{S_A}{S}\right)$$

$$= \tilde{r}(t_A - t_B)\frac{S_A}{S}$$

Plugging back into the FOC:

$$(1-t)\left(\frac{\partial S_B}{\partial K_B} - r\right) + (t_A - t_B)\frac{\tilde{r}\cdot S_A}{S} + t_B\frac{\partial S_B}{\partial K_B}\left(\frac{S_B}{S^2} - \frac{1}{S}\right)\cdot\pi_{MNC,\,t}^{residual} + t_A\frac{\partial S_B}{\partial K_B}\cdot\frac{S_A}{S^2}\cdot\pi_{MNC,\,t}^{residual} = 0$$

Rewriting $t_B \frac{\partial S_B}{\partial K_B}\left(\frac{S_B}{S^2}-\frac{1}{S}\right)\cdot \pi_{MNC,\,\mathrm{t}}^{residual}$

$$= t_B \frac{\partial S_B}{\partial K_B}\left(\frac{S_B}{S^2}-\frac{S}{S^2}\right)\cdot \pi_{MNC,\,\mathrm{t}}^{residual}$$

$$= -t_B \frac{\partial S_B}{\partial K_B}\left(\frac{S}{S^2}-\frac{S_B}{S^2}\right)\cdot \pi_{MNC,\,\mathrm{t}}^{residual}$$

$$= -t_B \frac{\partial S_B}{\partial K_B}\frac{S_A}{S^2}\cdot \pi_{MNC,\,\mathrm{t}}^{residual}$$

Plugging back into the FOC:

$$(1-t)\left(\frac{\partial S_B}{\partial K_B}-r\right)+(t_A-t_B)\frac{\tilde{r}\cdot S_A}{S}+t_A\frac{\partial S_B}{\partial K_B}\cdot\frac{S_A}{S^2}\cdot\pi_{MNC,\,\mathrm{t}}^{residual}-t_B\frac{\partial S_B}{\partial K_B}\frac{S_A}{S^2}\cdot\pi_{MNC,\,\mathrm{t}}^{residual}=0$$

$$(1-t)\left(\frac{\partial S_B}{\partial K_B}-r\right)+(t_A-t_B)\frac{\tilde{r}\,S_B}{S}+(t_A-t_B)\frac{\partial S_B}{\partial K_B}\frac{S_A}{S^2}\cdot\pi_{MNC,\,\mathrm{t}}^{residual}=0 \quad \Rightarrow \text{ see equation (38)}$$

7.1 SA versus the UA: sales shifting

Equation (43) – optimality condition for sales in high-tax country A under the UA

$$(1-t)\left(\frac{\partial S_A}{\partial K_A}-r\right)+(t_B-t_A)\frac{\tilde{r}\cdot S_B}{S}+(t_B-t_A)\frac{\partial S_A}{\partial K_A}\frac{S_B}{S^2}\cdot\pi^{residual}_{MNC,\,t}=0$$

$$\tilde{r}=r(1+m)$$

$$(1-t)\left(\frac{\partial S_A}{\partial K_A}-r\right)+r(1+m)(t_B-t_A)\frac{S_B}{S}+(t_B-t_A)\frac{\partial S_A}{\partial K_A}\frac{S_B}{S^2}\cdot\pi^{residual}_{MNC,\,t}=0$$

$$(1-t)\frac{\partial S_A}{\partial K_A}+(t_B-t_A)\frac{\partial S_A}{\partial K_A}\frac{S_B}{S^2}\cdot\pi^{residual}_{MNC,\,t}=(1-t)r-r(1+m)(t_B-t_A)\frac{S_B}{S}$$

$$\frac{\partial S_A}{\partial K_A}+\frac{\partial S_A}{\partial K_A}\cdot\frac{(t_B-t_A)}{(1-t)}\frac{S_B}{S^2}\cdot\pi^{residual}_{MNC,\,t}=r-\frac{r(1+m)(t_B-t_A)\frac{S_B}{S}}{(1-t)}$$

$$\frac{\partial S_A}{\partial K_A}\left(1+\frac{(t_B-t_A)}{(1-t)}\frac{S_B}{S^2}\cdot\pi^{residual}_{MNC,\,t}\right)=r-\frac{r(1+m)(t_B-t_A)\frac{S_B}{S}}{(1-t)}$$

$$\frac{\partial S_A}{\partial K_A}=\frac{r}{\left(1+\frac{(t_B-t_A)}{(1-t)}\frac{S_B}{S^2}\pi^{residual}_{MNC,\,t}\right)}-\frac{\frac{r(1+m)(t_B-t_A)\frac{S_B}{S}}{(1-t)}}{\left(1+\frac{(t_B-t_A)}{(1-t)}\frac{S_B}{S^2}\pi^{residual}_{MNC,\,t}\right)}$$

