Essays on Tax Evasion and Tax Avoidance

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M. Sc. Rebecca Valeska Reineke

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Prof. Dr. Stefan Wielenberg
Prof. Dr. Kay Blaufus

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Zusammenfassung

Diese Dissertation beinhaltet vier Beiträge zur Steuerhinterziehung und zur Steuervermeidung. Der erste Beitrag untersucht die Fragestellung, ob die Nutzung eines Verrechnungspreises für interne und externe Zwecke optimal für multinationale Unternehmen sein kann, obwohl ein zusätzlicher Freiheitsgrad durch die Verwendung eines zweiten Verrechnungspreises gewonnen wird. Die Berücksichtigung eines strategisch agierenden Betriebsprüfers führt dazu, dass ein einzelner Verrechnungspreis für die steuerliche Berichterstattung und die innerbetriebliche Anreizgestaltung verwendet werden sollte, sofern die Differenz zwischen den resultierenden Strafen im Falle eines nicht-regelkonformen Verrechnungspreises hinreichend groß ist. Des Weiteren wird gezeigt, dass ein steigendes Steuersatzgefälle zu weniger steueraggresivem Verhalten führt.

Der zweite Beitrag analysiert, ob ein immaterieller Vermögenswert eines multinationalen Unternehmens in einer Division in einem Hoch- oder in einem Niedrigsteuerland gehalten werden sollte, sofern die Nutzung in den verschiedenen Steuerjurisdiktionen nicht unabhängig voneinander ist. Ein hoher Spillover führt dazu, dass der immaterielle Vermögenswert optimalerweise in der Hochsteuerlanddivision gehalten werden sollte, obgleich dies mit höheren Steuerzahlungen einhergeht. Darüber hinaus wird gezeigt, dass die Einschränkung von Gewinnverschiebungsmöglichkeiten sowohl zu steigenden, als auch zu sinkenden Investitionen des Unternehmens führen kann.

Der dritte Beitrag untersucht, inwiefern sich die Investitionen einer Firma und die korrespondierende Steuerberichterstattung gegenseitig beeinflussen, wenn der Jahresabschluss als unpräzises Signal für die korrekte steuerliche Behandlung des Sachverhaltes in einer Betriebsprüfung verwendet wird. Es kann gezeigt werden, dass ein Anstieg, der Konformität zwischen Handels- und Steuerbilanz zu steigendem oder sinkendem erwarteten Steuereinkommen für die Finanzverwaltung führen kann. Einerseits führt die Erhöhung der Konformität zwischen Handels- und Steuerbilanz zu verringerten Investitionsanreizen durch steuerliche Begünstigungen. Andererseits kann eine Verringerung der zu niedrig ausgewiesenen Steuerberichte, die zu einer Differenz zwischen Handels- und Steuerbericht führen, erzielt werden.

Der letzte Beitrag analysiert, wie sich Steuern und der Fremdvergleichsgrundsatz auf die Kapazitätsplanung eines multinationalen Unternehmens auswirken, wenn der Spielraum für die Gewinnverschiebung mittels Berichterstattung durch strenge Regularien stark eingeschränkt ist. In einer derartigen Situation kann eine Gewinnverschiebung in ein Niedrigsteuerland mittels entsprechender operativer Entscheidungen erzielt werden, um so den Nachsteuergewinn des Konzerns zu maximieren. Es wird gezeigt, dass Steuern und entsprechende Verrechnungspreisregulierung zu einem Anstieg der Überkapazität führen, da ein Steuersatzgefälle zu einer Reduktion der mit Überkapazitäten einhergehenden Kosten führen kann.

Summary

This dissertation comprises four articles concerning tax evasion and tax avoidance. The first study investigates if a one set of books transfer pricing strategy can be part of a multinational's equilibrium strategy even though two sets of books provide an additional degree of freedom when transfer pricing is used for tax reporting and internal decision making. Using a game theoretic model the article shows that the penalty difference between the transfer pricing regimes in case of a detected non-compliant transfer price critically affects whether the multinational uses one set or two sets of books. Furthermore, the study shows that an increasing tax rate differential induces less tax-aggressiveness because high profit shifting incentives are anticipated by a strategic tax auditor.

The second article analyzes transfer pricing of an intangible while endogenizing its location choice. Multinationals are often suspected of using transfer pricing of intangibles to shift profits from high-tax to low-tax jurisdictions. However, if spillovers from the use of the intangible are prevalent and the multinational faces a trade-off between spillover internalization and tax minimization a 'home bias' might occur. In particular, for a high spillover and restrictions on tax avoidance, the intangible is optimally located in the headquarters which is in the high-tax country even though tax savings could be realized by locating the intangible in an offshore division. Additionally, the study shows that curtailing profit shifting possibilities can harm investment incentives.

The third article investigates the interdependence between a firm's tax reporting and investment behavior if the financial statement provides a noisy signal regarding the correct tax treatment of the project to a strategically acting tax authority. The study shows that the expected tax revenue for the tax authority can either increase or decrease with increasing book-tax conformity. Increasing book-tax conformity is detrimental for the investment incentives but leads to less understated non-conforming tax reports.

The fourth article examines how taxes and the transfer pricing regulation affect the capacity planning of a multinational company. In a situation where tight regulation curbs the reporting discretion, multinationals can shift profits to low-tax jurisdictions by adapting real decisions instead of manipulating the transfer price. The article shows that taxes and transfer pricing regulation increase the probability of excessive capacity. Therefore, taxes and corresponding regulation are identified as potential antecedents for organizational slack.

Schlagwörter: Verrechnungspreise · Two sets of books · One Set of Books · Strategischer Steuerprüfer · Gewinnverschiebung · Immaterielle Vermögenswerte · Spillover · Standortentscheidung · Überkapazität · Steuervermeidung · Bilanzenkonformität · Investitionsanreize · Steueraggresivität · Steuerhinterziehung

Keywords: Transfer Pricing · Two sets of books · One Set of Books · Strategic Tax Auditor · Profit Shifting · Intangibles · Spillover · Location Choice · Excessive Capacity · Tax Avoidance · Book-Tax Conformity · Investment Incentives · Tax-Aggressiveness · Tax Evasion

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Chapter 1

Introduction

1.1 Motivation

Firms typically aim at maximizing their after-tax profit. Obviously, reducing the tax liability is an appropriate means. Firms can do so either legally or illegally. However, fraudulent reporting behavior bears the risk of tax audits which might lead to potentially high penalties and reputational damages. Therefore, the majority of firms focus on compliance with tax law (The Economist, 2004; Cools and Emmanuel, 2006; Cools and Slagmulder, 2009) and prioritize preventing disputes with the tax authority above the tax minimization objective (Klassen et al., 2017). Alternatively, firms can engage in legal tax avoidance, i.e., in the usage of reporting discretion that is inherent to tax law. Despite being legal, tax avoidance is perceived as undesirable by the general public (The Guardian, 2007). Therefore, Bankman (2004) indicates that firms which aggressively avoid taxes may also suffer, like tax evaders, from reputational damages by being labeled as 'poor corporate citizens' even though its tax avoidance strategies are perfectly legal. Because of this threat, firms increasingly refrain from reporting behavior that is intended to minimize the tax liability. Without the option to optimize the after-tax profit by using reporting discretion, firms can alter strategic and operational decisions to maximize their after-tax income.

Governments and regulators are aware of firms' tax optimization incentives. Thus, they are particularly concerned about collecting their owing taxes (Wall Street Journal, 2017). In particular, low effective tax rates, especially from large multinationals, have drawn public attention to the topics of tax evasion and tax avoidance. Taxes are a major source of governments' income and, therefore, tax evasion and tax avoidance deprive governments of tax revenues. Consequently, tax evasion and tax avoidance are high on political agendas. Supranational organizations like the OECD and national policymakers collaborate to develop legislation which is dedicated to tackling strategic tax planning and especially profit shifting such as the recent Base Erosion Profit Shifting Project.

One of the most common tax minimization channels used by multinational firms is transfer pricing. In particular, firms evidently use transfer pricing schemes to shift profits from high-tax to low-tax countries (e.g. De Simone et al., 2017; Klassen et al., 2017; Blouin et al., 2018). Estimates regarding the magnitude of internal trade range from 33 % up to 60 %. For example, the OECD states that one-third of the worldwide trade occurs within the boundaries of multinational companies (Lanz and Miroudot, 2011). Therefore, transfer pricing is mandatory to allocate the taxable income to the participating tax jurisdictions. However, it also creates a huge potential for multinationals to realize tax savings. Transfer pricing of intangibles seems especially prone to generate tax savings due to the unique characteristics of intangibles that allow for a large discretion in the location choice and corresponding transfer pricing decisions. For example, intangibles are typically non-exclusive in its consumption, comparables are often rarely available, the using divisions incur no or negligible marginal costs once the intangible is developed, and spillovers and network effects regularly occur (Lev, 2001). Therefore, multinationals are typically suspected to locate their intangibles in divisions in low tax countries, thereby, generating tax savings by subsequent royalty flows. However, locating an intangible offshore can also have detrimental effects.

Besides the tax function, transfer prices are used for managerial purposes. Consequently, transfer pricing related conflicts between the different objectives of a multinational company can arise (e.g. Baldenius et al., 2004; Hyde and Choe, 2005; Labro, 2019). On the one hand, taxes should be minimized. On the other hand, divisions need to be coordinated correctly. Basically, the use of two sets of books, i.e., the use of two different transfer prices (see, for example, Baldenius et al., 2004) can mitigate those conflicts. In particular, one reported transfer price can be used to achieve tax minimization and another internal transfer price can induce efficient managerial decisions. Alternatively, firms can operate a one set of books accounting system, i.e., a single transfer price is used for both tax reporting and internal purposes (Göx and Schiller, 2007). Empirical research shows that both accounting systems are used (Klassen et al., 2017; Springsteel, 1999). Nevertheless, the majority of firms keep one set of books (Klassen et al., 2017; Baersch et al., 2018). Firms argue that finding two sets of books in a tax audit indicates tax-aggressive behavior that might lead to long-lasting and expensive disputes with the tax authority. Mills (1998) shows that large discrepancies between the financial statement and the taxable income create red flags for tax authorities. Finding two different transfer prices during a tax audit is similar and entails increased scrutiny of the tax auditor.

To prevent disputes between firms and tax authorities, regulators try to curtail strategic tax minimization possibilities. Therefore, they implement tight transfer pricing regulation to deter multinationals from shifting profits to low-tax jurisdictions. Less reporting scope combined with the threat of potential tax audits curtail firms' possibilities to engage in beneficial tax minimization by managing their reported income downwards.

Another promising means for regulators to tackle firms' tax minimization within the national boundaries is the reduction of book-tax differences. Increasing mandatory book-tax conformity reduces firms' possibilities to bias their taxable income downwards without affecting the financial statement.

Reducing firms discretion regarding tax reporting consequently affects firms' behavior. First, the reporting behavior is influenced due to less reporting scope. Second, firms might alter their real economic decision because the remaining scope might induce firms to optimize their after-tax income by means of operational decisions rather than by understated tax reports. Prior theoretical and empirical research indicates that curtailing tax minimization possibilities may lead to decreasing investments (Desai et al., 2006; Hong and Smart, 2010; Schwab and Todtenhaupt, 2017; Juranek et al., 2018). Therefore, tax regulation can cause inefficiencies like decreasing investments or organizational slack in the form of excessive production capacity. This highlights the complexity that legislators, tax authorities, and supranational organizations like the European Union need to consider when designing anti-avoidance legislation.

1.2 Contribution and Main Findings

This thesis consists of four articles. Table 1.1 provides an overview of the articles, the coauthors, the presentations at international conferences, and the status of publication.

Title	Coauthors	Conferences	Status of publication
When Do Firms Use One Set of Books in an International Tax Compliance Game?	Stefan Wielenberg Katrin Weiskirchner-Merten	ARFA 2017 ARW 2017 EAA 2017 VHB 2017	Revise and Resubmit: Review of Accounting Studies
Transfer Pricing and Location Choice of Intangibles – Spillover and Tax Avoidance through Profit Shifting	Katrin Weiskirchner-Merten	ARFA 2018 EAA 2018 EIASM 2018 GEABA 2018 VHB 2018	Working Paper
The Impact of Book-Tax Conformity on Reporting and Investment Behavior	Alexandra Lilge Michelle Muraz	EAA 2019 ARW 2019 VHB 2019	Working Paper
International Transfer Pricing and Capacity Planning	Katrin Weiskirchner-Merten	ARFA 2019 ARW 2019	Working Paper

Table 1.1: Article Overview

Prior theoretical research highlights the dominance of two sets of books compared to the use of a single transfer price for internal decisions and tax reporting. However, empirical results indicate that the majority of firms keep one set of books. The first article entitled *When Do Firms Use One Set of Books in an International Tax Compliance Game?* presented in chapter 2 addresses the question of whether firms keep one set of books in equilibrium when a strategic tax auditor is considered. While former work typically starts when the accounting system is already in place, we endogenize the choice of one set of books or two sets of books in a two-stage game theoretic model. We show that keeping one set of books is part of an equilibrium strategy when tax audits are considered and the choice of two sets of books is seen as an indication for purely tax-induced decisions. Thus, the article contributes to prior research illustrating that a one set of books strategy might be the outcome of strategic interaction with the tax auditor instead of a practical simplification. Interestingly, firms' tax-aggressiveness decreases with an increasing tax rate differential because high profit shifting motives are anticipated by the strategically acting tax auditor and are therefore incorporated in the tax decision.

The the second article entitled *Transfer Pricing and Location Choice of Intangibles – Spillover and Tax Avoidance through Profit Shifting*, the third study *The Impact of Book-Tax Conformity on Reporting and Investment Behavior*, and the fourth article *International Transfer Pricing and Capacity Planning* address calls for more research to better understand how tax incentives affect firms' real investment decisions (Hanlon and Heitzman, 2010). The articles show that tax regulation influences firms' behavior in a non-trivial way. Consequently, the studies reveal that investigating solely reporting behavior in the context of profit shifting and related countermeasures seems myopic because unintended and detrimental effects can occur.

Since multinationals are often assumed to use transfer pricing of intangibles to shift profits to low-tax countries, the second article presented in chapter 3 investigates whether an intangible should be located in the division of the low-tax country or in the division of the high-tax jurisdiction. Locating intangibles in offshore divisions and corresponding royalty flows can generate tax savings. Nevertheless, empirical evidence reveals that intangibles exhibit a large 'home bias', i.e., intangibles are often located in the headquarters home country even though it is a high-tax jurisdiction. Whereas the empirical literature imputes this 'home bias' to legal requirements and enforcement, the second study identifies economic conditions for which an intangible should be optimally located in the high-tax country. In particular, for a high spillover and restrictions on tax avoidance, the intangible is optimally located in the high-tax country. This provides a theoretical explanation for the empirically documented 'home bias'. Moreover, the article shows that curtailing profit shifting possibilities can lead to increasing or decreasing investments in the intangible. Furthermore, the model predicts that a 'home bias' which occurs in response to economic

circumstances and not because of particularities of the tax regulation, is most likely larger for trademarks than for patents.

The third article presented in chapter 4 analyzes the effect of increasing book-tax conformity on firms' investment behavior and related reporting. An investment decision is incorporated in a standard tax inspection game. Increasing book-tax conformity deteriorates investment incentives. Nevertheless, depending on the level of baseline book-tax conformity increasing book-tax conformity can be either beneficial or detrimental for the tax authority's tax revenue depending on whether more or less understated tax reports occur in response to increasing book-tax conformity. Thus, the article shows that the effect of regulation regarding book-tax conformity is ambiguous and therefore highlights challenges governments and regulators face while designing regulations regarding mandatory book-tax conformity.

The research questions of the fourth article presented in chapter 5 are similar. The study investigates how multinationals adapt their investment decisions when tight transfer pricing regulation curbs the reporting discretion. When market uncertainty is prevalent, firms tend to hold an excessive capacity to fulfill the ex ante unknown demand. The arm's length principle and a tax rate differential increase this tendency because excessive capacity becomes less costly due to a tax-saving effect. Therefore, the fourth article identifies tax regulation as a potential antecedent for organizational slack and highlights that focusing on reporting aspects might be myopic in the light of tax regulation.

Chapter 2

When Do Firms Use One Set of Books in an International Tax Compliance Game?*

Abstract

We study how a strategic tax auditor affects a multinational company's choice of a transfer pricing regime. In the first stage, a firm with a production division in a low-tax country and a sales division in a high-tax country implements its transfer pricing regime. In a regime with one set of books, the unique transfer price coordinates the quantity decision and determines the tax payments. In a regime with two sets of books, different transfer prices are used. After observing its cost type in the second stage, the firm can report a compliant or a non-compliant transfer price. In the third stage, the tax auditor decides whether to conduct an audit. The penalty differences between the two transfer pricing regimes drive the first-stage implementation decision. The tax auditor's personal audit costs critically influence the firm's compliance decision in the second stage. In equilibrium, an increase in the tax rate difference induces less tax-aggressive behavior because it also increases the tax auditor's incentives. This is anticipated by the firm.

* This chapter is joint work with Katrin Weiskirchner-Merten (Vienna University of Economics and Business) and Stefan Wielenberg (Leibniz University Hanover)

2.1 Introduction

Transfer prices serve two purposes in a divisionalized multinational company (MNC). On the one hand, they are necessary to compute divisional profits to provide incentives for internal decisions. On the other hand, they also determine the tax profits of the divisions in the different countries. Previous research illustrates that MNCs may either keep one set of books (OSB) or two sets of books (TSB). A transfer pricing regime with OSB uses the same transfer price for both internal and tax purposes (Göx and Schiller, 2007; Nielsen and Raimondos-Møller, 2012). Under a regime with TSB, the MNC uses two separate transfer prices, one for each purpose. Springsteel (1999), for example, finds that 77 percent of a best-practice group of large companies choose TSB. In a recent survey study among U.S.-based MNCs, Klassen et al. (2017) report that 16.3% of firms calculate different transfer prices for different purposes.

This paper scrutinizes the transfer pricing decisions of an MNC. We concentrate on two important aspects. First, the choice between a regime with OSB or TSB is a long-term decision because of implementation, user training, and other organizational issues. The decision will not depend on or be revised due to changes in short-term operating conditions. Therefore, we model the transfer pricing decision as a two-stage process: In the first stage, the MNC decides between OSB and TSB. Then, after experiencing operating conditions, such as production cost, the concrete transfer prices are determined in the second stage.

An MNC's decision of whether to keep OSB or TSB is not only long term but also strategic. This is the second aspect addressed in our paper. Transfer prices are frequently used as a profit shifting device and as such are subject to rigorous surveillance by tax authorities, especially in high-tax countries. According to EY's Global Transfer Pricing Survey 2013, transfer pricing remains a central disagreement between MNCs and tax authorities. A tax audit of a transfer pricing regime is a costly task, and tax authorities are resource constrained. Therefore, we model the tax auditor (TA) as a strategic player who makes her audit decision after observing the reported transfer price used for tax purposes. During the investigation, the firm's transfer pricing regime becomes observable to the TA.

It is a widely reported fact that OSB and TSB have different consequences in the event of a non-compliant transfer price. Companies argue that implementing TSB will invite increased scrutiny by tax authorities (EY, 2003). Mills (1998) notes that book-tax differences create red flags for the IRS. She finds empirical evidence that the audit adjustments proposed by the IRS increase when the book-tax difference increases. The discovery of two different transfer prices during a tax audit can be interpreted in the same way. Two different prices lead to the suspicion that tax transfer prices are out of compliance with the arm's length principle. Finding TSB in a tax audit indicates that

the reported transfer price is solely caused by tax optimization. On the other hand, OSB creates evidence for a transfer price that is also driven by economic considerations (EY, 2003). Therefore, the penalty payment faced by an MNC in the event of detected non-compliance in a tax audit increases in the case of TSB.[1]

In summary, the MNC has to consider the following trade-off in the decision between OSB or TSB: OSB induces inefficient internal decisions and higher tax payments than TSB, because TSB allows for an appropriate internal transfer price and a tax transfer price (Nielsen and Raimondos-Møller, 2012). TSB, however, induces more serious consequences in the event of detected non-compliance and subsequent intervention by the TA (see, for example, Narayanan and Smith (2000, p. 507), Smith (2002, p. 224), and Martini (2015, p. 873)).

We examine the MNC's transfer pricing decisions in an incomplete information tax compliance game between the MNC and the TA. The MNC consists of a foreign production division in a low-tax jurisdiction and a domestic sales division in a high-tax country. On the one hand, the transfer price affects the quantity decision of the sales division's manager by internalizing the costs of the intermediate product obtained from the production division. In a world without taxes, the optimal transfer price is set equal to the marginal costs of the production division (Hirshleifer, 1956). On the other hand, in a world with taxes, a higher transfer price reduces the MNC's tax payments. In line with prior literature, we assume that a compliance range limits the tax transfer price accepted by tax authorities.

In the first stage of the game, the MNC decides between OSB and TSB. After observing the unit cost in the production division, the firm sets the internal transfer price and the tax transfer price in the second stage. Firms with low unit costs may have an incentive to use a non-compliant high transfer price to compute tax profits. Then, the tax transfer price is reported for both divisions and communicated to the tax authorities in the second stage. In the third stage, the tax authority may conduct a tax audit. We only consider the audit decision in the domestic high-tax country. In the event of detected non-compliance, the firm faces a penalty that depends on the transfer pricing regime. Having TSB is seen as an indication of pure tax optimization motives for non-compliance, and thus, penalties are larger than under OSB. We find that these penalties determine the first-stage decision between OSB and TSB. If the penalties for OSB and TSB are similar, an equilibrium exists in which the MNC will always implement a TSB regime. In this

[1] For example, Australia levies a penalty of 25%. This rate is reduced to 10% when the MNC can demonstrate that it has a reasonably arguable position and increased to 50% when the TA can demonstrate that the dominant purpose is tax avoidance (EY, 2012). In New Zealand, the penalties vary between 20% and 150% (EY, 2012). The applied rate depends on the degree of intent to avoid tax payments in the MNC's gross negligence. In Hong Kong, the scale of penalty imposed on a taxpayer is determined based on the nature of the omission, amount of understatement of income or profits, the scale of the business, the degree of the taxpayer's cooperation or disclosure, and the length of the offence period. Penalties can be scaled upwards or downwards based on such facts (EY, 2012). In Spain, the TA can reduce or eliminate the penalty when the MNC can demonstrate conformity (KPMG, 2012, p. 202).

case, the advantage of OSB compared to TSB diminishes, and the firm implements TSB because of the greater flexibility in internal coordination. The firm randomizes between OSB and TSB as the difference between the two penalties increases. However, there is no difference in the penalties for finding OSB or TSB such that the MNC always implements OSB in the first stage; this is because the OSB advantage in the event of non-compliance is irrelevant for the high-cost type in the second stage because the high-cost type always acts compliantly. Therefore, TSB will always be part of an equilibrium.

The transfer pricing decision in the second stage is essentially a choice between compliance and non-compliance for the low-cost MNC. We find that a low-cost MNC will always choose non-compliance if an OSB transfer pricing regime was previously implemented. Compliance under a TSB transfer pricing regime depends on the level of audit costs faced by the TA. At a low level of audit costs, the TA wants to conduct audits more frequently. Thus, the probability of detecting non-compliance increases, and the MNC will more often choose a compliant transfer price in equilibrium.

In addition, our findings show that a higher tax rate difference between the two countries decreases the probability of using TSB in a non-compliant way. This result initially appears counterintuitive because profit shifting should be especially important in a situation where the tax rate difference is high. The finding, however, is due to the strategic TA. High tax-saving possibilities caused by a large tax rate difference induce increased scrutiny incentives for the TA. The MNC anticipates this when making its transfer pricing decisions.

Transfer pricing is a well-investigated topic in the literature. However, prior research typically begins with the transfer pricing regime already having been chosen, i.e., after the decision of whether OSB or TSB are kept. This appears myopic because the MNC's transfer pricing regime is crucial to various decisions. For instance, the resulting production decisions, managerial compensation, investment decisions or tax planning might differ substantially. Rather than assuming the dominance of a specific transfer pricing regime, we endogenize this decision. We extend prior research (see, for example, Baldenius et al., 2004; Martini et al., 2012) by addressing the question of whether tax regulation and strategic TAs can affect the choice of keeping OSB or TSB. Our results support the empirical evidence that OSB and TSB coexist among MNCs.