$$\frac{\partial S_A}{\partial K_A}=r\cdot\left(\frac{1}{\left(1+\frac{(t_B-t_A)}{(1-t)}\frac{S_B}{S^2}\pi^{residual}_{MNC,\,t}\right)}-\frac{\frac{(1+m)(t_B-t_A)\frac{S_B}{S}}{(1-t)}}{\left(1+\frac{(t_B-t_A)}{(1-t)}\frac{S_B}{S^2}\pi^{residual}_{MNC,\,t}\right)}\right)$$

$$\frac{\partial S_A}{\partial K_A} = r \cdot \left(\frac{1 - \frac{(1+m)\left(t_B - t_A\right)\frac{S_B}{S}}{\left(1-t\right)}}{\left(1 + \frac{\left(t_B - t_A\right)}{\left(1-t\right)} \frac{S_B}{S^2} \pi^{residual}_{MNC,\,t}\right)} \right)$$

$$\frac{\partial S_A}{\partial K_A} = r \cdot \left(\frac{\frac{(1-t)}{(1-t)} - \frac{(1+m)\left(t_B - t_A\right)\frac{S_B}{S}}{\left(1-t\right)}}{\left(\frac{(1-t)}{(1-t)} + \frac{\left(t_B - t_A\right)}{\left(1-t\right)} \frac{S_B}{S^2} \pi^{residual}_{MNC,\,t}\right)} \right)$$

$$\frac{\partial S_A}{\partial K_A} = r \cdot \left(\frac{\frac{(1-t) - (1+m)\left(t_B - t_A\right)\frac{S_B}{S}}{\left(1-t\right)}}{\frac{(1-t) + \left(t_B - t_A\right)\frac{S_B}{S^2} \pi^{residual}_{MNC,\,t}}{\left(1-t\right)}} \right)$$

$$\frac{\partial S_A}{\partial K_A} = r \cdot \frac{(1-t) - (1+m)\left(t_B - t_A\right)\frac{S_B}{S}}{(1-t) + \left(t_B - t_A\right)\frac{S_B}{S^2} \pi^{residual}_{MNC,\,t}} \quad \Rightarrow \text{ see equation (43)}$$

Equation (44) – optimality condition for sales in low-tax country B under the UA

$$\left(1-t\right)\left(\frac{\partial S_B}{\partial K_B} - r\right) + \left(t_A - t_B\right)\frac{\tilde{r}\, S_A}{S} + \left(t_A - t_B\right)\frac{\partial S_B}{\partial K_B}\frac{S_A}{S^2} \cdot \pi^{residual}_{MNC,\,t} = 0$$

$$\tilde{r} = r(1+m)$$

$$\left(1-t\right)\left(\frac{\partial S_B}{\partial K_B} - r\right) + r(1+m)\left(t_A - t_B\right)\frac{S_A}{S} + \left(t_A - t_B\right)\frac{\partial S_B}{\partial K_B}\frac{S_A}{S^2} \cdot \pi^{residual}_{MNC,\,t} = 0$$

$$\left(1-t\right)\frac{\partial S_B}{\partial K_B} + \left(t_A - t_B\right)\frac{\partial S_B}{\partial K_B}\frac{S_A}{S^2} \cdot \pi^{residual}_{MNC,\,t} = \left(1-t\right)r - r(1+m)\left(t_A - t_B\right)\frac{S_A}{S} = 0$$

$$\frac{\partial S_B}{\partial K_B} + \frac{\partial S_B}{\partial K_B} \cdot \frac{\left(t_A - t_B\right)}{\left(1-t\right)}\frac{S_A}{S^2} \cdot \pi^{residual}_{MNC,\,t} = r - \frac{r(1+m)\left(t_A - t_B\right)\frac{S_A}{S}}{(1-t)}$$

$$\frac{\partial S_B}{\partial K_B}\left(1+\frac{\left(t_A-t_B\right)}{\left(1-t\right)}\frac{S_A}{S^2}\cdot\pi_{MNC,\,\mathrm{t}}^{residual}\right)=r-\frac{r(1+m)\left(t_A-t_B\right)\frac{S_A}{S}}{\left(1-t\right)}$$

$$\frac{\partial S_B}{\partial K_B}=\frac{r}{\left(1+\frac{\left(t_A-t_B\right)}{\left(1-t\right)}\frac{S_A}{S^2}\pi_{MNC,\,\mathrm{t}}^{residual}\right)}-\frac{\frac{r(1+m)\left(t_A-t_B\right)\frac{S_A}{S}}{\left(1-t\right)}}{\left(1+\frac{\left(t_A-t_B\right)}{\left(1-t\right)}\frac{S_A}{S^2}\pi_{MNC,\,\mathrm{t}}^{residual}\right)}$$

$$\frac{\partial S_B}{\partial K_B}=r\cdot\left(\frac{1}{\left(1+\frac{\left(t_A-t_B\right)}{\left(1-t\right)}\frac{S_A}{S^2}\pi_{MNC,\,\mathrm{t}}^{residual}\right)}-\frac{\frac{(1+m)\left(t_A-t_B\right)\frac{S_A}{S}}{\left(1-t\right)}}{\left(1+\frac{\left(t_A-t_B\right)}{\left(1-t\right)}\frac{S_A}{S^2}\pi_{MNC,\,\mathrm{t}}^{residual}\right)}\right)$$

$$\frac{\partial S_B}{\partial K_B}=r\cdot\left(\frac{1-\frac{(1+m)\left(t_A-t_B\right)\frac{S_A}{S}}{\left(1-t\right)}}{\left(1+\frac{\left(t_A-t_B\right)}{\left(1-t\right)}\frac{S_A}{S^2}\pi_{MNC,\,\mathrm{t}}^{residual}\right)}\right)$$

$$\frac{\partial S_B}{\partial K_B}=r\cdot\left(\frac{\frac{(1-t)}{(1-t)}-\frac{(1+m)\left(t_A-t_B\right)\frac{S_A}{S}}{\left(1-t\right)}}{\left(\frac{(1-t)}{(1-t)}+\frac{\left(t_A-t_B\right)}{\left(1-t\right)}\frac{S_A}{S^2}\pi_{MNC,\,\mathrm{t}}^{residual}\right)}\right)$$

$$\frac{\partial S_B}{\partial K_B}=r\cdot\frac{(1-t)-(1+m)\left(t_A-t_B\right)\frac{S_A}{S}}{(1-t)+\left(t_A-t_B\right)\frac{S_A}{S^2}\pi_{MNC,\,\mathrm{t}}^{residual}}\qquad\Rightarrow\text{ see equation (44)}$$

Equation (45) – condition under which a switch from SA to UA will cause the MNC to sell *less* in high-tax country A :

$$r \cdot \left(\frac{(1-t) - (1+m)(t_B - t_A)\frac{S_B}{S}}{(1-t) + (t_B - t_A)\frac{S_B}{S^2} \cdot \pi^{residual}_{MNC,\,t}} \right) > r$$

$$\frac{(1-t) - (1+m)(t_B - t_A)\frac{S_B}{S}}{(1-t) + (t_B - t_A)\frac{S_B}{S^2} \cdot \pi^{residual}_{MNC,\,t}} > 1$$

$$(1-t) - (1+m)(t_B - t_A)\frac{S_B}{S} > (1-t) + (t_B - t_A)\frac{S_B}{S}\frac{1}{S}\pi^{residual}_{MNC,\,t}$$

$$-(1+m)(t_B - t_A)\frac{S_B}{S} > (t_B - t_A)\frac{S_B}{S}\frac{1}{S}\pi^{residual}_{MNC,\,t}$$

$$-(1+m)(t_B - t_A) > (t_B - t_A)\frac{1}{S}\pi^{residual}_{MNC,\,t}$$

note that $(t_B - t_A) < 0$

$$-(1+m) < \frac{\pi^{residual}_{MNC,\,t}}{S} \qquad \Rightarrow \text{ see equation (45)}$$

Equation (46) – condition under which a switch from SA to UA will cause the MNC to sell *more* in low-tax country B :

$$r \cdot \left(\frac{(1-t) - (1+m)(t_A - t_B)\frac{S_A}{S}}{(1-t) + (t_A - t_B)\frac{S_A}{S^2} \cdot \pi^{residual}_{MNC,\,t}} \right) < r$$

$$\frac{(1-t) - (1+m)(t_A - t_B)\frac{S_A}{S}}{(1-t) + (t_A - t_B)\frac{S_A}{S^2} \cdot \pi^{residual}_{MNC,\,t}} < 1$$

$$(1-t) - (1+m)(t_A - t_B)\frac{S_A}{S} < (1-t) + (t_A - t_B)\frac{S_A}{S}\frac{1}{S}\pi^{residual}_{MNC,\,t}$$

$$-(1+m)(t_A - t_B)\frac{S_A}{S} < (t_A - t_B)\frac{S_A}{S}\frac{1}{S}\pi^{residual}_{MNC,\,t}$$

$$-(1+m)(t_A - t_B) < (t_A - t_B)\frac{1}{S}\pi^{residual}_{MNC,\,t}$$

note that $(t_A - t_B) > 0$

$$-(1+m) < \frac{\pi^{residual}_{MNC,\,t}}{S} \qquad \Rightarrow \text{ see equation (46)}$$