The paper proceeds as follows. In the next section, we discuss the related literature. Then, the model is described, followed by a presentation and discussion of the equilibrium analysis in section 2.4. Section 2.5 concludes the paper.

2.2 Literature Review

A comprehensive overview of international transfer prices and their functions is provided by Sansing (2014). We focus on the literature that incorporates the trade-off between internal coordination and tax minimization. MNCs regularly incorporate differences in tax

and tariff rates as additional aspect of their transfer pricing decisions (see, for example, Schjelderup and Sorgard, 1997; Smith, 2002)).

Prior research has already shown that MNCs may use transfer prices as a device to shift profits from high- to low-tax jurisdictions (see, for example, Jacob, 1996; Clausing, 2003). In a recent empirical study Klassen et al. (2017) note that decoupled transfer prices are especially used by MNCs that pursue a tax minimization objective (instead of a tax compliance objective). The intuition for this result is straightforward. Keeping OSB necessarily entails a trade-off between the conflicting objectives of tax minimization and quantity distortion. Narayanan and Smith (2000) find that tax-adjusted marginal costs balance these conflicting objectives when using OSB. In a TSB setting, Baldenius et al. (2004) obtain a similar result. They show that tax-adjusted marginal costs should be used for internal purposes, while the external transfer price is straightforwardly the maximum of the compliance range accepted by the TA. However, these results ignore the potential case of non-compliance with the arm's length principle. Kant (1988), Smith (2002), Hyde and Choe (2005), and Choe and Hyde (2007) show that a corner solution is no longer straightforward when adjustments by the TA are taken into account. Furthermore, Eden et al. (2005) show that even the threat of transfer pricing penalties may have extensive impacts on the targeted firms. In addition, fiscal authorities have modernized to ensure the government a fair share of corporate taxes (Elliott and Emmanuel, 2000, p. 216). Despite numerous governments' efforts to secure higher tax payments, previous research has not regarded the TA as a strategic party. However, Cools and Emmanuel (2006) highlight the necessity of taking into account fiscal regulations as an endogenous variable.

Capuzzi (2010) notes that the TA and MNCs can use the arm's length principle to increase their incomes by interpreting it in their favor. Keuschnigg and Devereux (2013) have shown that MNCs' decisions are systematically distorted due to the application of the arm's length principle. However, they do not consider that detrimental distortions might be alleviated by keeping TSB. In addition, Samuelson (1982) finds that MNCs are able to manipulate the arm's length limits. Nevertheless, the arm's length principle is applied in nearly all countries with transfer pricing restrictions. Picciotto (1992) provides a detailed overview of arm's length implementation and its historical development. All of these papers take the decision of whether to keep OSB or TSB as given. By contrast, Nielsen and Raimondos-Møller (2012) do not. They investigate whether there might exist situations in which keeping OSB is preferable. However, their main research area is the field of interdependencies between the different transfer prices. By applying the formula apportionment approach, it is possible to obtain independence among different transfer prices (Hyde and Choe, 2005). However, Martini et al. (2012) demonstrate that under a formula apportionment approach, MNCs have incentives to shift the tax base by adjusting investment levels. In contrast, when not applying formula apportionment and thereby avoiding effects on investment levels, Martini et al. (2012) find that, MNCs use ex post

income shifting with separate entities and transfer prices. They conclude that neither the formula apportionment approach nor the separate entity approach is always preferable. Despite these advantages and disadvantages regarding the tax system, in almost all countries, the single entity approach is applied. Therefore, we restrict our attention to taxation in terms of the separate entity approach.

There is a strand of literature on the question of whether keeping OSB or TSB is optimal. In particular, only the strategic coordination literature examines the optimality of the different transfer pricing regimes. Schjelderup and Sorgard (1997), Arya and Mittendorf (2008), and Dürr and Göx (2011) investigate whether OSB or TSB is preferable under imperfect competition. In their studies, a single transfer price additionally serves as a commitment device to soften competition in external markets. The results depend substantially on whether competitors are able to observe the use of a single transfer price. The transfer pricing regime cannot be used to influence competitors when the number of books is unobservable. In contrast to this literature, we assume that the TA is not able to observe whether OSB or TSB has been chosen. None of these studies include a strategic TA in their considerations. Moreover, most of the existing research does not consider the possibility of tax audits. One exception is Diller and Lorenz (2016). They extend the work of Baldenius et al. (2004) by examining a strategic TA. In line with prior research, they take an MNC's decision of whether to keep OSB or TSB as given. They assume the superiority of keeping TSB because of the greater flexibility this approach offers.

2.3 Model Description

We consider an MNC operating in a low-tax jurisdiction and a high-tax jurisdiction. In contrast to prior research, we endogenize the MNC's choice of the transfer pricing regime while considering a strategic TA. In particular, we consider three stages. In the first stage, the MNC has to decide whether to keep OSB or TSB. Next, after observing the operating conditions, corresponding transfer prices are determined in the second stage. In the third stage, a TA in the high-tax country may detect the possibly non-compliant transfer price used by the MNC.

The MNC consists of a foreign production division and a domestic sales division. Specifically, the foreign division produces an intermediate product that is transformed into the final product by the domestic division. Without loss of generality, the domestic division's production costs are set equal to zero. There exists no external market for the intermediate product. The foreign division is located in a low-tax jurisdiction, where its income is taxed at rate t. Furthermore, the domestic division operates in a high-tax jurisdiction with income tax rate $t+h$, where $0 \leq t$, $h \leq 1$ and $t+h \leq 1$. The parameter h captures the tax rate difference between the low-tax and high-tax jurisdictions.

We assume taxation in terms of the source principle. Thus, the tax liability of each division is determined by the division's income. Hence, the MNC is interested in a high

reported transfer price for tax purposes to shift as much income as possible into the low-tax jurisdiction. We assume that each division has additional income such that the divisional after-tax income is always positive. However, the contribution of the internal trade to the after-tax income of the foreign division might be negative.

In the first stage of the game, the MNC has to decide whether to keep OSB or TSB. If OSB is chosen, the MNC uses a single transfer price for internal coordination and for tax purposes, i.e., the internal transfer price p_i equals the reported transfer price p_r. In the case of TSB, the MNC decouples its transfer pricing decisions and uses two different prices, i.e., $p_i \neq p_r$. The decision in the first stage is a long-term decision and takes place before cost uncertainty is resolved. We consider two possible states. The producing foreign division can face either high constant marginal costs c_H with probability β or low constant marginal costs c_L with probability $1-\beta$, where $0 < \beta < 1$ and $0 \leq c_L < c_H$. Both players know the ex ante probability β, but only the MNC observes the realization. The TA only observes the realized marginal cost in the event of an audit. The decision in the first stage is irreversible, i.e., cannot be changed upon observing the marginal costs. Thus, in the second stage of the game, the transfer pricing decision is based on the prior transfer pricing regime choice.

We consider a monopolistic setting with a revenue function $R(q) = \left(a - \frac{1}{2}q\right)q$, where q denotes the demanded quantity. The manager of the domestic division is evaluated on the basis of pre-tax divisional profit.[2] Considering the internal transfer price, the domestic sales division determines demand according to

$$q^D = \underset{q}{\operatorname{argmax}} \left\{ \Pi_D = \left(a - \frac{1}{2}q\right)q - p_i q \right\} = a - p_i. \tag{2.1}$$

In line with the OECD guidelines and the monopolistic setting, the transfer price is set using a cost-plus method. Under this transfer pricing method, marginal costs plus an appropriate markup fulfill the needs of the arm's length principle. Hence, the upper bound for the reported transfer price of a low-cost MNC is given by $\underline{p_r} = c_L + m_L$, where $m_L \geq 0$ captures the accepted markup. The appropriate markup for the high-cost type is m_H, yielding an upper bound $\overline{p_r}$. We assume m_H and m_L such that $\overline{p_r} > \underline{p_r}$. For the sake of convenient notation, we assume that the lower bound of the compliance rage is p_{rL} for both types, where $0 \leq p_{rL} < \underline{p_r} < \overline{p_r}$ holds. Thus, the arm's length compliance ranges are given by $\left[p_{rL}, \underline{p_r}\right]$ and $[p_{rL}, \overline{p_r}]$.

[2] Other authors assume that the divisions maximize their after-tax profits. This assumption is also ad hoc in the transfer pricing setting. Baldenius et al. (2004) explicitly highlight this fact and refer to the circumstance in which some firms evaluate their divisional managers on a pre-tax basis. For further discussion of the advantages of pre-tax vs. after-tax profit maximization for divisional performance measurement, see Nielsen and Raimondos-Møller (2012).

In the third stage, the TA has to decide whether to conduct an audit. The TA is located in the high-tax jurisdiction, i.e., in the home country of the domestic division.[3] We do not explicitly model the incentive problem between the tax authority and the TA. For the sake of simplicity, we assume that the incentive scheme is designed such that the TA is interested in maximizing the additional income that she generates for the tax authority. The TA faces personal audit costs K_a if she conducts an audit. Throughout the analysis, we assume that the audit costs are not prohibitively high.

We capture the TA's decision of whether to conduct an audit using a binary variable:

$$x_a = \begin{cases} 1 & \text{if an audit takes place,} \\ 0 & \text{if no audit is conducted.} \end{cases} \tag{2.2}$$

In line with the extensive documentation requirements imposed on MNCs, we assume that in the event of a tax audit, the TA observes the realized marginal costs, the transfer pricing regime (OSB or TSB), and in the case of TSB, the internally used transfer price.

In the event of detected non-compliance, the MNC will be forced to pay the previously saved tax liability plus a penalty. The saved tax liability is the difference between the tax payment based on the compliant transfer price enforced by the auditor (p_a) and the originally reported transfer price p_r. We assume that for a low-cost (high-cost) MNC, the enforced transfer price is $\underline{p_r}$ ($\overline{p_r}$). Moreover, the tax authority will levy an additional penalty, which is captured by a linear penalty factor $\delta \in \{\delta_{OSB}, \delta_{TSB}\}$, that is applied to the evaded tax (Yitzhaki, 1974).[4] In line with anecdotal findings and empirical evidence regarding book-tax conformity (Mills, 1998; EY, 2003, 2012; KPMG, 2012), we assume $1 \leq \delta_{OSB} < \delta_{TSB}$.

Hence, in the event of detected non-compliance, the MNC faces the following payment, depending on its transfer pricing regime:

$$S = (t+h)q\delta \cdot \max\{p_r - p_a, 0\}, \tag{2.3}$$

which comprises the intended tax evasion amount and the penalty. In the remainder of the paper, we refer to S as the penalty. Thus, the TA's decision problem can be written as

$$\max_{x_a \in \{0,1\}} \{x_A[E(S) - K_a]\}. \tag{2.4}$$

[3] We do not consider the TA in the low-tax jurisdiction. The foreign TA anticipates that profits will be shifted into her jurisdiction. In the event of a transfer pricing adjustment, double taxation occurs.

[4] In some jurisdictions, for example in the U.S., the enforced transfer price is the median of the arm's length compliance range. By assuming that the upper bound of the compliance range is enforced, we do not take into consideration the additional punishment from enforcing the median instead of the upper bound. We capture the whole penalty by the penalty factor δ.

The headquarters is interested in the global after-tax profit. Hence, the headquarters incorporates both tax savings due to tax rate differences and possibly resulting penalties. Thus, the headquarters maximizes

$$\Pi^{MNC} = q\left[(1-t-h)\left(a-\frac{1}{2}q\right)-(1-t)c+hp_r\right]-S. \tag{2.5}$$

The timing of the game is depicted in figure 2.1.

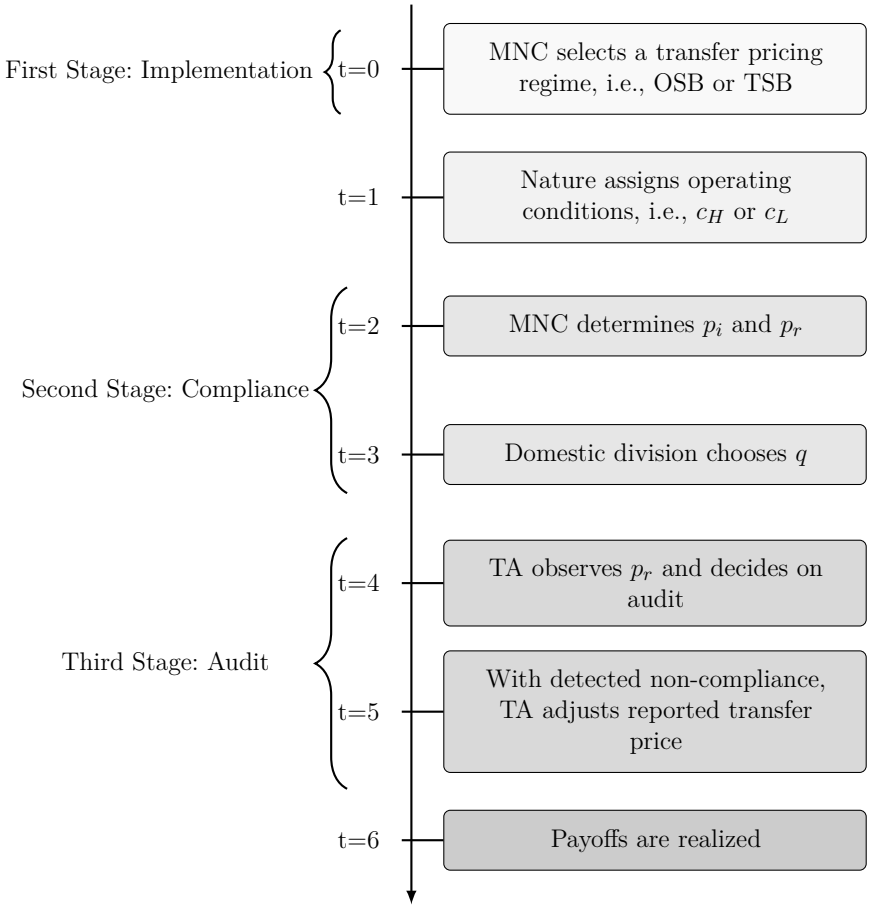

Figure 2.1: Timeline

2.4 Equilibrium Analysis

The TA's auditing decision takes place after the MNC has sent its transfer pricing report. Nevertheless, the decisions in both stages may be seen as strategically 'simultaneous' in the sense that the TA only observes the outcome of the chosen reporting strategy. The strategy itself remains concealed (Crawford and Sobel, 1982, p. 1433), but the reported transfer price p_r is a signal to the auditor. Thus, we apply the weak perfect Bayesian equilibrium (PBE) concept. Generally, the MNC's transfer pricing decision is a continuous decision, as the firm may choose an arbitrary $p_r, p_i > 0$. In the following, we argue

that the MNC will have to consider a very restricted set of potential transfer prices. We discuss the tax transfer price first.

A transfer price $p_r > \overline{p_r}$ is unambiguous evidence of non-compliance for the TA even without any tax audit. We assume that the TA punishes obvious non-compliance without facing substantial audit costs because such obvious tax evasion is beyond dispute. Hence, $p_r > \overline{p_r}$ will never be reported. Therefore, type c_H will always use a compliant transfer price p_r. Moreover, in the case of TSB, p_r will be set equal to $\overline{p_r}$ to minimize tax payments. This is not necessarily true for OSB because the trade-off between quantity distortion and tax savings has to be considered. However, we show that for a large prohibitive price a, the high reported transfer price $\overline{p_r}$ is also optimal under OSB. To see this, suppose that an MNC of type c_H has installed an OSB transfer pricing regime. Then, headquarters maximizes its expected profits by determining a transfer price:

$$\frac{\partial \Pi^{MNC}}{\partial p_r} = (1-t-h)(-p_r) + (1-t)c_H + ah - 2hp_r = 0$$

$$\iff p_r = \frac{1}{1-t+h}\left[(1-t)c_H + ah\right] \geq \overline{p_r}$$

for sufficiently large a. Thus, to remain compliant, the high-cost type chooses $\overline{p_r}$. The low-cost type may choose a non-compliant transfer price. As the TA anticipates that a high-cost MNC always reports $\overline{p_r}$, reporting a transfer price in the range $[\underline{p_r}, \overline{p_r})$ immediately identifies the MNC as a low-cost type. Therefore, the non-compliant MNC will choose $p_r = \overline{p_r}$ in the cases of OSB and TSB. If the MNC decides to be compliant and not to mimic the high-cost type, it chooses to report the highest possible arm's length price $\underline{p_r}$. Analogously, as shown for the high-cost type, a large enough prohibitive price ensures that $\underline{p_r}$ is also optimal under OSB. Lemma 2.1 summarizes.

Lemma 2.1. *Suppose a large prohibitive price a.*

1. *An MNC of type c_H sets the compliant transfer price $p_r = \overline{p_r}$ in the cases of TSB and OSB.*
2. *A non-compliant MNC of type c_L sets $p_r = \overline{p_r}$ in the cases of TSB and OSB.*
3. *A compliant MNC of type c_L sets $p_r = \underline{p_r}$ in the cases of TSB and OSB.*

Proof. See appendix. □

Essentially, lemma 2.1 states that the tax transfer pricing decision for the MNC reduces to the set $\{\underline{p_r}, \overline{p_r}\}$.

With TSB, the internal transfer price includes an adjustment of marginal costs. In particular, the MNC uses tax-adjusted marginal costs as the internal transfer price in the compliance case. This price induces the domestic sales division to make the optimal quantity decision. This matches the findings of Baldenius et al. (2004). In the non-compliance

case, the MNC additionally considers the potential costs following a transfer pricing audit. Hence, by considering a strategic TA, tax- and audit-adjusted marginal costs are used for internal optimization. This finding is summarized in lemma 2.2. Note that η denotes the TA's audit probability.

Lemma 2.2. *Suppose that the MNC has installed a TSB regime in the first stage.*

1. *In the case of a non-compliant transfer price being reported by the low-cost type, the possible penalty due to detection is incorporated for internal coordination:*

$$p_{i1} = \frac{1}{1-t-h}\left[(1-t)c_L - h\overline{p_r} + \eta\delta_{TSB}(t+h)(\overline{p_r} - \underline{p_r})\right]. \tag{2.6}$$

2. *In the case of a compliant tax transfer price, tax-adjusted marginal costs c_j, $j = H, L$ are adopted for internal coordination:*

$$p_{iH} = \frac{1}{1-t-h}\left[(1-t)c_H - h\overline{p_r}\right] \tag{2.7}$$

and

$$p_{i2} = \frac{1}{1-t-h}\left[(1-t)c_L - h\underline{p_r}\right].$$

Proof. See appendix. □

Finally, we consider the TA. She will never audit a tax transfer price $p_r \leq \underline{p_r}$, because the MNC will always be compliant.

The game tree depicted in figure 2.2 displays those strategies for the MNC and TA that are not dominated.

The game described above is an extended inspection game in which inspection decisions depend on the reported transfer price. Pure strategy equilibria will exist for extremely high or low audit costs in combination with low or high penalty payments for detected non-compliance. In such cases, the MNC will select TSB or OSB in stage 1 and then always or never choose a compliant transfer price in stage 2, and the TA never or always chooses to audit the MNC. We are not interested in such equilibria, because they cannot explain why compliance and non-compliance as well as non-trivial tax audit strategies can simultaneously be observed in reality. Therefore, we concentrate on mixed strategy equilibria. In our game, randomization may appear at three stages of the game tree: (1) The MNC may randomize between TSB and OSB in the implementation stage. We denote the corresponding probability by τ. (2) After observing its cost type in the compliance stage, the low-cost MNC may choose the non-compliant transfer price $\overline{p_r}$ with probability λ and the compliant price $\underline{p_r}$ with probability $1-\lambda$. (3) In the audit stage, the TA decides whether to conduct an audit (probability η) or not (probability $1-\eta$).

In a mixed strategy equilibrium, the players have to be indifferent among all the strategies that are played with a non-zero probability in equilibrium. That implies an equal

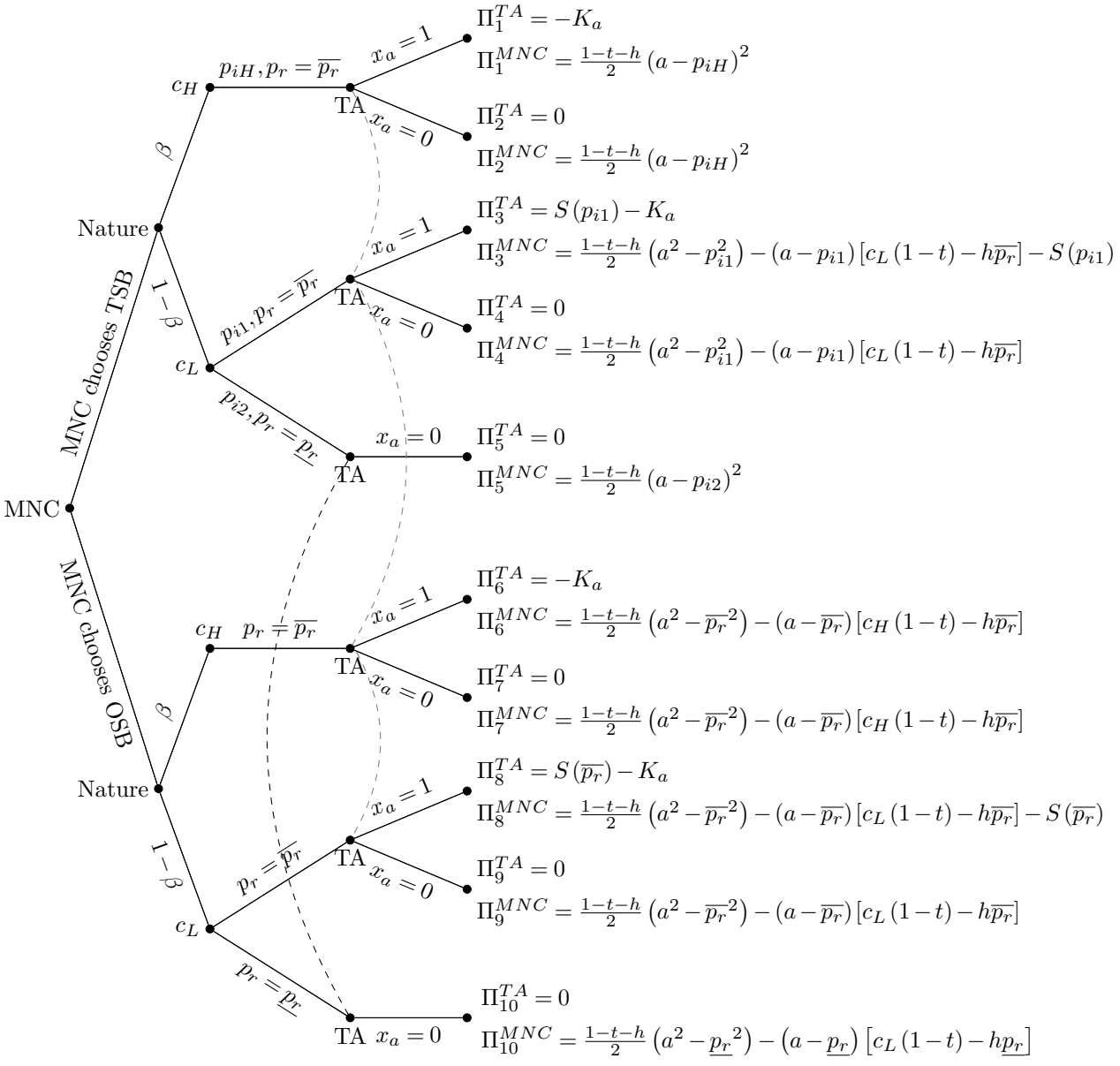

Figure 2.2: Game tree without dominated strategies

payoff for all these strategies. In our two-player game, payoff equality between the MNC's equilibrium actions is achieved by the TA's audit probability following a reported transfer price $\overline{p_r}$. Note that the MNC encounters two decisions in two stages. Randomization in both stages requires indifference both between the two implementation options and between compliance and non-compliance. However, the TA has only one decision variable to induce indifference. Therefore, randomization by the MNC will appear in only one of the two stages in equilibrium. In the following, we separately discuss equilibria with (1) deterministic implementation and random compliance and (2) random implementation and deterministic compliance decisions.

The first proposition considers equilibria in which the low-cost MNC randomizes between compliance and non-compliance. In equilibrium, TSB will be implemented in the first stage of the game.

Proposition 2.1 (Deterministic implementation and random compliance)**.** *Suppose that* $\delta_{OSB} \geq \overline{\delta}_{OSB}$ *and* $K_a < K_{a2}(\eta_1)$*. Then, the only equilibrium with deterministic implementation and random compliance is given by the following actions:*

- *The MNC always implements TSB. The low-cost type randomizes between compliance and non-compliance. The non-compliant reported transfer price, i.e.,* $\overline{p_r}$*, is chosen with probability* $\lambda_{TSB,I}$*. The high-cost type always chooses the compliant transfer price* $\overline{p_r}$*.*

- *The TA audits the high reported transfer price* $\overline{p_r}$ *with audit probability* η_I*.*

Proof. All proofs, equilibrium probabilities, and thresholds are stated in the appendix. □

The deterministic implementation of TSB is an equilibrium strategy for an OSB penalty factor close to the TSB penalty factor. In this case, the net benefit of reporting a non-compliant transfer price in an OSB transfer pricing regime compared to a non-compliant transfer price in a TSB transfer pricing regime is small because of the quantity distortion under OSB. In this situation, the MNC randomizes between compliance and non-compliance. The equilibrium will not occur for an OSB penalty factor that is relatively low compared to the TSB penalty factor because then the MNC prefers to deviate to OSB.

However, we will not observe an equilibrium with deterministic implementation of OSB and randomization in the compliance stage. The argument is as follows: Suppose that the MNC has implemented OSB and experiences c_H. In this case, compliance is the dominant action, and the MNC realizes the payoff under OSB and compliance (Π_6^{MNC}). This payoff is smaller than the payoff under TSB and compliance (Π_1^{MNC}) because of the quantity distortion. When observing c_L, the MNC would randomize between compliance and non-compliance. Payoff equality requires an equilibrium audit probability such that the expected payoff to the low-cost type is equal to the payoff under OSB and compliant

reporting (Π_{10}^{MNC}). Again, this payoff is lower than the payoff under TSB and compliant reporting. Thus, deterministic implementation of TSB and deterministic compliance dominates deterministic implementation of OSB and random compliance.

As a result, we will only observe equilibria with OSB as part of a randomized implementation decision in the first stage of the game. The second proposition regards the case of random implementation and deterministic compliance and shows that two equilibria can occur.

Proposition 2.2 (Random implementation and deterministic compliance)**.** *Suppose that $K_a < K_{a1}(\delta_{OSB})$. Then, the following actions constitute an equilibrium:*

- *The MNC implements TSB with probability τ_{II} and OSB with probability $1-\tau_{II}$. The low-cost MNC reports the compliant transfer price $\underline{p_r}$ under TSB and the non-compliant transfer price $\overline{p_r}$ under OSB. The high-cost MNC reports the compliant transfer price $\overline{p_r}$.*

- *The TA conducts an audit upon observing the high reported transfer price $\overline{p_r}$ with probability η_{II}.*

Suppose that $K_{a1}(\delta_{OSB}) < K_a < K_{a2}(\eta_{III})$. Now, the equilibrium actions are as follows:

- *The MNC chooses TSB with probability τ_{III} and OSB with probability $1-\tau_{III}$. The low-cost MNC chooses the non-compliant transfer price $\overline{p_r}$ under TSB and under OSB. The high-cost MNC reports the compliant transfer price $\overline{p_r}$.*

- *The TA audits the high reported transfer price $\overline{p_r}$ with probability η_{III}.*

Proof. All proofs, equilibrium probabilities, and thresholds are stated in the appendix. □

Note that the two equilibria described above are the only equilibria with deterministic compliance or non-compliance. The low-cost MNC always chooses to be non-compliant under OSB because the combination of a compliant transfer price and OSB will imply a lower payoff than a compliant transfer price and TSB. Therefore, payoff equality between OSB and TSB as required in the implementation stage will never be achieved with OSB and deterministic compliance. Moreover, an equilibrium with compliance under OSB and non-compliance under TSB will not exist because the MNC would deviate to a compliant transfer price under TSB.

Furthermore, the proposition shows that the audit costs critically influence the decision between compliance and non-compliance. In the case of low audit costs, the MNC chooses OSB with the non-compliant transfer price and TSB with the compliant transfer price. Due to the low audit costs, the MNC expects frequent tax audits. Hence, it balances the conflicting objectives while considering possible transfer pricing adjustments and penalties. The non-compliant use of OSB realizes tax savings. The compliant use

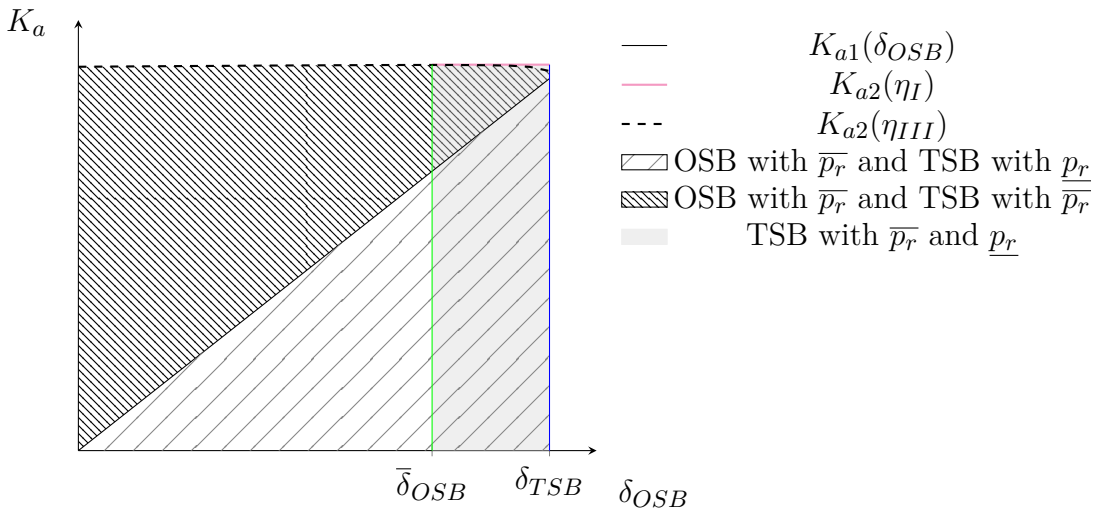

Figure 2.3: Equilibrium areas depending on K_a and δ_{OSB}. The strategies are depicted for the low-cost MNC. (plotted for $a = 10.000$, $c_H = 100$, $c_L = 60$, $t = 0.2$, $h = 0.1$, $\beta = 0.8$, $\underline{p_r} = 70$, $\overline{p_r} = 120$, $\delta_{TSB} = 1.2$.

of TSB yields the optimal quantity decision given the reported transfer price, while tax payments are minimized within the legal boundaries. In the case of high audit costs, tax audits are infrequent, and reporting the non-compliant transfer price dominates in the second stage even in the case of TSB. Although the low-cost type always prefers non-compliant reporting in the second stage, neither OSB nor TSB will be dominated in the first stage. OSB implies lower penalties in the event of detection for the low-cost type, and both types benefit from separating internal and external transfer prices under TSB.

Figure 2.3 summarizes the equilibria discussed above.

The figure shows that the equilibrium in our game is unique if the penalty parameter δ_{OSB} is low. In this case, the MNC randomizes between TSB and OSB, and the audit costs determine the compliance decision of the low-cost type under TSB. We observe that the critical value $K_{a1}(\delta_{OSB})$ increases in δ_{OSB}. This means that the most tax-aggressive equilibrium with non-compliant reporting under OSB and TSB especially appears if δ_{OSB} is low. This is also intuitive: A lower penalty factor under OSB decreases the TA's incentives. To keep the TA indifferent between auditing and not auditing, the audit costs K_a also have to decrease. For higher penalty factors, the random implementation equilibria coexist with the deterministic implementation equilibrium.

We now analyze the influence of the tax rate difference between the two countries. This question is especially interesting in the case of TSB because the tax rate difference directly and indirectly affects (1) the internal transfer price, (2) the audit probability, (3) the implementation probability, and (4) the compliance probability.

At first glance, a higher tax rate difference should make TSB with non-compliant reporting more attractive, because the possible gains from tax aggressiveness become

larger. However, we show that the opposite is true. The MNC tends to refrain from the non-compliant use of TSB given an increase in the tax rate difference. To understand this counterintuitive finding, we provide the intuition in two steps. First, we consider the impact of an increasing tax rate difference on the internal transfer prices and the audit probability. Second, we illustrate the effect on the implementation and compliance probabilities.

We begin with the discussion of the internal transfer prices in the case of compliant reporting. As stated in lemma 2.2, the internal transfer price for an MNC with marginal costs c_j, $j = H, L$, and compliant reporting is:

$$p_i = \frac{1}{1-t-h}\left[(1-t-h)c_j - hm_j\right].$$

An increase in the tax rate difference makes profit shifting to the low-tax country more attractive. With TSB, the MNC's reported transfer price is set solely to optimize the tax payments. Thus, the higher profit-shifting incentives are incorporated by lowering the internal transfer price, which induces the MNC of type c_j with $j = H, L$ to increase the quantity. That is, a higher tax rate difference results in lower tax-adjusted marginal costs for internal coordination:

$$\frac{\partial p_i}{\partial h} = (-1)\frac{1}{(1-t-h)^2}\left[(1-t)m_j\right] < 0.$$

This has an indirect effect on the MNC's expected profit. The price per unit sold externally decreases as the contribution margin per unit sold decreases. However, for a larger tax rate difference, the decrease in the contribution margin is outweighed by the positive effect of a higher quantity because the benefit from separating internal coordination and external reporting increases. In other words, inflating the external market reduces the revenue gained. Nevertheless, the net income of the MNC increases due to reduced tax liability.

Next, we consider the internal transfer price in the case of non-compliant reporting behavior (see lemma 2.2):

$$p_{i1} = \underbrace{\frac{1}{1-t-h}\left[(1-t)c_L - h\overline{p_r}\right]}_{\text{tax-adjustment}} + \underbrace{\frac{1}{1-t-h}\left[\eta\delta_{TSB}(t+h)(\overline{p_r} - \underline{p_r})\right]}_{\text{audit-adjustment}}.$$

Comparing the internal transfer price for compliant reporting behavior with the internal transfer price in the case of non-compliant reporting behavior reveals that lowering the tax adjustment of marginal costs due to an increasing tax rate difference occurs independent of the MNC's compliance.

In addition, an MNC non-compliantly using TSB considers the impact of a higher tax rate difference on the audit adjustment part because this is incorporated into the

internal transfer price. The effect is twofold. First, a higher tax rate difference directly increases the audit-adjustment part. However, as stated in the appendix, the reduced tax adjustment outweighs the increase in the audit adjustment. In sum, the direct effect of an increasing tax rate difference on the internal transfer price under non-compliant reporting is negative. Second, an increase in the tax rate difference affects the TA's audit probability η, which then influences the audit adjustment in the internal transfer price in the case of non-compliant reporting. Specifically, consider the direct and the indirect effect of an increasing tax rate difference on the penalty S. An increase in the tax rate difference directly increases the penalty S. Moreover, as described above, a higher tax rate difference directly decreases the internal transfer prices and, thus, leads to a higher produced and sold quantity q. This also leads to a higher penalty S.

In the deterministic implementation equilibrium with random compliance, a higher penalty affects only non-compliant reporting. However, the increasing quantity also affects the MNC's profit in the case of compliance. In sum, the quantity effect exceeds the increasing penalty such that profit shifting becomes especially attractive. This is anticipated by the TA and leads to more frequent audits. That is, η_I is increasing in the tax rate difference h, $d\eta_I/dh > 0$.

In the random implementation equilibrium with deterministic non-compliance, the threat of an increasing penalty harms both equilibrium strategies because the low-cost type always reports non-compliantly. However, the benefits of an increasing quantity can only be realized by keeping TSB, so that in total, a higher penalty decreases profit shifting incentives. Thus, a decreasing audit probability ensures the MNC's indifference condition, i.e., $d\eta_{III}/dh < 0$.

In both the deterministic implementation equilibrium with random compliance and the random implementation equilibrium with deterministic non-compliance, the sum of the direct and the indirect effect of an increasing tax rate difference on the non-compliant internal transfer price is negative. That is, for both compliant and non-compliant MNCs using TSB, a higher tax rate difference results in a lower internal transfer price and a higher quantity q. The findings described above are summarized in proposition 2.3.

Proposition 2.3. *In the deterministic implementation equilibrium with random compliance, an increase in the tax rate difference h increases the TA's audit probability, i.e., $d\eta_I/dh > 0$. In the random implementation equilibrium with deterministic non-compliance, an increase in the tax rate difference h decreases the TA's audit probability, i.e., $d\eta_{III}/dh < 0$. With TSB, an increase in the tax rate difference h decreases the internal transfer prices and, thus, increases the quantity q produced and sold by the MNC.*

Proof. See appendix. □

Next, we consider the MNC's willingness to keep TSB with non-compliant reporting. Reconsider the impact of a higher tax rate difference on the penalty S. A higher penalty

implies higher scrutiny incentives for the TA. In equilibrium, the MNC anticipates this and reduces the probability of tax-aggressive behavior to keep the expected penalty at the same level. This is true for all equilibria in which the non-compliant use of TSB is part of an equilibrium strategy. Hence, both the probability of reporting non-compliantly in the case of the deterministic implementation of TSB ($\lambda_{TSB,I}$) and the probability of implementing TSB in the equilibrium with stochastic implementation and deterministic non-compliant reporting (τ_{III}) are decreasing in the tax rate difference. That is,

$$\frac{d\lambda_{TSB,I}}{dh} = \underbrace{\frac{\partial \lambda_{TSB,I}}{\partial h}}_{<0} + \underbrace{\frac{\partial \lambda_{TSB,I}}{\partial p_{i1}}}_{>0} \cdot \underbrace{\frac{dp_{i1}}{dh}}_{<0} < 0$$

and

$$\frac{d\tau_{III}}{dh} = \underbrace{\frac{\partial \tau_{III}}{\partial h}}_{<0} + \underbrace{\frac{\partial \tau_{III}}{\partial p_{i1}}}_{>0} \cdot \underbrace{\frac{dp_{i1}}{dh}}_{<0} < 0$$

depending on the prevailing equilibrium. The findings are summarized in proposition 2.4.

Proposition 2.4. *Given a positive probability of tax-aggressive behavior, the probability of keeping TSB with the non-compliant transfer price $\overline{p_r}$ decreases following an increase in the tax rate difference h.*

Proof. See appendix. □

This result is in line with the empirical finding of Chan and Chow (1997) that high tax rate differences are not crucial for the inducement of transfer pricing manipulations. Nevertheless, their work demonstrates that the TA is aware of an MNC's profit shifting incentives. She assesses how likely an MNC is to engage in transfer pricing manipulations. This assessment depends on the profit shifting incentives for the MNC. Thus, accounting for the strategic interaction between the TA and the MNC leads to less manipulation in the case of an increasing tax rate difference.

2.5 Conclusion

Prior research has demonstrated that keeping OSB in markets with imperfect competition might become optimal despite the MNC's reduced flexibility in optimizing both internal decision making and tax payments (see, for example, Arya and Mittendorf, 2008; Dürr and Göx, 2011). However, these results depend crucially on whether competitors are able to observe when one transfer price is used to align conflicting objectives. We argue that strategic considerations in a tax compliance game are another explanation for the implementation of OSB. In our setting, the MNC faces a trade-off between flexibility and expected penalty payments. By keeping TSB, an MNC can separately induce the optimal quantity decision and minimize tax payments. However, a unique transfer price

used for internal and tax purposes will reduce penalty payments in the event that non-compliance is detected by the tax auditor. We show that the implementation of OSB together with non-compliant reporting is part of the equilibrium whenever the penalty difference between TSB and OSB is large.

Based on our equilibrium analysis, we investigate the consequences of the tax rate difference between the foreign and the domestic country. The findings show that when this parameter increases, an MNC's tax aggressiveness decreases. Specifically, we find that the probability of keeping non-compliant TSB decreases given an increase in the tax rate difference between the high-tax and the low-tax jurisdiction. This result is directly induced by the strategic TA: On the one hand, as expected, a high tax rate difference yields a high tax-savings potential for the MNC. By keeping TSB with a non-compliant transfer price, the MNC can exploit the high tax rate difference by shifting profits to the low-tax country. However, the TA is aware of the MNC's incentive to shift profits. Thus, the high tax-savings potential increases the TA's audit incentives. As a consequence, with an increasing tax rate difference, profit shifting becomes riskier, more expensive, and thus less attractive for the MNC. Then, the MNC increasingly refrains from keeping non-compliant TSB and deviates to compliant reporting or implementing OSB in the first stage.

These results highlight that tax regulation and tax enforcement affect taxpayer behavior in a non-trivial way. In particular, an MNC's choice of keeping OSB versus TSB and the related potential tax-saving behavior can be influenced by tax legislation and enforcement. This paper illustrates that the level of audit costs of the TA and the penalty factors applied in the event of detected non-compliance determine the MNC's tax-related equilibrium behavior. As a consequence, in addition to MNCs, the findings are highly relevant for a number of institutional players, for example, legislators, tax authorities, and supranational units such as the EU and the OECD.

2.6 Appendix

Proof of Lemma 2.1

The possible strategies are depicted in figure 2.4.

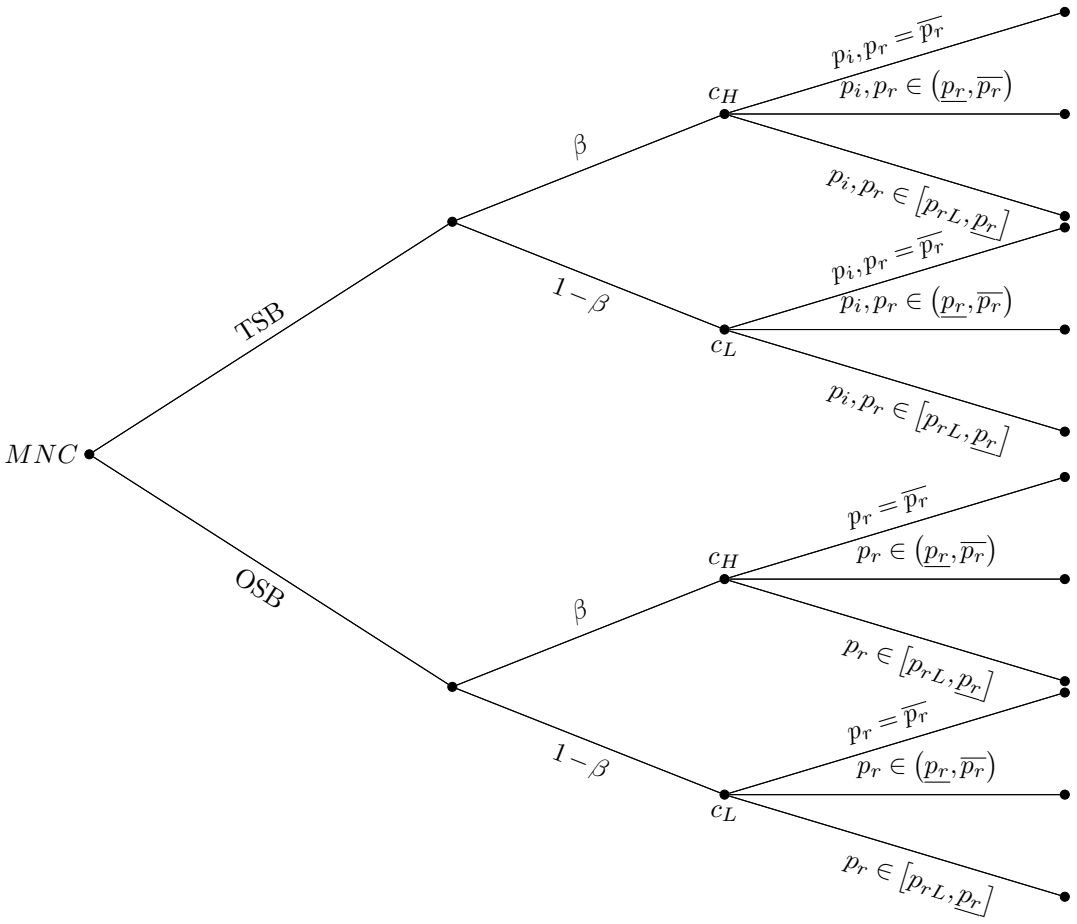

Figure 2.4: Possible strategy choices for an MNC with marginal costs c_j, where $j = H, L$

The following strategies are dominated:

- When the MNC reports $p_r = \underline{p_r}$, the MNC incurs the highest possible tax payments. Thus, a tax audit cannot result in additional tax revenues. Consequently, the TA never audits the reported transfer price $\underline{p_r}$.
- For $p_r > \overline{p_r}$, is an unambiguous signal of tax evasion which is punished without costs. Thus, setting $p_r > \overline{p_r}$ is never chosen by the MNC.
- The TA cannot generate any additional tax revenues in a tax audit when the MNC is of type $c = c_H$ and chooses a $p_r \leq \overline{p_r}$. The high-cost MNC minimizes the tax payments by setting $p_r = \overline{p_r}$ in case of TSB.

- For a high prohibitive price a, the MNC of type $c = c_H$ keeping OSB prefers the transfer price $p_r = \overline{p_r}$. Suppose an MNC of type c_H has installed a OSB transfer pricing regime. Then, headquarters maximizes its expected profit determining a transfer price:

$$\frac{\partial \Pi^{MNC}}{\partial p_r} = (1-t-h)(-p_r) + (1-t)c_H + ah - 2hp_r = 0$$

$$\iff p_r = \frac{1}{1-t+h}\left[(1-t)c_H + ah\right] \geq \overline{p_r}$$

for sufficiently large a. Thus, in order to stay compliant the high-cost type chooses $\overline{p_r}$. We assume throughout the paper, that a is sufficiently large.

- For TSB with a $p_r \in \left(\underline{p_r}, \overline{p_r}\right)$, the MNC of type $c = c_L$ prefers one of the not included corner solutions. Thus, using $p_r = \overline{p_r}$ ($p_r = \underline{p_r}$) strictly dominates the use of a p_r close to $p_r = \overline{p_r}$ ($p_r = \underline{p_r}$).

- For a high prohibitive price a, the MNC of type $c = c_L$ keeping OSB prefers the transfer price $p_r = \overline{p_r}$ or $p_r = \underline{p_r}$ to any $p_r \in \left(\underline{p_r}, \overline{p_r}\right)$.

  Suppose an MNC of type c_L has installed a OSB transfer pricing regime and wants to choose a compliant reported transfer price $p_r \leq \underline{p_r}$. Then, headquarters maximizes its expected profit determining a transfer price:

$$\frac{\partial \Pi^{MNC}}{\partial p_r} = (1-t+h)(-p_r) + (1-t)c_L + ah = 0$$

$$\iff p_r = \frac{1}{1-t+h}\left[(1-t)c_L + ah\right] \geq \underline{p_r}$$

  for sufficiently large a. Thus, in order to stay compliant the low-cost type chooses $\underline{p_r}$.

  Suppose an MNC of type c_L has installed a OSB transfer pricing regime and implements a reported transfer price $\underline{p_r} \leq p_r \leq \overline{p_r}$. Then, headquarters maximizes its expected profit determining a transfer price:

$$\frac{\partial \Pi^{MNC}}{\partial p_r} = (1-t+h-2\eta(t+h)\delta_{OSB})(-p_r) + (1-t)c_L + ah - \eta(t+h)\delta_{OSB}(a+\underline{p_r}) = 0$$

$$\iff p_r = \frac{1}{1-t+h-2\eta(t+h)\delta_{OSB}}\left[(1-t)c_L + ah - \eta(t+h)\delta_{OSB}(a+\underline{p_r})\right]$$

$$\frac{\partial^2 \Pi^{MNC}}{\partial p_r^2} = (1-t+h-2\eta(t+h)\delta_{OSB})(-1)$$

$\frac{\partial^2 \Pi^{MNC}}{\partial p_r^2}$ is negative for $\delta_{OSB} < \frac{1-t+h}{2\eta(t+h)}$. That is, for a $\delta_{OSB} > \frac{1-t+h}{2\eta(t+h)}$ the first order condition determines a local minimum and the MNC prefers a corner solution. Suppose $\delta_{OSB} < \frac{1-t+h}{2\eta(t+h)}$ so that the first order condition determines a local maximum. For a sufficiently large a, the MNC's FOC does not determine a p_r in the interval $[\underline{p_r}, \overline{p_r}]$. Therefore, the MNC prefers a corner solution. □

Proof of Lemma 2.2

This proof is organized in two steps. First, the case is considered in which the MNC reports a compliant transfer price under TSB. Second, the case is considered in which a low-cost MNC mimics a high-cost MNC.

Step 1: For an MNC of type c_j with $j = H, L$, the TA does not contest a reported transfer price that belongs to the range $[p_{rL}, \overline{p_r}]$ or $\left[p_{rL}, \underline{p_r}\right]$, respectively. Thus, the MNC's profit with marginal costs c_j is determined by

$$\Pi^{MNC}(p_i, p_r) = (a - p_i)\left[(1-t-h)\left(a - \frac{1}{2}(a-p_i)\right) - (1-t)c_j + hp_r\right]. \tag{2.8}$$

The FOC of equation 2.8 with respect to p_r is $(a - p_i)h > 0$. The Hessian matrix of equation 2.8 is not strictly definite. Hence, the MNC prefers to set p_r as large as possible, i.e., $\overline{p_r}$ ($\underline{p_r}$) for $c_j = c_H$ ($c_j = c_L$).

$$FOCp_i : -(1-t-h)p_i + (1-t)c_j - hp_r = 0$$

$$SOCp_i : -(1-t-h) < 0$$

Thus, the FOC for p_i determines a local maximum:

$$p_i = \frac{1}{1-t-h}\left[(1-t)c_j - hp_r\right].$$

Step 2: For an MNC of type c_L, the TA might want to contest a reported transfer price that belongs to the range $\left(\underline{p_r}, \overline{p_r}\right]$. Then, the MNC's profit is determined by

$$\Pi^{MNC}(p_i, p_r) = (a - p_i)\left[(1-t-h)\left(a - \frac{1}{2}(a-p_i)\right) - (1-t)c_L + hp_r\right] \tag{2.9}$$

$$-\eta\delta_{TSB}(t+h)(a-p_i)(p_r - \underline{p_r}).$$

The FOC of equation 2.9 with respect to p_r is $(a - p_i)\left[h - \eta\delta_{TSB}(t+h)\right]$. The Hessian matrix of equation 2.9 is not strictly definite. Hence, the MNC prefers to either set p_r as large or as small as possible. The case in which the MNC wants to set a small transfer price is already described in step 1. Thus, we next consider the case in which $\overline{p_r}$ is preferred.

$$FOCp_i : -(1-t-h)p_i + (1-t)c_L - h\overline{p_r} + \eta\delta_{TSB}(t+h)(\overline{p_r} - \underline{p_r}) = 0$$

$$SOCp_i : -(1-t-h) < 0$$

Thus, the FOC for p_i determines a local maximum:

$$p_i = \frac{1}{1-t-h}\left[(1-t)c_L - h\overline{p_r} + \eta\delta_{TSB}(t+h)(\overline{p_r} - \underline{p_r})\right].$$

□

Proof of Proposition 2.1 and 2.2

Let ρ be the TA's belief that an MNC reporting a high transfer price, $p_r = \overline{p_r}$, has high marginal costs, $c = c_H$. In addition, τ is the randomized strategy of the MNC regarding the transfer pricing regime. τ $(1-\tau)$ denotes the MNC's chosen probability to keep TSB (OSB). λ_{TSB} $(1-\lambda_{TSB})$ is the low-cost MNC's chosen probability to report the non-compliant (compliant) transfer price $\overline{p_r}$ $(\underline{p_r})$ when TSB are kept. λ_{OSB} $(1-\lambda_{OSB})$ is the low-cost MNC's chosen probability to report the non-compliant (compliant) transfer price $\overline{p_r}$ $(\underline{p_r})$ when OSB is kept. When observing a high reported transfer price $p_r = \overline{p_r}$, the TA chooses to (not) conduct an audit with probability η $(1-\eta)$. Note that an MNC with $c = c_H$ always reports the transfer price $p_r = \overline{p_r}$ and the TA never audits a low reported transfer price $p_r = \underline{p_r}$.

Proof of Proposition 2.1

We focus on mixed strategy equilibria. In a mixed strategy equilibrium the players have to be indifferent among all the strategies that are played with a non-zero probability in equilibrium. That implies an equal payoff for all these strategies. In our two player game, payoff equality between the MNC's equilibrium actions is achieved by the TA's audit probability following a reported transfer price $\overline{p_r}$. Note that the MNC makes two decisions at two stages. Randomization at both stages requires indifference between the two implementation options and between compliance and non-compliance at the same time. However, the TA has only one decision variable to induce indifference. Therefore, randomization by the MNC will appear at only one of the two stages in equilibrium.

First, consider randomization between compliance and non-compliance for the low-cost type when the MNC keeps OSB. The low-cost MNC randomizes between compliance and non-compliance if and only if, the expected profit of these two strategies are the same:

$$E\left[\Pi \mid c = c_L, OSB, p_r = \overline{p_r}\right] = \eta\Pi_8^{MNC} + (1-\eta)\Pi_9^{MNC},$$

$$E\left[\Pi \mid c = c_L, OSB, p_r = \underline{p_r}\right] = \Pi_{10}^{MNC},$$

$$\eta\Pi_8^{MNC} + (1-\eta)\Pi_9^{MNC} = \Pi_{10}^{MNC}$$

That is, the MNC's expected profit at the implementation stage is:

$$\beta\Pi_6^{MNC} + (1-\beta)\Pi_{10}^{MNC}$$

The MNC's expected profit for TSB and compliant reporting at the implementation stage is:

$$\beta\Pi_1^{MNC} + (1-\beta)\Pi_5^{MNC}$$

Note that $\Pi_6^{MNC} < \Pi_1^{MNC}$ and $\Pi_{10}^{MNC} < \Pi_5^{MNC}$. Therefore, the MNC always deviates to keeping TSB so that OSB with randomization at the compliance stage is not an equilibrium. As a consequence, keeping TSB and random compliance is the only equilibrium with deterministic implementation and random compliance.

Under which conditions does the MNC always keep TSB where the low-cost MNC randomizes between compliance and non-compliance? With TSB in place, the low-cost MNC randomizes between compliance and non-compliance if and only if, the expected profit of these two strategies are the same:

$$E\left[\Pi \mid c = c_L, TSB, p_r = \overline{p_r}\right] = \eta\Pi_3^{MNC} + (1-\eta)\Pi_4^{MNC},$$

$$E\left[\Pi \mid c = c_L, TSB, p_r = \underline{p_r}\right] = \Pi_5^{MNC},$$

$$\eta\Pi_3^{MNC} + (1-\eta)\Pi_4^{MNC} = \Pi_5^{MNC}$$

$$\iff \eta \in \left\{ \frac{h}{\delta(t+h)}, \frac{h}{\delta(t+h)} + \frac{2\left[a(1-t-h) - c_L(1-t)\right]}{\delta(\overline{p_r} - \underline{p_r})(t+h)} \right\}.$$

Conducting an audit is associated with costs for the TA. Thus, the TA audits with probability

$$\eta_I = \frac{h}{\delta(t+h)} > 0.$$

η_I is smaller than 1.

The MNC wants to deviate to keeping OSB with $\overline{p_r}$ in $t = 0$ when $\overline{\delta}_{OSB} \leq \delta_{OSB}$. $\overline{\delta}_{OSB}$ is determined by the following equation:

$$\beta\Pi_1^{MNC} + (1-\beta)\Pi_5^{MNC} = \beta\Pi_6^{MNC} + (1-\beta)\left[\eta_I\Pi_8^{MNC} + (1-\eta_I)\Pi_9^{MNC}\right]$$

$$\iff \overline{\delta}_{OSB} = \frac{1}{(\beta-1)h(a-\overline{p_r})(\overline{p_r} - \underline{p_r})} \cdot \delta_{TSB} \cdot$$

$$\Big[(1-\beta)\left[p_{i2}\left(2c_L(1-t) - 2h\underline{p_r} - p_{i2}(1-t-h)\right)\right] + \beta p_{iH}\left(2c_H(1-t) - p_{iH}(1-t-h) - 2h\overline{p_r}\right)$$

$$+\overline{p_r}\left(1-t-h-2c_H(1-t)+2h\overline{p_r}\right) - 2a(1-\beta)\left[(c_L-c_H)(1-t) + h(\overline{p_r} - \underline{p_r})\right]\Big]$$

For observing a high reported transfer price, the TA wants to randomize between conducting and not conducting an audit if and only if, the expected profit of these strategies are the same:

$$\beta\Pi_1^{TA} + (1-\beta)\lambda_{TSB}\Pi_3^{TA} = 0$$

$$\iff \lambda_{TSB} = \frac{K_a}{(1-\beta)(t+h)\delta_{TSB}(\overline{p_r}-\underline{p_r})(a-p_{i1})} := \lambda_{TSB,I}.$$

$\lambda_{TSB,I}$ is positive. In addition, it is smaller than 1 if and only if $K_a < K_{a2}(\eta_I)$, where

$$K_{a2}(\eta_I) := \delta_{TSB}(a-p_{i1})(1-\beta)(t+h)(\overline{p_r}-\underline{p_r}). \tag{2.10}$$

In sum, always keeping TSB and the low-cost MNC randomizing between $p_r = \overline{p_r}$ and $p_r = \underline{p_r}$ can occur for $K_a < K_{a2}(\eta_I)$ and $\delta_{OSB} \geq \overline{\delta}_{OSB}$. In this case, $\tau = 1$, $\lambda_{TSB} = \lambda_{TSB,I}$, $\eta = \eta_I$, and $\rho = \frac{\beta}{\beta+(1-\beta)\lambda_{TSB,I}}$ constitute a weak PBE.

Proof of Proposition 2.2

Step 1: Under which conditions does the MNC randomize between OSB and TSB and the low-cost MNC reports compliantly under TSB and non-compliantly under OSB? The MNC randomizes the strategies OSB and TSB if and only if, the expected profit of these two strategies are the same:

$$E[\Pi \mid TSB] = \beta\Pi_1^{MNC} + (1-\beta)\Pi_5^{MNC},$$

$$E[\Pi \mid OSB] = \beta\Pi_6^{MNC} + (1-\beta)\left[\eta\Pi_8^{MNC} + (1-\eta)\Pi_9^{MNC}\right],$$

$$E[\Pi \mid TSB] = E[\Pi \mid OSB]$$

$$\iff \eta = \frac{1}{(1-\beta)(a-\overline{p_r})\delta_{OSB}(t+h)(\overline{p_r}-\underline{p_r})}$$

$$\left[\frac{1-t-h}{2}\left[a^2 - \overline{p_r}^2 - \beta(a-p_{iH})^2 - (1-\beta)(a-p_{i2})^2\right]\right.$$

$$\left.-\beta(a-\overline{p_r})(1-t)c_H - c_L(1-t)(1-\beta)(a-\overline{p_r}) + h\overline{p_r}(a-\overline{p_r})\right] := \eta_{II}.$$

For sufficiently large a is $\eta_{II} > 0$.

η_{II} is always smaller than 1 because:

$$\Pi_5^{MNC} - \Pi_8^{MNC} = \frac{1-t-h}{2}(\overline{p_r}-p_{i2})^2 + (a-\overline{p_r})(\overline{p_r}-\underline{p_r})\left[\underbrace{\delta_{OSB}(t+h)-h}_{>0 \text{ for } \delta_{OSB}>1}\right] > 0.$$

Moreover, for a large prohibitive price a, $\Pi_9^{MNC} > \Pi_5^{MNC} > 0$ holds true. Thus, $\eta_{II} < 1$.

The MNC might have an incentive to deviate keeping TSB and then choosing the non-compliant transfer price $\overline{p_r}$ in the case of low cost. This is the case if and only if

$$\beta\Pi_1^{MNC} + (1-\beta)\left[\eta_{II}\Pi_3^{MNC} + (1-\eta_{II})\Pi_4^{MNC}\right] > \beta\Pi_1^{MNC} + (1-\beta)\Pi_5^{MNC}$$

$$\iff \eta_{II}\Pi_3^{MNC} + (1-\eta_{II})\Pi_4^{MNC} > \Pi_5^{MNC}.$$

$$\iff \frac{1-t-h}{2}\left(p_{i2}^2 - p_{i1}^2\right) < a(\overline{p_r} - \underline{p_r})\left[h - \eta_{II}\delta_{TSB}(t+h)\right].$$

For a large a the term $[h - \eta_{II}\delta_{TSB}(t+h)]$ becomes negative so that $a[h - \eta_{II}\delta_{TSB}(t+h)]$ is negative. The inequality is violated for sufficiently large a. Therefore, the MNC does not want to deviate to non-compliant TSB.

For observing a high reported transfer price, the TA wants to randomize between conducting and not conducting an audit if and only if the expected profits of both strategies are the same:

$$\tau\beta\Pi_1^{TA} + (1-\tau)\left[\beta\Pi_6^{TA} + (1-\beta)\Pi_8^{TA}\right] = 0$$

$$\iff \tau = 1 - \frac{K_a}{\delta_{OSB}(1-\beta)(t+h)(\overline{p_r} - \underline{p_r})(a - \overline{p_r})} := \tau_{II}.$$

τ_{II} is smaller than 1. In addition, it is positive if and only if $K_a \leq K_{a1}(\delta_{OSB})$ of (2.12).

In sum, randomizing between OSB and TSB where the low-cost MNC reports compliantly under TSB and non-compliantly under OSB can occur for $K_a < K_{a1}(\delta_{OSB})$. In this case, $\tau = \tau_{II}$, $\lambda_{TSB} = 0$, $\lambda_{OSB} = 1$, $\eta = \eta_{II}$, and $\rho = \frac{\beta}{\beta + (1-\tau_{II})(1-\beta)}$ constitute a weak PBE. □

Step 2: Under which conditions does the MNC randomize between OSB and TSB and the low-cost MNC always reports the non-compliant transfer price $\overline{p_r}$? The MNC randomizes the strategies OSB and TSB if and only if, the expected profit of these two strategies are the same:

$$E[\Pi \mid TSB] = \beta\Pi_1^{MNC} + (1-\beta)\left[\eta\Pi_3^{MNC} + (1-\eta)\Pi_4^{MNC}\right],$$

$$E[\Pi \mid OSB] = \beta\Pi_6^{MNC} + (1-\beta)\left[\eta\Pi_8^{MNC} + (1-\eta)\Pi_9^{MNC}\right],$$

$$E[\Pi \mid TSB] = E[\Pi \mid OSB]$$

$$\iff \eta^2 + 2B\eta + C = 0, \tag{2.11}$$

where

$$B = \frac{1}{\delta_{TSB}^2(\overline{p_r} - \underline{p_r})(t+h)}[c_L\delta_{TSB}(1-t) + a(\delta_{OSB} - \delta_{TSB})(1-t-h) - \overline{p_r}(\delta_{OSB}(1-t-h) + \delta_{TSB}h)],$$

$$C = \frac{(1-t)^2}{(1-\beta)\delta_{TSB}^2(\overline{p_r} - \underline{p_r})^2(t+h)^2}[\beta(c_H - c_L)(c_H + c_L - 2\overline{p_r}) + (c_L - \overline{p_r})^2].$$

For $\beta \in [0,1]$, C is positive. We assume throughout the paper that a is sufficiently large so that $B<0$ and $B^2-C>0$. Thus, the MNC is indifferent between OSB and TSB for

$$\eta_{III} := -B - \sqrt{B^2-C} > 0.$$

For a large a, η_{III} is smaller than 1.

The MNC might have an incentive to deviate keeping TSB and then choosing the compliant transfer price $\underline{p_r}$ in the case of low costs. This is the case if and only if

$$\beta\Pi_1^{MNC} + (1-\beta)\Pi_5^{MNC} > \beta\Pi_6^{MNC} + (1-\beta)\left[\eta_{III}\Pi_8^{MNC} + (1-\eta_{III})\Pi_9^{MNC}\right]$$

$$\iff \beta\frac{1-t-h}{2}\left((\overline{p_r}-p_{i2})^2 - (p_{iH}-\overline{p_r})^2\right) <$$

$$\underbrace{\frac{1-t-h}{2}(\overline{p_r}-p_{i2})^2}_{>0} + (1-\beta)(a-\overline{p_r})(\overline{p_r}-\underline{p_r})\left[\eta_{III}\delta_{OSB}(t+h)-h\right].$$

For a large a the term $[\eta_{III}\delta_{OSB}(t+h)-h]$ becomes negative so that $a[\eta_{III}\delta_{OSB}(t+h)-h]$ is negative. Hence, for large a the inequality is violated. Therefore, the MNC never deviates to TSB with compliant reporting.

For observing a high reported transfer price, the TA wants to randomize between conducting and not conducting an audit if and only if the expected profits of both strategies are the same:

$$\tau\left[\beta\Pi_1^{TA} + (1-\beta)\Pi_3^{TA}\right] + (1-\tau)\left[\beta\Pi_6^{TA} + (1-\beta)\Pi_8^{TA}\right] = 0$$

$$\iff \tau = \frac{K_a - (1-\beta)(t+h)(a-\overline{p_r})(\overline{p_r}-\underline{p_r})\delta_{OSB}}{(1-\beta)(t+h)(\overline{p_r}-\underline{p_r})[(a-p_{i1})\delta_{TSB} - (a-\overline{p_r})\delta_{OSB}]} := \tau_{III}.$$

τ_{III} is positive and smaller than 1 if and only if $K_{a1}(\delta_{OSB}) < K_a < K_{a2}(\eta_{III})$, where

$$K_{a1}(\delta_{OSB}) := \delta_{OSB}(1-\beta)(t+h)(\overline{p_r}-\underline{p_r})(a-\overline{p_r}) \tag{2.12}$$

and

$$K_{a2}(\eta_{III}) := \delta_{TSB}(a-p_{i1})(1-\beta)(t+h)(\overline{p_r}-\underline{p_r}). \tag{2.13}$$

In sum, randomizing between OSB and TSB where the low-cost MNC is always noncompliant can occur for $K_{a1}(\delta_{OSB}) < K_a < K_{a2}(\eta_{III})$. In this case, $\tau = \tau_{III}$, $\lambda_{TSB} = 1$, $\lambda_{OSB} = 1$, $\eta = \eta_{III}$, and $\rho = \beta$ constitute a weak PBE. □

Proof of Proposition 2.3

A high-cost MNC uses the internal transfer price

$$p_{iH} = \frac{1}{1-t-h}\left[(1-t)c_H - h\overline{p_r}\right].$$

$$\frac{dp_{iH}}{dh} = (-1)\frac{1}{(1-t-h)^2}\left[(1-t)m_H\right] < 0.$$

A low-cost MNC keeping TSB with $\underline{p_r}$ uses the internal transfer price

$$p_{i2} = \frac{1}{1-t-h}\left[(1-t)c_L - h\underline{p_r}\right].$$

$$\frac{dp_{i2}}{dh} = (-1)\frac{1}{(1-t-h)^2}\left[(1-t)m_L\right] < 0.$$

In the equilibrium where the MNC always keeps TSB, a low-cost MNC reporting $\overline{p_r}$ uses the internal transfer price

$$p_{i1} = \frac{1}{1-t-h}\left[(1-t)c_L - h\overline{p_r} + \eta_I\delta_{TSB}(t+h)(\overline{p_r}-\underline{p_r})\right] = \frac{1}{1-t-h}\left[(1-t)c_L - h\underline{p_r}\right].$$

$$\frac{dp_{i1}}{dh} = (-1)\frac{1}{(1-t-h)^2}\left[(1-t)(-m_L)\right] < 0.$$

In the equilibrium where the MNC randomizes between TSB and OSB and the low-cost MNC always reports the non-compliant transfer price $\overline{p_r}$, a low-cost MNC keeping TSB with $\overline{p_r}$ uses the internal transfer price

$$p_{i1} = \frac{1}{1-t-h}\left[(1-t)c_L - h\overline{p_r} + \eta_{III}\delta_{TSB}(t+h)(\overline{p_r}-\underline{p_r})\right].$$

$$\frac{\partial p_{i1}}{\partial h} = \frac{1}{(1-t-h)^2}\left[\underbrace{(1-t)(c_L-\overline{p_r})}_{<0} + \underbrace{\eta_{III}\delta_{TSB}(\overline{p_r}-\underline{p_r})}_{>0}\right].$$

For a high prohibitive price a, $\frac{\partial p_{i1}}{\partial h}$ is negative.

$$\frac{\partial p_{i1}}{\partial \eta_{III}} = \frac{t+h}{1-t-h}\delta_{TSB}(\overline{p_r}-\underline{p_r}) > 0.$$

The probability to keep TSB η_{III} is implicitly defined by $F = \eta^2 + B\eta + C = 0$ (see equation (2.11)).

$$\frac{\partial F}{\partial \eta_{III}} = 2\eta_{III} + B > 0.$$

$$\frac{\partial F}{\partial h} = \frac{\partial B}{\partial h}\eta + \frac{\partial C}{\partial h},$$

which is positive for a large prohibitive price a. According to the implicit function theorem,

$$\frac{d\eta_{III}}{dh} = -\frac{\frac{\partial F}{\partial h}}{\frac{\partial F}{\partial \eta_{III}}} < 0.$$

In sum,

$$\frac{dp_{i1}}{dh} = \underbrace{\frac{\partial p_{i1}}{\partial h}}_{<0} + \underbrace{\frac{\partial p_{i1}}{\partial \eta_{III}}}_{>0} \cdot \underbrace{\frac{d\eta_{III}}{dh}}_{<0} < 0.$$

According to equation 2.1, a smaller internal transfer price results in a higher quantity produced and sold. □

Proof of Proposition 2.4

In the equilibrium where the MNC always keeps TSB, the low-cost MNC reports the non-compliant transfer price $\overline{p_r}$ with probability $\lambda_{TSB,I}$ and uses the internal transfer price

$$p_{i1} = \frac{1}{1-t-h}\left[(1-t)c_L - h\overline{p_r} + \eta_I \delta_{TSB}(t+h)(\overline{p_r} - \underline{p_r})\right] = \frac{1}{1-t-h}\left[(1-t)c_L - h\underline{p_r}\right],$$

where $\frac{dp_{i1}}{dh}$ is negative according to section 2.6.

$$\frac{\partial \lambda_{TSB,I}}{\partial h} = \frac{(-1)}{(t+h)^2} \frac{K_a}{(1-\beta)\delta_{TSB}(a-p_{i1})(\overline{p_r} - \underline{p_r})} < 0.$$

$$\frac{\partial \lambda_{TSB,I}}{\partial p_{i1}} = \frac{K_a (a-p_{i1})^2}{(1-\beta)(t+h)\delta_{TSB}(\overline{p_r} - \underline{p_r})} > 0.$$

Therefore,

$$\frac{d\lambda_{TSB,I}}{dh} = \underbrace{\frac{\partial \lambda_{TSB,I}}{\partial h}}_{<0} + \underbrace{\frac{\partial \lambda_{TSB,I}}{\partial p_{i1}}}_{>0} \underbrace{\frac{dp_{i1}}{dh}}_{<0} < 0.$$

In the equilibrium where the MNC randomizes between TSB and OSB and the low-cost MNC always reports the non-compliant transfer price $\overline{p_r}$, the MNC keeps TSB with probability τ_{III} and uses the internal transfer price

$$p_{i1} = \frac{1}{1-t-h}\left[(1-t)c_L - h\overline{p_r} + \eta_{III} \delta_{TSB}(t+h)(\overline{p_r} - \underline{p_r})\right],$$

where $\frac{dp_{i1}}{dh}$ is negative according to section 2.6.

$$\frac{\partial \tau_{III}}{\partial h} = (-1) \frac{K_a}{(1-\beta)(t+h)^2(\overline{p_r} - \underline{p_r})\left[\delta_{TSB}(a-p_{i1}) - \delta_{OSB}(a-\overline{p_r})\right]} < 0.$$

$$\frac{\partial \tau_{III}}{\partial p_{i1}} = \delta_{TSB}\left[\delta_{TSB}(a-p_{i1}) - \delta_{OSB}(a-\overline{p_r})\right]^{-2}\left[(1-\beta)(t+h)(\overline{p_r} - \underline{p_r})\right]^{-1} \cdot$$

$$\underbrace{\left[K_a - \delta_{OSB}(a-\overline{p_r})(1-\beta)(t+h)(\overline{p_r} - \underline{p_r})\right]}_{>0 \text{ for } K_a > K_{a1}} > 0.$$

In sum,

$$\frac{d\tau_{III}}{dh} = \underbrace{\frac{\partial \tau_{III}}{\partial h}}_{<0} + \underbrace{\frac{\partial \tau_{III}}{\partial p_{i1}}}_{>0} \underbrace{\frac{dp_{i1}}{dh}}_{<0} < 0.$$

□

Chapter 3

Transfer Pricing and Location Choice of Intangibles – Spillover and Tax Avoidance through Profit Shifting[†]

Abstract

Large multinational companies are regularly suspected of using transfer pricing of intangibles to shift profits from high- to low-tax jurisdictions. We study the optimal transfer prices while endogenizing the location choice of intangibles and considering spillovers. In line with the initial intuition, we find that multinationals locate their intangibles in low-tax jurisdictions and deploy royalty flows to minimize tax payments. However, if multinationals face a trade-off between tax minimization and efficient spillover internalization, the so-called 'home bias' might occur. Then, for a large spillover, the intangible is optimally located in the high-tax domestic country. This leads to less severe investment distortions because the spillover is internalized. In addition, the model predicts that curtailing profit shifting possibilities can either harm or facilitate multinationals' overall investments. This depends heavily on unobservable factors such as the underlying accounting system. Therefore, our analysis highlights challenges for the anti-avoidance legislation of governments.

[†] This chapter is joint work with Katrin Weiskirchner-Merten (Vienna University of Economics and Business)

3.1 Introduction

The low effective tax rates enjoyed by large multinational companies (MNCs) and the underlying profit shifting to low-tax jurisdictions have drawn public attention. The European Union and its member states are particularly concerned about collecting the taxes they are owed (Drozdiak, 2017; Wall Street Journal, 2017). Transfer pricing is often used to shift profits. In particular, locating intangibles in low-tax jurisdictions and the subsequent royalty flows are effective means of avoiding tax payments. Empirical evidence reveals that intangibles display a 'home bias'. Karkinsky and Riedel (2012) show that the average European MNC files 57.1 percent of its annual patent applications from the parent location. For trademarks, Heckemeyer et al. (2018) find an even stronger 'home bias'. They document that 95.3 percent of the U.S. trademarks registered at the USPTO between 2003 and 2012 are owned by U.S. constituents of the S&P 500. This seems to be counterintuitive at first glance.

The unique nature and especially the public good character of intangibles allow for considerable discretion in their location choice and respective transfer pricing. Moreover, the use of existing intangibles entails no or negligible marginal costs. Additionally, an intangible is typically non-exclusive in its consumption, and spillovers or network effects typically occur (Lev, 2001). These network effects may appear as spillovers from one division's investments in intangibles to other divisions' profits. The internalization of these spillovers is crucial for the success of decentralized MNCs (Roberts, 2005). The prior literature demonstrates that transfer pricing might help to induce the internalization of spillovers (Bouwens et al., 2017). However, most of the existing research regarding transfer pricing neglects these aspects and investigates only tax optimization. We extend this strand of literature by incorporating both spillovers and tax optimization. Tax-saving incentives may interfere with the internalization incentives of spillovers, therefore affecting the location choice and the respective transfer pricing. The objective of this paper is to shed light on the impact of an intangible's specific characteristics on its location choice and corresponding transfer pricing decisions.

Regarding the unique characteristics of intangibles, we focus on missing marginal costs for using an existing intangible, spillovers, non-rivalry in its consumption, and the ease of the location choice. In particular, we examine the following research questions: Is the intangible optimally located in the high- or in the low-tax jurisdiction? That is, do MNCs exhibit a 'home bias' for their location choice of intangibles? How does a spillover influence the MNCs' location choice, respective royalty payments, and corresponding investment decisions related to intangibles?

We consider a decentralized MNC comprising a headquarters and a domestic and a foreign division. The MNC's headquarters and the domestic division are located in a high-tax jurisdiction. The foreign division operates in a low-tax country. Each division seeks to

maximize its after-tax divisional profits. The MNC has a ready-to-use intangible (for example, a brand, a patent, a database, or a quality concept) and headquarters determines this intangible's location, i.e., which part of the MNC owns the intangible. This intangible is separately used by the MNC's divisions. The use of the intangible by one division is not detrimental to the consumption possibilities of the other division, and marginal costs do not arise from its use. In order to sustain or even increase the expected benefits resulting from the intangible, the divisions using it need to invest in maintenance (Roberts, 2005; Sandner and Block, 2011). For example, creating a brand, a patent, or a database is usually the first step. Failure to maintain the brand in each market might result in its deterioration. Similarly, an unmaintained database might soon become out-of-date and thus useless. Failing to maintain or even establish the MNC's operations according to the patent's technology means that the patent's profit potential cannot be realized. These maintenance investments may create spillovers for other divisions, i.e., one division might benefit from the maintenance investment of another division. For example, advertising investments in the domestic country may also increase the awareness of a brand in a foreign country through word-of-mouth, internet presence, or product placement in movies, sitcoms, and talk shows. In the considered setting, transfer pricing has two functions: first, paying for the use of the existing intangible and, second, providing the divisions with incentives for making maintenance investments. This results in two potentially conflicting objectives of transfer pricing.

The MNC can either implement a one set of books (OSB) or two sets of books (TSB) transfer pricing system. Empirical findings indicate that both accounting systems are used (Klassen et al., 2017; Springsteel, 1999), so we consider each system. First, a OSB setting is investigated where a single transfer price is determined to induce optimal maintenance investments and report the taxable income. Second, we consider a TSB setting that allows the MNC to decouple its internal decision making from external reporting.[5]

When an MNC faces no restrictions on internal transfer pricing, the foreign division operating in the low-tax jurisdiction owns the intangible. The external royalty rate[6] is straightforwardly the highest acceptable rate. Thus, profit is shifted to the low-tax jurisdiction. In general, the optimal internal royalty rate does not equal zero despite the lack of costs incurred from using the intangible. The reason is that adequate maintenance investments are induced by non-zero internal royalty rates. Specifically, the optimal internal royalty rate is positive (negative) for a small (high) spillover. Thus, with a high spillover, the domestic division receives a maintenance investment subsidy. This is beneficial for the foreign division because the domestic division internalizes its spillover on the foreign division's contribution margin.

[5] We are not interested in the question of whether OSB or TSB is preferable or used in equilibrium. There is literature investigating this question (see, for example, Haak et al., 2017).

[6] The MNC uses royalty-based transfer pricing, so we use the terms royalty rate and transfer price interchangeably throughout the paper.

Despite the huge tax-saving potential of intangibles' transfer pricing, companies aim at complying with tax law (The Economist, 2004; Cools and Emmanuel, 2006; Cools and Slagmulder, 2009). Moreover, Klassen et al. (2017) have shown in a survey regarding transfer pricing strategies for large multinationals that the majority of MNCs prioritized preventing disputes with tax authorities above the tax minimization objective. Mills (1998) and Mills and Sansing (2000) have highlighted that large book-tax differences create red flags for tax authorities. The identification of large discrepancies between internal and external transfer prices has similar consequences. Thus, an MNC using TSB with large differences between internal and taxable income induces increased scrutiny by tax authorities (EY, 2003). Although, tax avoidance is perfectly legal, higher scrutiny by tax authorities is undesirable since participation in the audit process is costly. On the one hand, time needs to be spent preparing for the audit. On the other hand, tax professionals charge fees for representation. Beck et al. (2000) term this the audit participation penalty. Thus, MNCs aim at avoiding long-lasting audits and disputes. Therefore, MNCs refrain from creating large discrepancies. This creates restrictions on an MNC's transfer pricing. In particular, we consider a restriction on an MNC's internal transfer price. For the sake of simplicity, we assume that MNCs refrain from using negative internal royalty rates, while the arm's length principle requires positive external royalty rates. This non-negativity assumption is a surrogate for a restriction on transfer pricing when MNCs focus on preventing disputes triggered by large discrepancies between internal and external transfer prices. In our model, other restrictions regarding excessive discrepancies between the internal and external transfer price will yield qualitatively identical effects.

When restrictions on the internal royalty rate are present, i.e., either TSB with restrictions or OSB, locating the intangible in the low-tax foreign jurisdiction is discouraged. Then, assigning ownership to the high-tax country can be optimal. Specifically, for small (large) spillovers, the intangible is optimally located in the low-tax (high-tax) jurisdiction. The MNC faces the following trade-off. On the one hand, tax-saving behavior is most effective when the foreign division owns the intangible. On the other hand, better internalization of the spillover is obtained when the intangible is located in the high-tax domestic jurisdiction. For a large spillover, internalization becomes more important. That is, the threat of inconclusive but long-lasting and expensive disputes with the tax authority caused by large discrepancies between internal and external transfer prices can induce MNCs to locate the intangible in the domestic, high-tax jurisdiction. Thus, our findings illustrate that a trade-off between tax minimization and efficient spillover internalization may explain the empirical evidence on MNCs' tendency to hold intangibles in the parent's high-tax jurisdiction, the so-called 'home bias' (Karkinsky and Riedel, 2012; Griffith et al., 2014; Dischinger et al., 2014; Heckemeyer et al., 2018).

Tax authorities and governments determine the MNCs' abilities to engage in profitable profit shifting by defining the legal environment. Our results show that the effect

of curtailing profit shifting possibilities is intricate. Indeed, restricting profit shifting can harm domestic investment. This is in line with prior research (Desai et al., 2006; Hong and Smart, 2010; Juranek et al., 2018). However, we extend this strand of literature by showing that whether lower profit shifting possibilities are detrimental for investment incentives depends on the underlying accounting system and the spillover's magnitude. If TSB with restrictions are in place, transfer pricing is already used to optimally tackle tax minimization and induce investment decisions. Thus, decreasing profit shifting possibilities leads to decreased investment. However, under an OSB accounting system, the transfer pricing decision simultaneously targets tax optimization and providing investment incentives. Hence, reducing profit shifting possibilities mitigates the trade-off because the tax-saving possibilities decrease. This, in turn, may either increase or decrease investment incentives depending on which objective dominates the decision.

This highlights the problem regulators face when designing anti-avoidance legislation. On the one hand, governments are interested in collecting the taxes they are owed and therefore introduce countermeasures to circumvent profit shifting and tax avoidance, such as the recent BEPS project. However, our results show that the outcome of restricting profit shifting depends on the accounting system in place and the spillover's magnitude. The coexistence of different accounting systems and spillovers are only two of a variety of factors that could lead to unintended consequences. Thus, our results show that implementing anti-avoidance regulations is a very complex task.

The remainder of the paper proceeds as follows. In the next two sections, the related literature and the model are presented. Then, section 3.4 presents two benchmark cases. The first-best solution and a no-tax world are considered. Section 3.5 depicts the optimal location choice under OSB. Section 3.6 discusses the location choice when the MNC keeps TSB and restrictions on internal royalty rates are either absent or present. Section 3.7 concludes the paper.

3.2 Literature Review

Hall and Jorgenson (1967) illustrate that taxes affect the attraction of additional capital investment. Our findings show that curtailing profit shifting possibilities can either reduce or increase MNCs' incentives to invest in intangible maintenance.

The literature on transfer pricing for intangibles (with tax considerations) is scarce. Johnson (2006) examines different transfer pricing methods for intangibles. In the studied setting, two divisions consecutively create the intangible. Her results highlight that royalty-based transfer pricing with renegotiation can achieve the first-best investment incentives when the investments are either quasi-independent or substitutes. As we concentrate on compliant tax avoidance and negotiated transfer prices are perceived as potentially harming tax compliance (Cools and Slagmulder, 2009), our analysis is restricted to royalty-based transfer pricing. We add to the findings of Johnson (2006) by showing

that spillovers affect internal transfer prices and that an MNC facing a trade-off between tax minimization and efficient spillover internalization may exhibit a 'home bias'.

De Simone and Sansing (2014) investigate whether cost sharing arrangements serve to shift intellectual property offshore to low-tax jurisdictions in the presence of spillovers from marketing intangibles. They show that a cost sharing arrangement can be useful to shift profits if the spillover of the domestic division exceeds the foreign spillover on domestic profits. This result occurs because the Internal Revenue Service assumes that marketing intangibles increase only the profits of the division that owns them. Hence, spillovers are neglected in IRS considerations. We show that it is crucial to consider spillovers to estimate the consequences of regulatory activities. Bornemann (2018) additionally investigates different consequences of cost sharing versus licensing agreements. He finds that investment-specific characteristics affect the decision to design a contract as a licensing or cost sharing agreement. In contrast to De Simone and Sansing (2014) and Bornemann (2018), we investigate the location choice of an existing intangible rather than its development because empirical findings show that an intangible's development and subsequent location choice can easily be disentangled (Karkinsky and Riedel, 2012).

De Waegenaere et al. (2012) model a patent race among MNCs making research and development investments and the subsequent production of tangible assets. During the production of tangible assets, the intangible is exploited. The production can take place either domestically or in the foreign country. De Waegenaere et al. (2012) show that weaker enforcement of the arm's length principle may improve social welfare. We find related results by showing that narrowing the arm's length range can harm the investments of an MNC. We extend their findings by showing that investment incentives can also increase depending on spillovers and the accounting system in place.

Recently, Juranek et al. (2018) investigate how different methods employed in determining an arm's length price influence MNCs' investment decisions when the intangible is located in a low-tax jurisdiction. Moreover, they are interested in the appropriateness of a source tax for reducing profit shifting via royalties. We add to their findings by considering different accounting systems and a spillover. We show that a spillover combined with decreasing profit shifting possibilities can also induce increasing investment incentives. For a high spillover, in line with the empirically documented 'home bias', we find that locating the intangible in the high-tax country can become optimal. Then, it becomes possible to internalize the spillover in the MNC's investment decisions. Moreover, we respond to the call by Shackelford and Shevlin (2001) for more theoretical research regarding the development of theories allowing for the development of testable hypotheses.

In addition, we contribute to the empirical literature on the location choice for intangibles (Karkinsky and Riedel, 2012; Griffith et al., 2014; Dischinger et al., 2014; Heckemeyer et al., 2018). This literature offers several potential explanations for a 'home bias'. These are that headquarters often finances the development of the intangible and bears the risk,

making it the legal owner of the intangible (Karkinsky and Riedel, 2012). Moreover, the headquarters exhibits economies of scale in the administration and management process of intangibles (Karkinsky and Riedel, 2012; Heckemeyer et al., 2018), and headquarters' managers value their influence over valuable assets and, thus, seek to keep them at the headquarters (Dischinger et al., 2014). Furthermore, MNCs want to avoid taxes upon the repatriation of profits from the foreign division to the headquarters (Dischinger et al., 2014) and to minimize payments regarding withholding taxes (Heckemeyer et al., 2018). Additionally, particularities in tax transfer pricing regulation and the law regulating and protecting the intangible can make transferring the intangible to the low-tax jurisdiction unattractive (Heckemeyer et al., 2018).

Whereas these antecedents of the 'home bias' are mostly related to particularities of tax regulations and law, we illustrate the impact of spillovers on the location choice for intangibles. Thus, we provide an additional economic explanation for the 'home bias' documented in the empirical literature. In addition, our model predicts that the 'home bias' of trademarks is most likely larger than the 'home bias' of patents. This implication is supported by empirical evidence reported by Karkinsky and Riedel (2012) and Heckemeyer et al. (2018).

3.3 Model Description

We investigate whether an intangible should be located in the low-tax country when restrictions on transfer pricing exist. We are interested in the implications of the location choice and an MNC's maintenance investments. Therefore, in line with prior work of Juranek et al. (2018), we neglect the initial invention and innovation of the intangible. According to the findings of Karkinsky and Riedel (2012) and Schwab and Todtenhaupt (2017), neglecting the development of an intangible is not restrictive. They show that the development of an intangible and its actual location are independent. This becomes even more relevant if exit taxes are considered. Obviously, exit taxes make a relocation less attractive. Thus, MNCs will attempt to avoid costly relocations by anticipating subsequent consequences and determine the intangible's location ex ante. This is in line with empirical findings that the location choice of an intangible typically takes place at an early stage of the development process when the intangible's prospects are highly uncertain. Thus, we assume that MNCs anticipate the consequences of their location choice, so that the location choice takes place ex ante and no relocation occurs.

We consider a divisionalized MNC operating in a low- and a high-tax country. The MNC has a ready-to-use intangible and comprises a headquarters HQ, a domestic division D, and a foreign division F. The foreign division operates in the low-tax jurisdiction. Its income is taxed at tax rate t. The headquarters and the domestic division are located in the high-tax jurisdiction, where their income is taxed at rate $t+h$, where $0 < t, h < 1$ and $t+h < 1$. Both divisions generate profits using the existing intangible. These profits

can be increased by maintenance investments of each division j, with $j = F, D$. The maintenance investments are costly $c_j = \frac{k}{2}\theta_j^2$, with $j = F, D$, where $k > 0$ denotes the unit cost of the investment, and $\theta_j \in [0, 1]$ is division j's investment. We assume that k is sufficiently large in order to ensure that $0 \leq \theta_j \leq 1$ holds true. Maintenance investments are expensed. Division j decides on the investment θ_j to maximize the division's after-tax profit Π_j. The headquarters cannot verify the total investment.[7] Thus, it is not possible for the headquarters to administer the maintenance investments.[8] These costs reduce the investing division's taxable income. Division j generates direct contribution margin x_j, which is either high or low, where division j's investment θ_j determines the probability of obtaining the high direct contribution margin. That is, $x_j = 1$ is realized with probability θ_j. Otherwise, the investing division faces the baseline contribution margin, which we normalize without loss of generality to $x_j = 0$.

We assume that the investment of the high-tax division has a spillover β, with $0 \leq \beta \leq 1$, on the contribution margin of the foreign division (the indirect effect on the contribution margin). All results hold true if we consider bilateral spillovers as long as the domestic spillover exceeds the foreign spillover. Thus, we normalize the spillover from the foreign division's investment on the domestic division's contribution margin to zero. Of course, negative spillovers might also occur. However, if a sufficiently detrimental spillover is expected, it would be reasonable to deny the non-owning division access to the intangible imposing negative externalities on the other division. A typical example of negative spillovers are luxury brands. The allowance to use the brand name in other divisions can be detrimental by inflating the market and thereby destroying the exclusiveness of the brand. For example, Burberry recently attracted adverse media attention by burning tons of clothes rather than discounting them and thereby possibly inflating the market.[9] This shows that MNCs attempt to prevent negative expected spillovers. Thus, in expectation, the spillover should be positive. Therefore, we assume a positive spillover. In line with Bouwens et al. (2017), we model a linear spillover. That is, the total contribution margin of the low-tax division is $M_F = x_F + \beta x_D$, whereas the contribution margin of the domestic division is determined solely by its own investments, i.e., $M_D = x_D$.

Due to the specific features of intangibles, the boundaries of ownership are blurred. In particular, the non-rivalry in consumption allows both divisions to use the intangible without facing scarcity. However, the owning division has the right to decide whether other parties are allowed to use the intangible or not. In particular, the legal owner of the intangible is determined by the right to enjoy, sell, rent, or even destroy an item of property. In line with prior research (Grossman and Hart, 1986), we define the owner of an intangible as the residual claimant. However, in contrast to Grossman and Hart (1986),

[7] This is a standard assumption in the literature (Johnson, 2006).

[8] For the sake of simplicity, we assume that each division has additional operations generating revenues and costs, so that the investment expenditures c_j cannot be inferred.

[9] https://www.bbc.com/news/business-44885983.

the right to determine corresponding quantities or investments does not belong to the residual rights in our setting.

The headquarters locates the ready-to-use intangible in order to maximize its overall after-tax profit Π_{HQ}.[10] The headquarters has various strategic choices. On the one hand, it can decide that one of its two divisions legally owns the intangible. On the other hand, the headquarters can own the intangible or decide that both divisions jointly hold the intangible. That is, we consider four possibilities for the intangible's location. Either, the domestic division, the foreign division, both divisions jointly, or the headquarters can own the intangible.

We consider an administered transfer pricing environment, i.e., the price setting power remains under the headquarters' control for all ownership possibilities. Based on prior research, we tie the royalty rate $\gamma \in \mathbb{R}$ to the non-owning division's contribution margin (see, for example, Johnson, 2006; Bornemann, 2018). The headquarters chooses the transfer prices, i.e., the internal and the external royalty rate, in order to maximize the overall after-tax profit. To ensure that our results do not depend on the underlying but unobservable accounting system, we conduct the analysis twice. First, we consider an OSB setting. Afterward, we investigate the TSB case. In the TSB case, the MNC disentangles the royalty rates for internal and external purposes. In particular, investment decisions might be affected by an internal royalty rate $\gamma_i \in \mathbb{R}$, whereas the external royalty rate $\gamma_r \in \left[\underline{\gamma_r}, \overline{\gamma_r}\right]$ with $0 < \underline{\gamma_r} < \overline{\gamma_r} < 1$ serves for tax reporting. This range reflects the acceptable arm's length royalty rates. In line with the transfer pricing literature, we assume exogenous boundaries for the arm's length range (see, for example, Baldenius et al., 2004; Johnson, 2006)). Since we are interested in tax avoidance rather than illegal tax evasion, the MNC always chooses a price from this exogenous arm's length range. [11] The timing of the game is depicted in figure 3.1.

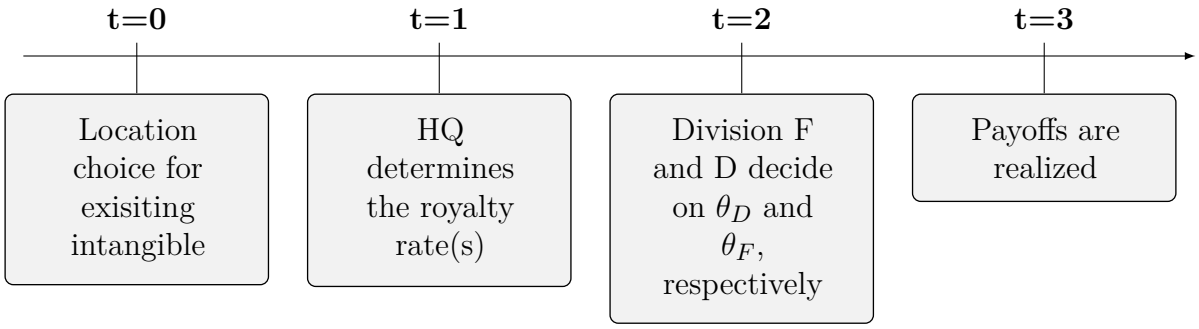

Figure 3.1: Timeline

[10] The divisions' after-tax profits Π_D and Π_F and the headquarters' after-tax profit Π_{HQ} depend on the location choice, the determined royalty rates, and the accounting system in place. Whenever necessary, we present the expected profit functions in the main text or the appendix.

[11] Juranek et al. (2018) investigate how different transfer pricing methods and the possibly differing arm's length ranges influence profit shifting with intangibles.

3.4 Benchmark Cases

We now turn to the analysis of the location choice. This section provides two benchmarks to demonstrate that the 'home bias' does not occur in the first-best solution or in a no-tax world. In particular, in the first benchmark, we examine the location choice when the headquarters observes and dictates the investment decisions, i.e., the first-best solution. The second benchmark considers a no-tax world.

3.4.1 Benchmark 1: First-Best Solution

In the first-best solution, the headquarters observes the divisions' investment decisions. If the divisions implement investment levels different from the headquarters' preferred ones, the headquarters can punish the division managers. Therefore, investment decisions according to the headquarters' preferences are induced.

Locating the intangible in the foreign division allows the MNC to legally shift profits from the high- to the low-tax jurisdiction. This reduces the MNC's tax liability, so that locating the intangible in the foreign division is preferred to ownership by the domestic division, headquarters, or joint ownership.

If the headquarters assigns ownership to the foreign division, the domestic division makes a royalty payment to the low-tax jurisdiction. The maximum profit is shifted to the low-tax jurisdiction by setting the external royalty rate as high as possible, i.e., $\gamma_r = \overline{\gamma_r}$. The first-best investment decisions of the headquarters are

$$\theta_{D,fb} = \frac{1}{k} + \frac{\beta(1-t) + h\overline{\gamma_r}}{k(1-t-h)},$$

$$\theta_{F,fb} = \frac{1}{k}.$$

Obviously, the domestic investment level is increasing in the spillover β, and the foreign investment is unaffected.

Lemma 3.1. *In the first-best solution, the MNC locates the intangible in the low-tax foreign division.*

Proof. See appendix. □

3.4.2 Benchmark 2: No-Tax World

As a second benchmark, we investigate which location is preferable in a no-tax world. This enables us to isolate tax effects in the next section. This is especially interesting because MNCs are often suspected to locate their intangibles solely to reduce their tax liability. Without tax regulation, the MNC is free to design its royalty scheme in order to maximize the overall profit. We acknowledge that taxes induce different first-best investments than in a no-tax world. Therefore, the first-best investments of the domestic

division are affected by taxes, so that we consider an adapted level of the first-best domestic investment in a no-tax world. First-best investments cannot be achieved if the domestic division owns the intangible. Basically, the royalty payment from the foreign division leads to a partial internalization of the indirect effect on the foreign contribution margin. However, a royalty payment reduces the investment incentives of the foreign division in a no-tax world. Hence, a trade-off is inherent in designing the transfer pricing scheme even without taxes.[12] This negative effect can easily be avoided as the following analysis shows. Legal ownership can be assigned to the foreign division. Then, transfer pricing is used to affect the divisions' decisions regarding maintenance investments. The domestic division expects the following profit:[13]

$$E\left[\Pi^F_{D,NT}\right] = (1-\gamma)\,\theta_D - \frac{k}{2}\theta_D^2$$

and the foreign division's profit comprises its own revenues and the royalty income. Hence, its expected profit is given by:

$$E\left[\Pi^F_{F,NT}\right] = \theta_F + \theta_D\,(\beta+\gamma) - \frac{k}{2}\theta_F^2.$$

Hence, the division's investment decisions are as follows:

$$\theta^F_{D,NT} = \frac{1-\gamma}{k}$$

and

$$\theta^F_{F,NT} = \frac{1}{k}.$$

Thus, the investment incentives of the foreign division are not affected by the royalty payment. Nevertheless, the foreign division is also interested in providing investment incentives to the domestic division due to the indirect effect on its own contribution margin. Obviously, a royalty rate $\gamma^F_{NT} = -\beta$ induces the first-best domestic investment. For economic reasons, this royalty rate is negative and can be interpreted as an investment subsidy. Although the foreign division owns the intangible, it pays an investment subsidy to the domestic division to ensure that the spillover is internalized correctly.

The same result is achieved if the headquarters owns the intangible. Then, both divisions have to pay royalties in order to secure access to the intangible. First-best investments can be achieved if the foreign division uses the intangible free of charge. Thus, the headquarters asks for a zero royalty $\gamma^{HQ}_{F,NT} = 0$. Furthermore, the headquarters pays an investment subsidy, i.e., $\gamma^{HQ}_{D,NT} = -\beta$ to the domestic division to induce the spillover's internalization. Hence, first-best investments in both divisions require a redistribution

[12] The proofs for all four considered ownership settings are in the appendix.

[13] The subscript NT highlights the no-tax cases, whereas the absence of the NT subscript signals tax world considerations. The superscript indicates the owner of the intangible.

of profits. In a no-tax world without any restrictions concerning the royalty rate, profit shifting is necessary to induce optimal maintenance investments.

With joint ownership, an investment subsidy might be profit enhancing. However, no subsidy can be found that the foreign division is willing to accept. Both divisions own the intangible, so that no royalties are paid, and first-best investments cannot be induced. Hence, foreign ownership or ownership by the domestic headquarters dominates joint ownership.

Proposition 3.1. *Without taxes, the MNC is indifferent between locating the intangible in the domestic headquarters or abroad. For either location choice, first-best investments can be induced. Despite the absence of marginal costs, optimal transfer pricing includes non-zero royalty rates.*

Proof. See appendix. □

3.5 Location Choice of Intangibles under OSB

Before examining the TSB case in section 3.6, we investigate the OSB setting in this section. That is, we restrict the MNC's transfer pricing flexibility by requiring the internal and the external royalty rate to coincide.

3.5.1 Royalty Rates and Location Choices under OSB

If the foreign division owns the intangible, the overall after-tax profit contains a tax-saving position. Thus, the headquarters' expected profit is given by:

$$E\left[\Pi_{HQ}^{F}\right] = (1-t-h)\left[\theta_D - \frac{k}{2}\theta_D^2\right] + (1-t)\left[\beta\theta_D + \theta_F - \frac{k}{2}\theta_F^2\right] + h\gamma_r\theta_D. \tag{3.1}$$

Under an OSB setting, a single royalty rate has to be determined that balances the conflicting objectives and therefore maximizes the headquarters' overall after-tax profit. The entire transfer pricing decision is restricted to the interval $\left[\underline{\gamma_r}, \overline{\gamma_r}\right]$ because we focus on legal tax avoidance. Thus, a trade-off is inherent in the MNC's decision. The resulting transfer pricing decision if the intangible is located in the foreign division is given by:[14]

$$\gamma_r^{F,OSB} = \begin{cases} \overline{\gamma_r} & \text{for } \beta \in \left[0, \beta_1^{F,OSB}\right] \\ \frac{h-(1-t)\beta}{1-t+h} & \text{for } \beta \in \left(\beta_1^{F,OSB}, \beta_2^{F,OSB}\right) \\ \underline{\gamma_r} & \text{for } \beta \in \left[\beta_2^{F,OSB}, 1\right]. \end{cases} \tag{3.2}$$

The divisions' investment choices with foreign ownership are:

$$\theta_D^{F,OSB} = \frac{1}{k}\left(1 - \gamma_r^{F,OSB}\right), \tag{3.3}$$

[14] All threshold values and findings in this section are presented in the appendix.

$$\theta_F^{F,OSB} = \frac{1}{k}. \tag{3.4}$$

If the domestic division owns the intangible, the overall after-tax profit contains a term indicating that incoming royalties have to be taxed at the higher tax rate. Thus, the headquarters' expected profit is given by:

$$E\left[\Pi_{HQ}^{D}\right] = (1-t-h)\left[\theta_D - \frac{k}{2}\theta_D^2\right] + (1-t)\left[\beta\theta_D + \theta_F - \frac{k}{2}\theta_F^2\right] - h\gamma_r\left(\beta\theta_D + \theta_F\right). \tag{3.5}$$

The resulting transfer pricing decision if the intangible is located in the domestic division is given by:

$$\gamma_r^{D,OSB} = \begin{cases} \underline{\gamma_r} & \text{for } \beta \in \left[0, \beta_1^{D,OSB}\right] \\ \frac{(1-t)\beta^2 - h(1+\beta)}{\beta^2(1-t+h)+1-t-2h} & \text{for } \beta \in \left(\beta_1^{D,OSB}, \beta_2^{D,OSB}\right) \\ \overline{\gamma_r} & \text{for } \beta \in \left[\beta_2^{D,OSB}, 1\right]. \end{cases} \tag{3.6}$$

The divisions' investment choices with domestic ownership are:

$$\theta_D^{D,OSB} = \frac{1}{k}\left(1 + \beta\gamma_r^{D,OSB}\right), \tag{3.7}$$

$$\theta_F^{D,OSB} = \frac{1}{k}\left(1 - \gamma_r^{D,OSB}\right). \tag{3.8}$$

With joint ownership, the effect of the spillover is never internalized. That is, both divisions invest $1/k$.

For a low spillover, i.e., $\beta < \beta_J^F$,[15] it is optimal to locate the intangible abroad. The ownership of the intangible is assigned to the foreign division, and profits are shifted effectively. While the foreign division implements the first-best investment decision, the domestic division underinvests relative to the first-best solution. This investment distortion is small for a low spillover, so that the tax-saving motive drives the location choice. That is, even for the most restrictive internal pricing policy, i.e., forcing MNCs to use OSB, the tax-saving motive dominates the location choice for a small spillover.

The MNC only uses the most tax-effective transfer price $\overline{\gamma_r}$ for a very low spillover, i.e., for $\beta \in \left[0, \beta_1^{F,OSB}\right]$.[16] Otherwise, a transfer price smaller than $\overline{\gamma_r}$, i.e., either $\frac{h-(1-t)\beta}{1-t+h}$ or $\underline{\gamma_r}$, is used (see equation (3.2)). That is, the MNC mitigates the investment distortion by partially forgoing the profit shifting benefits.

If the spillover is high, the investment distortion is detrimental. Therefore, investment decisions drive the location choice. In case of joint ownership, profit shifting does not

[15] The superscript F and the subscript J indicate that the threshold β_J^F is the level of the spillover at which the headquarters is indifferent between locating the intangible in the foreign division or using joint ownership.

[16] As outlined in the appendix: $0 < \beta_1^{F,OSB} < \beta_2^{F,OSB} < \beta_J^F$.

occur at all. Additionally, while the foreign division still invests according to the first-best solution, the domestic division underinvests less relative to the foreign ownership case. Hence, for a medium spillover, joint ownership becomes optimal in the OSB setting.

The intangible is optimally held in the high-tax jurisdiction for a high spillover. The domestic division owns the intangible under OSB for a high spillover to mitigate the investment distortion. In particular, compared to foreign and joint ownership, the domestic division underinvests less in this case. Paying a royalty induces the foreign division to underinvest. The spillover is so important that profit shifting to the high-tax country is accepted as a consequence. In sum, we can show that the intangible is located in the high-tax jurisdiction for a high spillover, i.e., $\beta \geq \beta_J^D$, where $\beta_J^D < \beta_1^{D,OSB}$.[17]

For $\beta \in \left[\beta_J^D, \beta_1^{D,OSB}\right]$, profits are shifted to the high-tax country using the least harmful transfer price $\underline{\gamma_r}$. When the spillover is very high, i.e., $\beta > \beta_1^{D,OSB}$, the investment distortions are the most severe. Then, the MNC is willing to shift more profits to the high-tax country by setting a transfer price larger than $\underline{\gamma_r}$ (see equation (3.6)). Our findings are summarized in proposition 3.2 and illustrated in figure 3.2.

Proposition 3.2. *For $h < \frac{3-\sqrt{5}}{2}(1-t)$ and $\overline{\gamma_r} < \frac{1-t}{1-t+h}$,[18] under an OSB accounting system, and*

- *a low spillover, i.e., $\beta \leq \beta_J^F$, the intangible is located in the low-tax foreign division,*
- *a medium spillover, i.e, $\beta_J^F < \beta < \beta_J^D$, joint ownership is optimal,*
- *a high spillover, i.e., $\beta \geq \beta_J^D$, the intangible is located in the high-tax domestic division.*

Proof. See appendix. □

3.5.2 Profit Shifting Effects on Investments under OSB

Next, we examine the effect of various exogenous factors on our OSB findings. For $\beta \in \left[\beta_2^{F,OSB}, \beta_J^F\right]$, an increase in the lower bound of the arm's length range $\underline{\gamma_r}$ reduces the domestic investment when the intangible is located abroad. Thus, greater investment distortion results from an increasing $\underline{\gamma_r}$, while the investment with joint ownership is unaffected. As a consequence, the higher the lower bound of the arm's length range is, the lower the spillover needs to be for the headquarters to favor foreign ownership. For

[17] The superscript D and the subscript J indicate that the threshold β_J^D is the level of the spillover at which the headquarters is indifferent between locating the intangible in the domestic division or using joint ownership.

[18] The first threshold is decreasing in the tax rate t. For $t = 0.1$ or $t = 0.3$, the first threshold allows a maximal tax rate differential of 0.344 or 0.267, respectively. The second threshold is decreasing in t and h. For $t = 0.3$ and $h = 0.25$, the maximal upper bound of the arm's length range $\overline{\gamma_r}$ is 0.737. That is, numerous tax jurisdictions fulfill these two criteria regarding h and $\overline{\gamma_r}$.

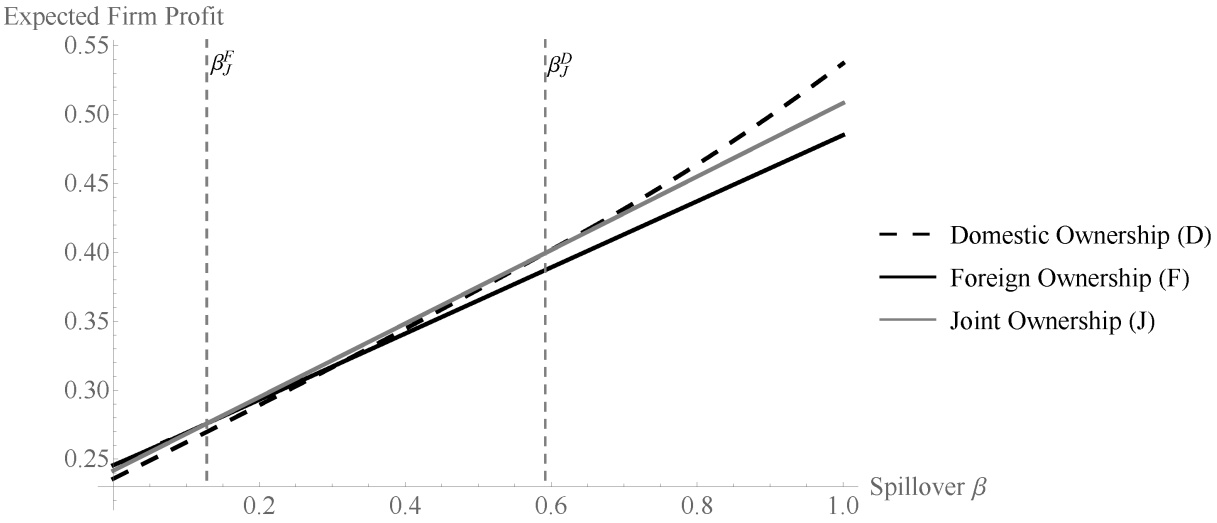

Figure 3.2: Expected Firm Profits with Foreign (F), Joint (J) and Domestic (D) Ownership under OSB (plotted for $\underline{\gamma_r} = 0.1, \overline{\gamma_r} = 0.5, t = 0.2, h = 0.15$, and $k = 3$)

$\beta \in \left[\beta_J^F, \beta_1^{D,OSB}\right]$ and domestic ownership, a higher arm's length price $\underline{\gamma_r}$ reduces the domestic investment distortion by increasing domestic investment. However, the investment distortion of the foreign division increases. A higher $\underline{\gamma_r}$ induces more profits being shifted from the low- to the high-tax jurisdiction. This unfavorable effect dominates the investment effects, so that a higher spillover is needed to induce the headquarters to locate the intangible in the domestic division.

For $\beta \in \left[\beta_1^{F,OSB}, \beta_2^{D,OSB}\right]$, an increase in the upper bound of the arm's length range $\overline{\gamma_r}$ does not affect the divisions' investment decisions because the used transfer price is smaller than $\overline{\gamma_r}$. That is, the attractiveness of domestic, foreign, or joint ownership is unaffected by a rise in $\overline{\gamma_r}$.

Furthermore, an increasing tax rate differential h makes profit shifting to the low-tax jurisdiction more attractive and profit shifting to the high-tax jurisdiction more costly. Therefore, a higher spillover is required to make it optimal for the headquarters to use joint and domestic ownership.

Corollary 3.1. *The threshold levels of the spillover β_J^F and β_J^D are*

- *decreasing and increasing in the lower bound of the arm's length range $\underline{\gamma_r}$, respectively,*
- *unaffected by a rise in the upper bound of the arm's length range $\overline{\gamma_r}$, and*
- *increasing in the tax rate differential h.*

Proof. See appendix. □

When the headquarters uses a transfer price that is an interior value from the arm's length range, i.e., $\beta \in \left(\beta_1^{F,OSB}, \beta_2^{F,OSB}\right)$ or $\beta \in \left(\beta_1^{D,OSB}, \beta_2^{D,OSB}\right)$, the spillover β affects

the royalty rate. A higher spillover increases the importance of domestic investment. Thus, lowering the royalty rate under foreign ownership provides higher investment incentives to the domestic division. Under domestic ownership, a higher royalty rate provides the domestic division with a larger share of the spillover effect. Therefore, the domestic division's investment incentives increase. However, an increasing spillover does not affect the royalty rate when the headquarters has already applied a corner value of the arm's length range.

Proposition 3.3. *For foreign ownership and OSB, an increasing spillover either decreases the royalty rate or the royalty rate is unaffected.*

For domestic ownership and OSB, an increasing spillover either increases the royalty rate or the royalty rate is unaffected.

Proof. See appendix. □

We are also interested in the effect of reducing the MNC's profit shifting possibilities by narrowing the arm's length range. Whenever the headquarters applies a corner value of the arm's length range as the transfer price, the divisions' investments are affected by an increasing lower bound or a decreasing upper bound. Specifically, a higher lower bound is detrimental to the MNC's investment incentives, while a lower upper bound fosters these incentives. This is summarized in proposition 3.4 and depicted in figure 3.3.

Proposition 3.4. *For $\beta \in \left[0, \beta_1^{F,OSB}\right]$ or $\beta \in \left[\beta_2^{D,OSB}, 1\right]$, curtailing profit shifting possibilities by narrowing the arm's length range leads to increased investment incentives for the MNC under OSB.*

For $\beta \in \left[\beta_2^{F,OSB}, \beta_J^F\right]$ or $\beta \in \left[\beta_J^D, \beta_1^{D,OSB}\right]$, curtailing profit shifting possibilities by narrowing the arm's length range leads to decreased investment incentives for the MNC under OSB.

For any other spillover β, curtailing profit shifting possibilities by narrowing the arm's length range does not affect the investment incentives for the MNC under OSB.

Proof. See appendix. □

The tax rate differential h affects the divisions' investment choices only when the headquarters does not use a corner value of the arm's length range. A higher tax rate differential increases the benefits from shifting profits from the high- to the low-tax jurisdiction but does not affect the benefits from the spillover. The MNC reacts to the higher tax-saving potential by increasing (decreasing) the royalty rate under foreign (domestic) ownership. This results in lower domestic investment. In the case of domestic ownership, due to the lower royalty rate, the foreign division retains a higher share of its contribution margin. That is, the marginal benefits from foreign investment on foreign profits increase, while the marginal investment costs are unaffected. Thus, the foreign division

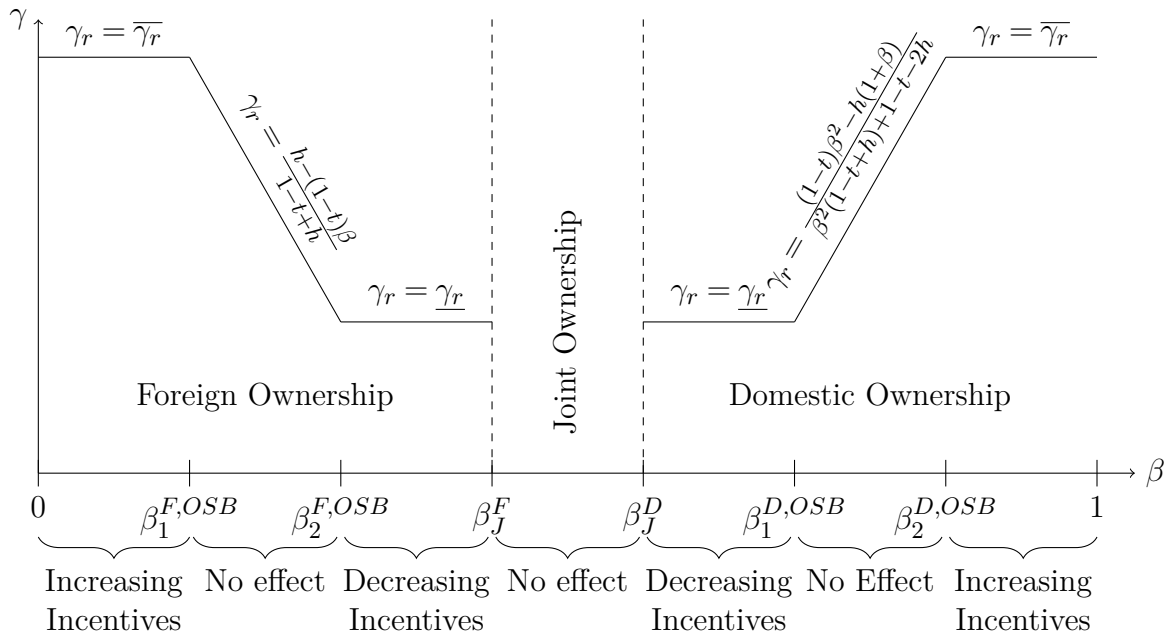

Figure 3.3: The Effect of Narrowing the Arm's Length Range on the Investment Incentives for the MNC under OSB (γ_r is the transfer price; β is the spillover from domestic investment to the foreign contribution margin)

invests more. When the headquarters uses a corner value of the arm's length range as the transfer price, a rise in the tax rate differential does not affect the royalty rate. Therefore, domestic and foreign investment are unaffected.

Proposition 3.5. *Suppose that the MNC keeps OSB. An increasing tax rate differential*

- *decreases or does not affect domestic investment and*
- *increases or does not affect foreign investment.*

Proof. See appendix. □

3.6 Location Choice of Intangibles under TSB

The conflict between the different objectives is mitigated by keeping TSB because the headquarters faces a higher degree of freedom in using different royalty rates for different purposes. Hence, relaxing the requirement that the internal and external royalty rates have to coincide makes the trade-off less severe.

3.6.1 No Restriction on Transfer Pricing

In a TSB setting without any restrictions on the internal royalty rate, foreign ownership dominates.[19] Specifically, the expected profits are given by:

$$E\left[\Pi_D^F\right] = (1-t-h)\left[\theta_D - \frac{k}{2}\theta_D^2\right] - \gamma_i\theta_D + \gamma_r\theta_D\,(t+h)$$

[19] All proofs are in the appendix.

and

$$E\left[\Pi_F^F\right] = (1-t)\left[\theta_F + \beta\theta_D - \frac{k}{2}\theta_F^2\right] + \gamma_i\theta_D - t\gamma_r\theta_D.$$

The headquarters' expected profit is given by equation (3.1), which was introduced in section 3.5. The internal royalty rate is only implicitly considered in the headquarters' expected profit because it affects the investment decisions of divisional managers. Since the internal incentive provision and external reporting objectives are decoupled, it is obvious that the MNC is interested in the highest possible external transfer price under foreign ownership, i.e., $\overline{\gamma_r}$, to maximize its tax savings. The divisions choose their investment levels to maximize their own after-tax profits.The divisions' investment decisions are given by:

$$\theta_D^F = \frac{1}{k} + \frac{1}{k\,(1-t-h)}\left[\overline{\gamma_r}\,(t+h) - \gamma_i\right] \tag{3.9}$$

and

$$\theta_F^F = \frac{1}{k}. \tag{3.10}$$

Stipulating the following internal royalty rate induces first-best investments:

$$\gamma_i^F = \overline{\gamma_r}t - (1-t)\,\beta. \tag{3.11}$$

In this subsection, we do not consider restrictions on transfer prices, so that this internal royalty rate becomes negative for a high spillover β. Then, the foreign division subsidizes the investment of the domestic division. Therefore, the spillover is optimally exploited. Hence, the underinvestment problem present under OSB is alleviated. In addition to the internalization problem, maximal tax savings can be generated by legally shifting profits from the high-tax to the low-tax jurisdiction.

3.6.2 Restriction on Transfer Pricing and Resulting Home Bias

Recently, Mescall and Klassen (2018) demonstrate that MNCs incorporate the transfer pricing risk due to potential future tax audits into their considerations. Moreover, extant evidence has shown that large discrepancies between internal and external transfer prices entail increased scrutiny in a potential tax audit (Badertscher et al., 2009; Mills, 1998; Mills and Sansing, 2000; Chen and Gavious, 2017). That is, MNCs focusing on preventing long-lasting and costly disputes with the tax authority consider restrictions on transfer pricing to avoid large discrepancies. We assume that internal royalty rates have to be non-negative in cross-border transactions. We use this non-negativity requirement for the internal royalty rate to display restrictions on internal transfer pricing. However, this surrogate is chosen for the sake of simplicity and convenient presentation. Non-negativity is not necessary to obtain our results. Merely the existence of restrictions on internal transfer pricing decisions is needed, which are decidedly prevalent in MNCs' decision making (Graham et al., 2014).

If restrictions on transfer pricing are present, an investment subsidy is not possible because large discrepancies should be avoided. Then, it is no longer straightforward that the foreign division owns the intangible.

For a low spillover, namely $\beta < \beta^F$, optimal investments can be achieved. If the spillover is high, i.e., $\beta > \beta^F$, first-best investments cannot be induced. Refraining from large discrepancies in cross-border transactions curtails the MNC's internal pricing possibilities. Thus, the MNC has to trade off the conflicting objectives of tax minimization and investment incentives even when decoupling internal and external decision making.

For a large spillover, ownership by the headquarters can be used to induce less distorted investment incentives for the domestic division by setting appropriate internal transfer prices. The domestic division and the headquarters are located in the same tax jurisdiction. Hence, tax avoidance via profit shifting between the headquarters and the domestic division is not an issue.[20] Tax authorities are resource constrained and therefore need to strategically choose which transactions will be considered in greater detail (OECD, 2015). Therefore, it is most likely that cross-border transactions are scrutinized because of the absence of a profit shifting motive in purely domestic transactions. Thus, the headquarters can differentiate the royalty rates so that the restriction on internal transfer pricing is only a concern in cross-border transactions.

If the headquarters owns the intangible, it charges royalty fees to both divisions. Hence, the expected profits of the divisions are as follows:

$$E\left[\Pi_D^{HQ}\right] = (1-t-h)\left[\theta_D - \frac{k}{2}\theta_D^2\right] + \theta_D\left[\gamma_r\left(t+h\right) - \gamma_{iD}\right]$$

and

$$E\left[\Pi_F^{HQ}\right] = (1-t)\left[\theta_F + \beta\theta_D - \frac{k}{2}\theta_F^2\right] + \left(\theta_F + \beta\theta_D\right)\left[\gamma_r t - \gamma_{iF}\right].$$

The headquarters receives the royalty payments. Because the headquarters is located in the high-tax jurisdiction, all royalty income is taxed within the high-tax country. Thus, the expected overall after-tax profit of the MNC is given by:

$$E\left[\Pi_{HQ}^{HQ}\right] = (1-t-h)\left[\theta_D - \frac{k}{2}\theta_D^2\right] + (1-t)\left[\theta_F + \beta\theta_D - \frac{k}{2}\theta_F^2\right] - h\gamma_r\left(\theta_F + \beta\theta_D\right).$$

Obviously, the headquarters chooses $\underline{\gamma_r}$ in order to minimize its tax liability while complying with the arm's length principle. The internal trade is perfectly legal because the arm's length principle is not violated. Thus, the domestic division has to pay an internal royalty rate of:

$$\gamma_{iD}^{HQ} = \underline{\gamma_r}\left(t+h\right) - \beta\left(1-t-h\underline{\gamma_r}\right).$$

[20] This holds true if there is no reduced tax rate for passive income, i.e., no IP-Box. Furthermore, we suppress the possibility of loss carryforwards and hidden distributions.

The domestic division faces a royalty agreement that can be either positive or negative. However, the domestic tax authorities' income is not affected. Thus, the MNC cannot be accused of tax avoidance. The foreign division is incentivized with the following internal royalty rate when the headquarters owns the intangible:

$$\gamma_{iF}^{HQ} = \underline{\gamma_r}\,(t+h)\,.$$

In line with prior research, we show that the internal royalty rates depend on the externally accepted royalty rate (Hyde and Choe, 2005; Haak et al., 2017).

If the indirect effect of the domestic division's investment on the contribution margin of the foreign division is high, i.e., $\beta > \beta^{HQ}$, ownership by the headquarters becomes preferable. The intuition is as follows. If the foreign division holds the intangible, tax savings might be generated because profits are shifted to the low-tax jurisdiction. However, a high spillover leads to a severe domestic investment distortion if the domestic division is not forced to internalize this spillover. Hence, appropriate investment incentives become more important as the spillover increases. Ownership by the headquarters leads to a less severe domestic investment distortion because it allows for the subsidization of the domestic division's investment and thus leads to an internalization of the spillover.

Our findings are summarized in proposition 3.6 and illustrated in figure 3.4.

Proposition 3.6. *In a TSB setting without restrictions on internal transfer pricing, the intangible is located in the foreign division. With restrictions on internal transfer pricing and*

- *a low spillover, i.e., $\beta < \beta^{HQ}$, the intangible is located in the low-tax foreign division*
- *a large spillover, i.e., $\beta > \beta^{HQ}$, the intangible is located in the domestic headquarters even though it is in the high-tax jurisdiction.*

Despite the absence of marginal costs, optimal transfer pricing schemes include non-zero internal royalty rates for a very low and a large spillover.

Proof. See appendix. □

In contrast to the OSB setting, joint ownership is always dominated by foreign ownership for an MNC keeping TSB. Similar to the OSB setting, the intangible is optimally held in the high-tax jurisdiction under a high spillover, i.e., the 'home bias' occurs. In particular, the spillover is so important that profit shifting to the high-tax country is accepted. With OSB, a single transfer price is used to provide investment incentives to both divisions. That is, higher domestic investment incentives can only be achieved by reducing foreign investment incentives. While decoupling under TSB allows better tax-saving behavior, the link between the domestic and foreign investment incentives persists.

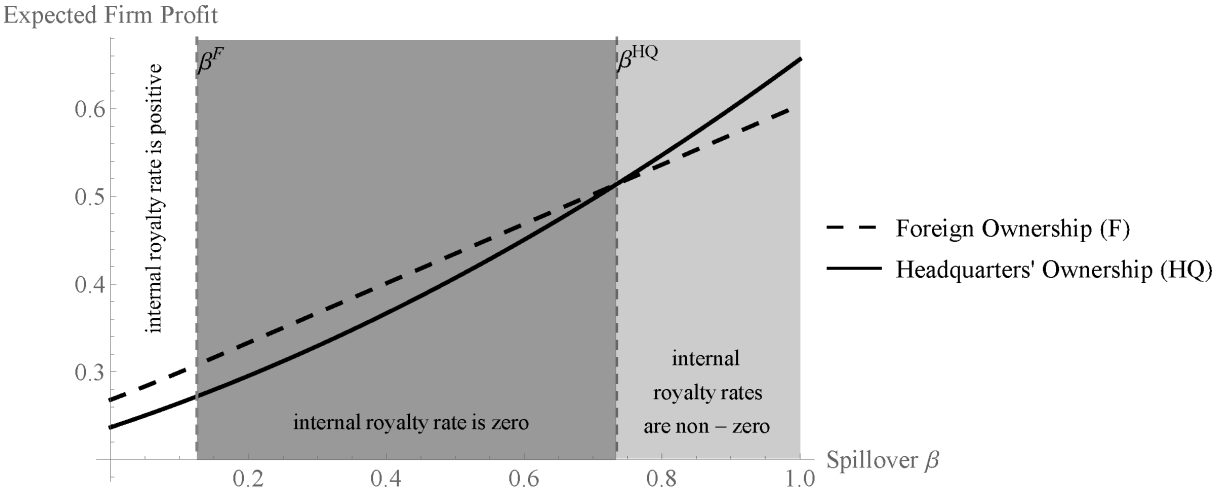

Figure 3.4: Expected Firm Profits with Foreign (F) and Headquarters (HQ) Ownership under Restrictions on Transfer Pricing (plotted for $\underline{\gamma_r} = 0.1, \overline{\gamma_r} = 0.5, t = 0.2, h = 0.15$, and $k = 3$)

However, by using headquarters ownership under TSB, the investment incentives for the domestic and the foreign division can be separated. Therefore, the headquarters can provide higher domestic investment incentives without harming foreign investment incentives. Rather than locating the intangible in the domestic division as under OSB, headquarters ownership is preferred under TSB.

Empirical findings suggest that intangibles are often located in the high-tax jurisdiction of an MNC's headquarters despite the presence of tax rate differentials and that profit shifting might reduce the MNC's tax liability (Karkinsky and Riedel, 2012; Dischinger et al., 2014; Heckemeyer et al., 2018). Empirical studies conclude that the so-called 'home bias' is difficult to explain. Potentially, part of this bias stems from spillovers and transfer pricing considerations. We have shown that locating the intangible in the high-tax jurisdiction is preferable for a high spillover under TSB with restrictions on internal transfer pricing and OSB. That is, a 'home bias' might occur whenever the MNC faces a trade-off between tax minimization and efficient investment incentives.

The findings of proposition 3.6 imply that a high (low) spillover is associated with locating the intangible in the high-tax domestic (low-tax foreign) jurisdiction. Patents relate to a specific technology, product, or process, whereas trademarks likely affect the entire business of an MNC. That is, trademarks seems to have larger spillovers than patents. Thus, our model predicts that trademarks exhibit a larger 'home bias' than patents. This empirical implication is supported. Whereas Heckemeyer et al. (2018) document that 95.3 percent of US trademarks are located in the US, Karkinsky and Riedel (2012) depict that only 57.1 percent of patent applications occur in the parent location. This finding seems to be especially surprising because the results of Pfeiffer and Voget (2017) indicate that MNCs use trademarks more frequently for tax planning than they do patents. According

to our model, this difference might stem from spillovers and considerations regarding the prevention of inconclusive but costly disputes with the tax authority.

Of course, there is a large body of additional explanations of the 'home bias'. Typical examples are litigation costs, legal certainty in the home country, and exit taxes. We do not negate all these potential explanations for the 'home bias'. Our aim is to show that there might be economic reasons in addition to all the other factors that might lead to a 'home bias'. Hence, the location choice of intangibles might be much more complex than it appears at first sight. That is, although tax-saving potentials are considered in the location choice of the intangible, the MNC also considers spillover effects. Our results might help to better understand reasons for intangible location choice beyond pure tax and legal considerations.

3.6.3 Profit Shifting Effects on Investments

In the following, we investigate how our results are affected by varying exogenous factors. The threshold β^{HQ} determines the minimum spillover that is needed to optimally locate the intangible in the high-tax jurisdiction under TSB with restrictions on internal transfer pricing. This threshold is increasing in the lower bound of the arm's length range $\underline{\gamma_r}$. An increase in $\underline{\gamma_r}$ forces the MNC with headquarters ownership to shift more profit from the low-tax to the high-tax jurisdiction, whereas the MNC's profit under foreign ownership is unaffected. Thus, to induce the MNC to locate the intangible at the headquarters, which is in the high-tax jurisdiction, the investment incentives need to become more important. Therefore, the threshold β^{HQ} increases with a rise in $\underline{\gamma_r}$. This is similar to the result under OSB in corollary 3.1. When the upper bound of the arm's length range $\overline{\gamma_r}$ increases, the MNC's profit shifting possibilities under foreign ownership increase. The arm's length price $\overline{\gamma_r}$ does not affect the MNC's profit under headquarters ownership. This means that solely foreign ownership becomes more attractive. Thus, a higher spillover is required to make it optimal to assign ownership to the headquarters.

This finding is contrary to the OSB finding in corollary 3.1, where an increase in the upper bound of the arm's length range does not affect the location choice. The reason is that in the OSB setting, the royalty rate for a medium spillover is smaller than the upper bound of the arm's length range. Therefore, the expected profits are unaffected.

A higher tax rate differential implies higher incentives for shifting profits to the low-tax jurisdiction. With foreign ownership, the MNC can optimally exploit legal tax-saving possibilities. This is not possible with ownership by the headquarters because profits are shifted to the high-tax country and then have to be taxed at the higher tax rate. Hence, foreign ownership becomes more attractive. However, whereas foreign ownership results in a greater distortion of the domestic investment decision, headquarters ownership allows better domestic investment. In order to still outweigh the increasing benefits of foreign ownership due to an increase in the tax rate differential, the minimum spillover β^{HQ} has

to increase to make headquarters ownership optimal. This is similar to the OSB finding in corollary 3.1.

Corollary 3.2. *The threshold level of the spillover β^{HQ} is increasing in*

- *the lower bound of the arm's length range $\underline{\gamma_r}$,*
- *the upper bound of the arm's length range $\overline{\gamma_r}$, and*
- *the tax differential h for $h < (1-t)/2$.*

Proof. See appendix. □

When the spillover is high, its internalization becomes important. The internal royalty rate becomes negative when preventing disputes with the tax authority is not an issue, i.e., no restriction on the internal transfer price is imposed. This can be interpreted as an investment subsidy. Nevertheless, an increasing spillover leads to decreased internal royalty rates under foreign ownership. Two effects on the headquarters' expected profit occur. First, an increasing spillover leads to a higher foreign contribution margin. Second, the domestic investment affects both the domestic and the foreign divisions' contribution margins. Hence, with an increasing spillover, the investment incentives of the domestic division become more important from the headquarters' perspective. If the MNC is interested in preventing long-lasting and expensive disputes, ownership by the headquarters allows the implementation of less distorted domestic investment. The headquarters faces a higher degree of freedom in the transfer pricing design if the intangible is located in the high-tax jurisdiction. The internal royalty rate for cross-border transactions does not depend on the spillover. However, the internal royalty rate for domestic transactions decreases with an increasing spillover. In particular, the investment subsidy increases because a higher spillover makes domestic investment incentives more important.

Proposition 3.7. *An increasing spillover either decreases the internal royalty rate, or the internal royalty rate is unaffected.*

Proof. See appendix. □

The finding of proposition 3.7 is similar to the result regarding foreign ownership under OSB (proposition 3.3). However, proposition 3.3 states a contrary finding for domestic ownership under OSB. With domestic ownership, the foreign division makes a royalty payment to the domestic division. For a higher spillover and thus higher benefits from less distorted domestic investment, the MNC induces the domestic division to invest more by using a higher royalty rate. When the MNC already uses a corner value of the arm's length range, a marginal increase in the spillover benefits cannot be exploited by increasing the royalty rate.

Furthermore, we are interested in the effect of reducing the profit shifting possibilities. The arm's length range determines the MNC's possibilities to engage in legal tax avoidance and corresponding profit shifting. In line with prior theoretical research (Desai et al., 2006; Hong and Smart, 2010; Juranek et al., 2018) and empirical findings (Schwab and Todtenhaupt, 2017), we can show that narrowing the arm's length range and corresponding reduction in profit shifting possibilities harms the investment incentives in the TSB setting. If the intangible is located in the low-tax jurisdiction, the investment incentives provided to the domestic division decreases if less profit shifting is possible. The investment incentives of the foreign division remain the same because its investment affects only its own profits. In the case of headquarters ownership, reducing profit shifting possibilities harms the investment incentives for both divisions.

Our result also contributes to prior findings of De Waegenaere et al. (2012), who show that a weaker enforcement of the arm's length principle may improve social welfare. Under TSB, the deterioration of the overall investment incentives due to reduced profit shifting possibilities is not sensitive to the ownership location of the intangible. That is, tight transfer pricing regulations may have negative impacts on real investment decisions. This finding is summarized in Proposition 3.8.

Proposition 3.8. *Curtailing profit shifting possibilities by narrowing the arm's length range leads to decreased investment incentives for the MNC under TSB.*

Proof. See appendix. □

Parts of related OSB findings in proposition 3.4 are contrary to proposition 3.8. The difference occurs because an MNC keeping OSB has to use a transfer price belonging to the arm's length range for both tax and internal objectives. Whenever a corner value of the arm's length range is applied, one of the purposes dominates. For example, the tax-saving objective dominates for a very low spillover, so that the MNC locates the intangible in the low-tax foreign jurisdiction and uses the upper bound of the arm's length range as the transfer price. This allows maximal legal profit shifting while providing little investment incentives for the domestic division. By curtailing the profit shifting possibilities, the internal objective receives more emphasis. That is, the MNC's investment incentives increase. Propositions 3.4 and 3.8 illustrate that the effect of curtailing profit shifting possibilities depends on the underlying accounting system and with OSB additionally on the spillover's magnitude. Both the accounting system and the spillover are usually unobservable. As a consequence, regulators that curtail profit shifting possibilities have difficulty estimating the consequences of their actions for MNCs' investments. This makes anti-avoidance regulation a complex task.

Next, we consider the impact of the tax rate differential h on the divisions' investment incentives. An increase in the tax rate differential decreases the domestic division's after-tax investment costs because the investment costs are tax deductible. A higher tax rate

differential does not affect the benefits from the domestic division's maintenance investment, so that in sum, the domestic investment increases. This is true for both foreign and headquarters ownership.

The impact on the foreign division's investment incentives depends on the location choice. First, an increase in the tax rate differential does not affect the foreign division's investment decision at all in the case of foreign ownership. Second, under ownership by the headquarters, the foreign division pays a positive external royalty rate for using the intangible. The headquarters in turn enjoys royalty income. An increase in the tax rate differential decreases the after-tax benefit from this royalty income. However, the foreign division's investment costs are unaffected. As a consequence, headquarters provides less investment incentives through a higher internal royalty rate. In sum, the location choice does not affect the impact of an increasing tax rate differential on the domestic investment decision. The impact on the foreign investment decision depends on the location choice.

Proposition 3.9. *Suppose that the MNC keeps TSB. An increase in the tax rate differential*

- *increases the domestic investment,*
- *decreases (does not affect) foreign investment when the intangible is located in the high-tax headquarters (low-tax foreign division).*

Proof. See appendix. □

Most parts of proposition 3.9 are contrary to the related OSB findings in proposition 3.5. Again, using a single transfer price for both tax optimization and to provide investment incentives under OSB is responsible for the difference. The tax rate differential affects the investments under OSB only when neither of the inherent objectives dominates. This is the case when the transfer price employed is not a corner value of the arm's length range. A higher tax rate differential increases the benefits from profit shifting to the low-tax jurisdiction so that the tax optimization objective gains importance. With foreign ownership, the MNC increases the royalty rate to shift more profits from the domestic to the foreign division. This curbs the domestic investment benefits. As with TSB, the foreign investment benefits are unaffected. With domestic ownership under OSB, the MNC decreases the royalty rate payable by the foreign to the domestic division. Thus, the domestic division obtains a smaller part of the spillover. Therefore, the marginal investment benefits decrease, while the marginal investment costs are unaffected. A smaller royalty rate increases the foreign division's marginal investment benefits, so that foreign investment rises. As with curtailing profit shifting possibilities, the MNC's accounting system affects how changes in the tax rate differential influence the investments.

3.7 Conclusion

Intangibles are critical for an MNC's success and are often unique but not exclusive in their consumption. Furthermore, the use of an intangible is typically associated with no or negligible marginal costs, and spillovers regularly occur. Nevertheless, when an intangible is used by several divisions, internal royalty payments are necessary to induce adequate maintenance investments. In addition to this internal role of royalty payments, an external transfer price is mandatory to report taxable income. Cross-border transactions are likely to entail tax audits. Therefore, MNCs that are especially concerned with the prevention of disputes with the tax authority refrain from large discrepancies between the internal and external transfer price.

We study the optimal royalty rates while endogenizing the location choice of an intangible. Non-zero royalty rates are necessary to induce adequate maintenance investments because of a spillover from the domestic to the foreign division's contribution margin.

Our model highlights that without restrictions on the internal transfer price, the intangible is located in the low-tax jurisdiction. This allows the MNC to optimally shift profits to minimize its tax liability. This result is in line with initial intuition. However, it is well known that large discrepancies between internal and external transfer prices trigger increased scrutiny and mistrust. MNCs that are interested in preventing disputes with the tax authority while keeping TSB therefore consider restrictions on internal transfer prices.

If restrictions on the internal transfer price are present and spillovers are low, locating the intangible in the low-tax jurisdiction is still optimal. However, for a high spillover, the MNC needs to trade-off effective legal profit shifting and investment distortions. Beneficial profit shifting is obtained when the intangible is held by the foreign division operating in the low-tax jurisdiction. A higher spillover results in higher benefits from adequate maintenance investments. As a consequence, for a large spillover, the benefits from less severe domestic investment distortions exceed the costs arising from ineffective profit shifting. Thus, the intangible is located in the high-tax domestic jurisdiction. A similar finding occurs when the MNC keeps OSB. This provides a potential explanation for the 'home bias' found in the empirical literature.

Recently, governments and tax authorities have sought to curtail MNCs' profit shifting possibilities. In particular, the BEPS project is intended to reduce profit shifting. Our analysis illustrates that the consequences of restricting profit shifting possibilities depend on several parameters. Our work has identified the unobservable accounting system and spillovers as two factors influencing the outcome of such regulations. Thus, curtailing profit shifting possibilities can either increase or decrease the MNC's investment incentives. This highlights the complexity that legislators, tax authorities, and supranational organizations such as the OECD and the EU face when designing anti-avoidance legislation while preventing unintended outcomes.

3.8 Appendix

Proof of Lemma 3.1

When the foreign division owns the intangible headquarters' expected profit is:

$$E\left[\Pi_{HQ,fb}\right] = (1-t-h)\left[\theta_D - \frac{k}{2}\theta_D^2\right] + (1-t)\left[\beta\theta_D + \theta_F - \frac{k}{2}\theta_F^2\right] + h\gamma_r\theta_D$$

The MNC is interested in the highest possible external transfer price, i.e., $\overline{\gamma_r}$, in order to maximize its tax savings. Headquarters is interested in investment decisions maximizing overall after-tax profits:

$$FOC\theta_D : (1-t-h)(1-k\theta_1) + \beta(1-t) + h\overline{\gamma_r}(t+h) = 0$$

$$SOC\theta_D : (1-t-h)(-k) < 0$$

$$FOC\theta_F : (1-t)(1-k\theta_2) = 0$$

$$SOC\theta_F : (1-t)(-k) < 0.$$

Thus, the FOCs determine a local maximum: $\theta_{D,fb}$ and $\theta_{F,fb}$. □

Proof of Proposition 3.1

We first consider all possible location choices in a no-tax world.

The Domestic Division owns the Intangible

Expected profits are given by:

$$E[\Pi_D] = \theta_D - \frac{k}{2}\theta_D^2 + \gamma(\theta_F + \beta\theta_D)$$

and

$$E[\Pi_F] = (1-\gamma)(\theta_F + \beta\theta_D) - \frac{k}{2}\theta_F^2.$$

The divisions choose their investments in order to maximize the divisional profit:

$$FOC\theta_D : 1 - k\theta_D + \gamma\beta = 0$$

$$SOC\theta_D : -k < 0$$

$$FOC\theta_F : 1 - k\theta_F - \gamma = 0$$

$$SOC\theta_F : -k < 0.$$

Thus, the FOCs determine a local maximum:

$$\theta_D^D = \frac{1+\gamma\beta}{k}$$

and

$$\theta_F^D = \frac{1-\gamma}{k}.$$

The headquarters' profit is equal to:

$$E\left[\Pi_{HQ}\right] = \theta_D + \theta_F + \beta\theta_D - \frac{k}{2}\left(\theta_D^2 + \theta_F^2\right). \tag{3.12}$$

First-best investments cannot be achieved. The headquarters chooses the transfer price in order to maximize the overall profit given the division's investments:

$$FOC\gamma : \frac{1}{k}\left[\beta - 1 + \beta^2 - \frac{1}{2}\left(2\beta + 2\beta^2\gamma - 2 + 2\gamma\right)\right]$$

$$SOC\gamma : \frac{1}{k}\left(\left(2\beta^2 + 2\right)\cdot -\frac{1}{2}\right) < 0.$$

Thus, the FOC determines a local maximum. The optimal transfer price is:

$$\gamma^D = \frac{\beta^2}{1+\beta^2}. \tag{3.13}$$

The Foreign Division owns the Intangible

Expected profit of the domestic division, incorporating royalty payments is:

$$E\left[\Pi_D\right] = (1-\gamma)\,\theta_D - \frac{k}{2}\theta_D^2$$

and the foreign division expects a profit of:

$$E\left[\Pi_F\right] = \theta_F + (\gamma + \beta\theta_D) - \frac{k}{2}\theta_F^2.$$

Following the procedure used in section 3.8 yields:

$$\theta_D^F = \frac{1-\gamma}{k}$$

and

$$\theta_F^F = \frac{1}{k}.$$

The headquarters objective remains in all no-tax scenarios unchanged and are depicted in (3.12). First-best investments can easily be achieved setting $\gamma = -\beta$. The foreign division is willing to accept a negative royalty payment administered by the headquarters because

its expected profit with the subsidy

$$E[\Pi_F] = \frac{1}{k} + \beta\frac{1+\beta}{k} - \frac{k}{2}\frac{1}{k^2} - \beta\frac{1+\beta}{k} = \frac{1}{2k} \tag{3.14}$$

equals the expected profit of the foreign division if it denies access to the intangible for the domestic division:

$$E[\Pi_F] = \frac{1}{k} - \frac{k}{2}\frac{1}{k^2} = \frac{1}{2k}.$$

First-best investments imply $E\left[\Pi^F_{HQ}\right] > E\left[\Pi^D_{HQ}\right]$ where the superscript denotes the location choice of the intangible.

Joint Ownership of the Intangible

In case of a joint ownership no division faces royalty payments. The expected profits are:

$$E[\Pi_D] = \theta_D - \frac{k}{2}\theta_D^2$$

and

$$E[\Pi_F] = \theta_F + \beta\theta_D - \frac{k}{2}\theta_F^2.$$

Following the procedure used in section 3.8 yields:

$$\theta^J_D = \frac{1}{k}$$

and

$$\theta^J_F = \frac{1}{k}.$$

Despite the absence of royalty payments an investment subsidy might be profit enhancing. However, no subsidy can be found the foreign division is willing to accept. This result is due to the joint ownership. No division is able to deny the other division access to the intangible. Hence, both divisions use the intangible without permission of the other one. Thus, the expected profit of the foreign division without subsidy:

$$E[\Pi_F] = \frac{1}{k} + \frac{\beta}{k} - \frac{k}{2}\frac{1}{k^2} = \frac{1}{2k}(1+2\beta) \tag{3.15}$$

is higher than with subsidy because (3.15)>(3.14).

The investment incentives with foreign ownership can easily replicate the incentives under consideration using $\gamma = 0$. This implies that $E\left[\Pi^F_{HQ}\right] > E\left[\Pi^J_{HQ}\right]$ holds true so that joint ownership of the intangible is strictly dominated.

The Headquarters owns the Intangible

Both divisions pay royalty fees for using the intangible. Expected profits are:

$$E[\Pi_D] = (1-\gamma)\theta_D - \frac{k}{2}\theta_D^2$$

and

$$E[\Pi_F] = (1-\gamma)(\theta_F + \beta\theta_D) - \frac{k}{2}\theta_F^2.$$

Following the procedure used in section 3.8 yields:

$$\theta_D^{HQ} = \frac{1-\gamma}{k}$$

and

$$\theta_F^{HQ} = \frac{1-\gamma}{k}$$

First-best investments can be achieved using $\gamma_D^{HQ} = -\beta$ and $\gamma_F^{HQ} = 0$. This implies $E\left[\Pi_{HQ}^{HQ}\right] = E\left[\Pi_{HQ}^{F}\right]$. □

Proof of Proposition 3.2

We now provide an overview over possible location choices in a tax-world when OSB is kept.

The Domestic Division owns the Intangible

Expected profit of the domestic division is given by:

$$E\left[\Pi_D^D\right] = (1-t-h)\left[\theta_D + \gamma(\beta\theta_D + \theta_F) - \frac{k}{2}\theta_D^2\right]$$

and the expected profit of the royalty paying foreign division is given by:

$$E\left[\Pi_F^D\right] = (1-t)\left[(1-\gamma)(\beta\theta_D + \theta_F) - \frac{k}{2}\theta_F^2\right].$$

The divisions choose their investment levels in order to maximize their own after-tax profits.

$$FOC\theta_D : (1-t-h)(1+\gamma\beta - k\theta_D) = 0$$

$$SOC\theta_D : (1-t-h)(-k) < 0$$

$$FOC\theta_F : (1-t)(1-\gamma - k\theta_F) = 0$$

$$SOC\theta_F : (1-t)(-k) < 0.$$

Thus, the FOCs determine a local maximum and the investments are:

$$\theta_D^{D,OSB} = \frac{1}{k}(1+\gamma\beta) \tag{3.16}$$

and

$$\theta_F^{D,OSB} = \frac{1}{k}(1-\gamma). \tag{3.17}$$

Headquarters expects the following profit:

$$E\left[\Pi_{HQ}^{D}\right] = (1-t-h)\left[\theta_D^{D,OSB} - \frac{k}{2}\left(\theta_D^{D,OSB}\right)^2\right]$$

$$+(1-t)\left[\beta\theta_D^{D,OSB} + \theta_F^{D,OSB} - \frac{k}{2}\left(\theta_F^{D,OSB}\right)^2\right] - h\gamma\left(\beta\theta_D^{D,OSB} + \theta_F^{D,OSB}\right) \tag{3.18}$$

Differentiating headquarters' expected profit with respect to γ yields:

$$FOC\gamma : \frac{1}{k}\left[\gamma\left(2h-1+t-\beta^2(1-t+h)\right)+(1-t)\beta^2-h(1-\beta)\right]=0$$

$$SOC\gamma : \frac{1}{k}\left[2h-1+t-\beta^2(1-t+h)\right],$$

which is negative for $h < (1-t)/2$. Thus, the FOC determines a local maximum. Hence, the optimal royalty rate is:

$$\gamma_1^{D,OSB} = \frac{(1-t)\beta^2 - h(1+\beta)}{\beta^2(1-t+h)+(1-t-2h)}. \tag{3.19}$$

However, the royalty rate needs to belong to the arm's length range. For $\underline{\gamma_r} \leq \frac{1-t}{1-t+h}$ and $h < \frac{1-t}{2}$, $\gamma_1^{D,OSB} \geq \underline{\gamma_r}$ if and only if

$$\beta \geq \beta_1^{D,OSB} := \frac{1}{2(1-t-\underline{\gamma_r}(1-t+h))}\left[h+\sqrt{h^2+4(1-t-\underline{\gamma_r}(1-t+h))(h+(1-t-2h)\underline{\gamma_r})}\right].$$

For $\overline{\gamma_r} \leq \frac{1-t}{1-t+h}$ and $h < \frac{1-t}{2}$, $\gamma_1^{D,OSB} \leq \overline{\gamma_r}$ if and only if

$$\beta \leq \beta_2^{D,OSB} := \frac{1}{2(1-t-\overline{\gamma_r}(1-t+h))}\left[h+\sqrt{h^2+4(1-t-\overline{\gamma_r}(1-t+h))(h+(1-t-2h)\overline{\gamma_r})}\right].$$

In sum, for $\overline{\gamma_r} \leq \frac{1-t}{1-t+h}$ and $h < \frac{1-t}{2}$ the optimal royalty rate is as stated in equation (3.6).

The Foreign Division owns the Intangible

Expected profit of the royalty paying domestic division is given by:

$$E\left[\Pi_D^F\right] = (1-t-h)\left[(1-\gamma)\theta_D - \frac{k}{2}\theta_D^2\right]$$

and the expected profit of the foreign division is given by:

$$E\left[\Pi_F^F\right] = (1-t)\left[\beta\theta_1 + \theta_F + \gamma\theta_D - \frac{k}{2}\theta_F^2\right].$$

Following the procedure used in section 3.8 yields:

$$\theta_D^{F,OSB} = \frac{1}{k}(1-\gamma) \tag{3.20}$$

and

$$\theta_F^{F,OSB} = \frac{1}{k}. \tag{3.21}$$

Headquarters expects the following profit:

$$E\left[\Pi_{HQ}^F\right] = (1-t-h)\left[\theta_D^{F,OSB} - \frac{k}{2}\left(\theta_D^{F,OSB}\right)^2\right]$$

$$+ (1-t)\left[\beta\theta_D^{F,OSB} + \theta_F^{F,OSB} - \frac{k}{2}\left(\theta_F^{F,OSB}\right)^2\right] + h\gamma\theta_D^{F,OSB}. \tag{3.22}$$

Differentiating headquarters' expected profit with respect to γ yields:

$$FOC\gamma : \frac{1}{k}\left[-\gamma(1-t+h) + h - (1-t)\beta\right] = 0$$

$$SOC\gamma : -\frac{1}{k}(1-t+h) < 0.$$

Thus, the FOC determines a local maximum and the optimal royalty rate is:

$$\gamma_1^{F,OSB} = \frac{h-\beta(1-t)}{1-t+h}. \tag{3.23}$$

However, the royalty rate needs to belong to the arm's length range. $\gamma_1^{F,OSB} \geq \underline{\gamma_r}$ if and only if

$$\beta \leq \beta_2^{F,OSB} := \frac{h-\underline{\gamma_r}(1-t+h)}{1-t}.$$

$\gamma_1^{F,OSB} \leq \overline{\gamma_r}$ if and only if

$$\beta \geq \beta_1^{F,OSB} := \frac{h-\overline{\gamma_r}(1-t+h)}{1-t}.$$

In sum, the optimal royalty rate is as stated in equation 3.2.

Joint Ownership of the Intangible

Expected profit of the domestic division:

$$E\left[\Pi_D^J\right] = (1-t-h)\left[\theta_D - \frac{k}{2}\theta_D^2\right]$$

and

$$E\left[\Pi_F^J\right] = (1-t)\left[\theta_F + \beta\theta_D - \frac{k}{2}\theta_F^2\right].$$

Following the procedure used in section 3.8 yields:

$$\theta_D^{J,OSB} = \frac{1}{k} \tag{3.24}$$

and

$$\theta_F^{J,OSB} = \frac{1}{k}. \tag{3.25}$$

Headquarters expected profit is:

$$E\left[\Pi_{HQ}^J\right] = (1-t-h)\left[\theta_D^{J,OSB} - \frac{k}{2}\left(\theta_D^{J,OSB}\right)^2\right] + (1-t)\left[\theta_F^{J,OSB} + \beta\theta_D^{J,OSB} - \frac{k}{2}\left(\theta_F^{J,OSB}\right)^2\right].$$

Headquarters' Ownership of the Intangible

Expected profit of the domestic division is:

$$E\left[\Pi_D^{HQ}\right] = (1-t-h)\left[(1-\gamma_D)\theta_D - \frac{k}{2}\theta_D^2\right]$$

and the expected profit of the foreign division is:

$$E\left[\Pi_F^{HQ}\right] = (1-t)\left[(1-\gamma_F)(\beta\theta_D + \theta_F) - \frac{k}{2}\theta_F^2\right].$$

Following the procedure used in section 3.8 yields:

$$\theta_D^{HQ,OSB} = \frac{1}{k}(1-\gamma_D) \tag{3.26}$$

and

$$\theta_F^{HQ,OSB} = \frac{1}{k}(1-\gamma_F). \tag{3.27}$$

Headquarters expected profit is:

$$E\left[\Pi_{HQ}^{HQ}\right] = (1-t-h)\left[\theta_D^{HQ,OSB} - \frac{k}{2}\left(\theta_D^{HQ,OSB}\right)^2\right]$$

$$+(1-t)\left[(1-\gamma_2)(\theta_F^{HQ,OSB}+\beta\theta_D^{HQ,OSB})-\frac{k}{2}\left(\theta_F^{HQ,OSB}\right)^2\right]$$

$$+(1-t-h)\gamma_2\left(\theta_F^{HQ,OSB}+\beta\theta_D^{HQ,OSB}\right).$$

$$\frac{\partial^2 E\left[\Pi_{HQ}^{HQ}\right]}{\partial\gamma_1^2}=\frac{1}{k}(1-t-h)(-1)<0$$

$$\frac{\partial^2 E\left[\Pi_{HQ}^{HQ}\right]}{\partial\gamma_2^2}=\frac{1}{k}(2h+t-1),$$

which is negative for $h<(1-t)/2$.

$$\frac{\partial^2 E\left[\Pi_{HQ}^{HQ}\right]}{\partial\gamma_1\partial\gamma_2}=\frac{\partial^2 E\left[\Pi_{HQ}^{HQ}\right]}{\partial\gamma_2\partial\gamma_1}=\frac{1}{k}\beta h.$$

The determinant of the Hessian matrix is

$$\frac{1}{k}\left[(1-t-h)(1-t-2h)-\beta^2h^2\right],$$

which is positive for $h<(1-t)(3-\sqrt{5})/2<(1-t)/2$. Thus, the Hessian matrix is negative definite and the headquarters' expected profit is concave.

The headquarters maximizes this expected profit under the restriction that the transfer prices belong to the arm's length range. This restriction satisfies the constraint qualification. Thus, the Kuhn-Tucker maximum conditions are necessary for an optimal solution. The headquarters expected profit is differentiable and concave in the non-negative orthant. According to the Kuhn-Tucker sufficiency theorem, transfer prices satisfying the Kuhn-Tucker maximum conditions give a global maximum. In sum, the Kuhn-Tucker maximum conditions are necessary and sufficient for a maximum.

For $\gamma_D=\underline{\gamma_r}$ and $\gamma_F=\underline{\gamma_r}$, all Kuhn-Tucker maximum conditions are satisfied.

$E\left[\Pi_{HQ}^{J}\right]\geq E\left[\Pi_{HQ}^{HQ}\right]$ so that headquarters' ownership is dominated by joint ownership. $E\left[\Pi_{HQ}^{J}\right]\geq E\left[\Pi_{HQ}^{D}\right]$ if and only if $\beta<\beta_J^D$, where

$$\beta_J^D:=\frac{h+\sqrt{h^2+(\underline{\gamma_r}(1+h-t)+2(t-1))(\underline{\gamma_r}(2h+t-1)-2h)}}{2(1-t)-\underline{\gamma_r}(1+h-t)}. \tag{3.28}$$

$E\left[\Pi_{HQ}^{J}\right]\geq E\left[\Pi_{HQ}^{F}\right]$ if and only if $\beta>\beta_J^F$, where

$$\beta_J^F:=\frac{2h+\underline{\gamma_r}(t-h-1)}{2(1-t)} \text{ and} \tag{3.29}$$

$$\beta_1^{D,OSB}<\beta_2^{F,OSB}<\beta_J^F<\beta_J^D<\beta_1^{D,OSB}<\beta_2^{D,OSB}.$$

Therefore, the intangible is located in the foreign division for $\beta \in \left[0, \beta_J^F\right]$. Joint ownership dominates for $\beta \in \left(\beta_J^F, \beta_J^D\right)$. The intangible is located in the domestic division for $\beta \in \left[\beta_J^D, 1\right]$. □

Proof of Corollary 3.1

This directly follows from calculating the first derivatives of equations (3.28) and (3.29) with respect to $\underline{\gamma_r}$, $\overline{\gamma_r}$, or h. □

Proof of Proposition 3.3

For $\beta \leq \beta_J^F$, the intangible is located in the foreign division. For $\beta \in \left[0, \beta_1^{F,OSB}\right]$ and $\beta \in \left[\beta_2^{F,OSB}, \beta_J^F\right]$, $\overline{\gamma_r}$ and $\underline{\gamma_r}$ are used, respectively. Then, $\partial \gamma_r^{F,OSB}/\partial\beta = 0$. For $\beta \in \left(\beta_1^{F,OSB}, \beta_2^{F,OSB}\right)$, $\partial \gamma_r^{F,OSB}/\partial\beta < 0$.

For $\beta \geq \beta_J^D$, the intangible is located in the domestic division. For $\beta \in \left[\beta_J^D, \beta_1^{D,OSB}\right]$ and $\beta \in \left[\beta_2^{D,OSB}, 1\right]$, $\underline{\gamma_r}$ and $\overline{\gamma_r}$ are used, respectively. Then, $\partial \gamma_r^{D,OSB}/\partial\beta = 0$. For $\beta \in \left(\beta_1^{D,OSB}, \beta_2^{D,OSB}\right)$, $\partial \gamma_r^{D,OSB}/\partial\beta > 0$. □

Proof of Proposition 3.4

Consider the equations (3.2), (3.3), (3.4), (3.6), (3.7), and (3.8). For $\beta \leq \beta_J^F$, the intangible is located in the foreign division so that the MNC invests $\theta_D^{F,OSB} + \theta_F^{F,OSB}$ in total. The first derivatives of total investment with regard to $\underline{\gamma_r}$ and $\overline{\gamma_r}$ are:

$$\frac{\partial\left(\theta_D^{F,OSB} + \theta_F^{F,OSB}\right)}{\partial \underline{\gamma_r}} = \begin{cases} 0 & \text{for } \beta \in \left[0, \beta_2^{F,OSB}\right] \\ \frac{-1}{k} & \text{for } \beta \in \left(\beta_2^{F,OSB}, \beta_J^F\right], \end{cases}$$

$$\frac{\partial\left(\theta_D^{F,OSB} + \theta_F^{F,OSB}\right)}{\partial \overline{\gamma_r}} = \begin{cases} \frac{-1}{k} & \text{for } \beta \in \left[0, \beta_1^{F,OSB}\right] \\ 0 & \text{for } \beta \in \left(\beta_1^{F,OSB}, \beta_J^F\right]. \end{cases}$$

For $\beta \geq \beta_J^D$, the intangible is located in the domestic division so that the MNC invests $\theta_D^{D,OSB} + \theta_F^{D,OSB}$ in total. The first derivatives of total investment with regard to $\underline{\gamma_r}$ and $\overline{\gamma_r}$ are:

$$\frac{\partial\left(\theta_D^{D,OSB} + \theta_F^{D,OSB}\right)}{\partial \underline{\gamma_r}} = \begin{cases} \frac{\beta-1}{k} & \text{for } \beta \in \left[\beta_J^D, \beta_1^{D,OSB}\right] \\ 0 & \text{for } \beta \in \left(\beta_1^{D,OSB}, 1\right], \end{cases}$$

$$\frac{\partial\left(\theta_D^{D,OSB} + \theta_F^{D,OSB}\right)}{\partial \overline{\gamma_r}} = \begin{cases} 0 & \text{for } \beta \in \left[\beta_J^D, \beta_2^{D,OSB}\right] \\ \frac{\beta-1}{k} & \text{for } \beta \in \left(\beta_2^{D,OSB}, 1\right]. \end{cases}$$

Decreasing $\overline{\gamma_r}$ and increasing $\underline{\gamma_r}$ jointly present curtailing profit shifting possibilities. □

Proof of Proposition 3.5

Consider the equations (3.2), (3.3), (3.4), (3.6), (3.7), and (3.8). For $\beta \leq \beta_J^F$, the intangible is located in the foreign division. The first derivatives of domestic and foreign investment with regard to h are:

$$\frac{\partial \theta_D^{F,OSB}}{\partial h} = \begin{cases} 0 & \text{for } \beta \in \left[0, \beta_1^{F,OSB}\right] \\ \frac{-(1+\beta)(1-t)}{k(1-t+h)^2} < 0 & \text{for } \beta \in \left(\beta_1^{F,OSB}, \beta_2^{F,OSB}\right) \\ 0 & \text{for } \beta \in \left[\beta_2^{F,OSB}, \beta_J^F\right], \end{cases}$$

$$\frac{\partial \theta_F^{F,OSB}}{\partial h} = 0,$$

For $\beta \geq \beta_J^D$, the intangible is located in the domestic division. The first derivatives of domestic and foreign investment with regard to h are:

$$\frac{\partial \theta_D^{D,OSB}}{\partial h} = \begin{cases} 0 & \text{for } \beta \in \left[\beta_J^D, \beta_1^{D,OSB}\right] \\ \frac{\beta\left(1+\beta-\beta^2+\beta^3+\beta^4\right)(t-1)}{k\left(-1+2h+t+\beta^2(t-h-1)\right)^2} < 0 & \text{for } \beta \in \left(\beta_1^{D,OSB}, \beta_2^{D,OSB}\right) \\ 0 & \text{for } \beta \in \left[\beta_2^{D,OSB}, 1\right], \end{cases}$$

$$\frac{\partial \theta_F^{D,OSB}}{\partial h} = \begin{cases} 0 & \text{for } \beta \in \left[\beta_J^D, \beta_1^{D,OSB}\right] \\ \frac{\left(1+\beta-\beta^2+\beta^3+\beta^4\right)(1-t)}{k\left(-1+2h+t+\beta^2(t-h-1)\right)^2} > 0 & \text{for } \beta \in \left(\beta_1^{D,OSB}, \beta_2^{D,OSB}\right) \\ 0 & \text{for } \beta \in \left[\beta_2^{D,OSB}, 1\right]. \end{cases}$$

□

Proof of Proposition 3.6

We now provide an overview over possible location choices in a tax-world keeping TSB.

The Domestic Division owns the Intangible

Expected profit of division 1 is given by:

$$E\left[\Pi_D^D\right] = (1-t-h)\left[-\frac{k}{2}\theta_1^2\right] + \gamma_i\left(\beta\theta_D + \theta_F\right) - (t+h)\,\gamma_r\left(\beta\theta_D + \theta_F\right)$$

and the expected profit of the royalty paying foreign division is given by:

$$E\left[\Pi_F^D\right] = (1-t)\left[\beta\theta_D + \theta_F - \frac{k}{2}\theta_F^2\right] - \gamma_i\left(\beta\theta_D + \theta_F\right) + t\gamma_r\left(\beta\theta_D + \theta_F\right).$$

Due to the tax rate differential the transfer price is not canceled out. The transfer pricing decision affects MNC's overall after-tax profit. Similar to the no-tax world the divisions choose their investment levels in order to maximize their own after-tax profits. They have to take into account the internal as well as the tax royalty rate.

$$FOC\theta_D : (1-t-h)(1-k\theta_D)+\gamma_i\beta-\beta\gamma_r(t+h)=0$$

$$SOC\theta_D : (1-t-h)(-k)<0$$

$$FOC\theta_F : (1-t)(1-k\theta_F)-\gamma_i+t\gamma_r=0$$

$$SOC\theta_F : (1-t)(-k)<0.$$

Thus, the FOCs determine a local maximum and the investments are:

$$\theta_D^D=\frac{1}{k}+\frac{1}{k(1-t-h)}\left[\beta\left(\gamma_i-\underline{\gamma_r}(t+h)\right)\right] \tag{3.30}$$

and

$$\theta_F^D=\frac{1}{k}+\frac{1}{k(1-t)}\left[t\underline{\gamma_r}-\gamma_i\right]. \tag{3.31}$$

The internal royalty rate γ_i affects both divisions' investment decision so that first-best investments cannot be achieved. Hence, the headquarters maximizes its overall after-tax profit choosing the internal royalty rate taking into account the divisions' investment decisions.

$$FOC\gamma_i : \frac{1}{1-t-h}\left[\beta^2\gamma_r(t+h)-\beta^2\gamma_i+\beta^2(1-t)-\beta^2h\underline{\gamma_r}\right]+\frac{1}{1-t}\left[\underline{\gamma_r}(t+h)-\gamma_i\right]=0$$

$$SOC\gamma_i : \frac{1}{1-t-h}\left(-\beta^2\right)-\frac{1}{1-t}<0.$$

Hence, the optimal internal royalty rate is:

$$\gamma_i^D=\frac{1}{1-t-h+\beta^2(1-t)}\left[\beta^2(1-t)\left(t\underline{\gamma_r}+1-t\right)+\underline{\gamma_r}(t+h)(1-t-h)\right]. \tag{3.32}$$

The Foreign Division owns the Intangible

Expected profit of the domestic division:

$$E\left[\Pi_D^F\right]=(1-t-h)\left[\theta_D-\frac{k}{2}\theta_D^2\right]-\gamma_i\theta_D+\gamma_r\theta_D(t+h)$$

and of the foreign:

$$E\left[\Pi_F^F\right]=(1-t)\left[\theta_F+\beta\theta_D-\frac{k}{2}\theta_F^2\right]+\gamma_i\theta_D-t\gamma_r\theta_D.$$

Following the procedure used in section 3.8 yields:

$$\theta_D^F = \frac{1}{k} + \frac{1}{k\left(1-t-h\right)}\left[\overline{\gamma_r}\left(t+h\right) - \gamma_i\right] \tag{3.33}$$

and

$$\theta_F^F = \frac{1}{k}. \tag{3.34}$$

Stipulating the following internal royalty rate induces first-best investments:

$$\gamma_i^F = \overline{\gamma_r}t - \left(1-t\right)\beta \tag{3.35}$$

Joint Ownership of the Intangible

Expected profit of the domestic division:

$$E\left[\Pi_D^J\right] = \left(1-t-h\right)\left[\theta_D - \frac{k}{2}\theta_D^2\right]$$

and

$$E\left[\Pi_F^J\right] = \left(1-t\right)\left[\theta_F + \beta\theta_D - \frac{k}{2}\theta_F^2\right].$$

Following the procedure used in section 3.8 yields:

$$\theta_D^J = \frac{1}{k} \tag{3.36}$$

and

$$\theta_F^J = \frac{1}{k}. \tag{3.37}$$

By setting $\gamma_i = \overline{\gamma_r}\left(t+h\right)$ in 3.8 the investment incentives in 3.8 can be replicated. But $\theta_D^J \neq \theta_D^F$. Hence, $E\left[\Pi_{HQ}^F\right] > E\left[\Pi_{HQ}^J\right]$.

Headquarters' Ownership of the Intangible

The domestic (foreign) division pays a royalty rate $\gamma_{iD}\left(\gamma_{iF}\right)$. The expected profit of the domestic division is:

$$E\left[\Pi_D^{HQ}\right] = \left(1-t-h\right)\left[\theta_D - \frac{k}{2}\theta_D^2\right] - \gamma_{iD}\theta_D + \gamma_r\theta_D\left(t+h\right)$$

and the expected profit of the foreign division is:

$$E\left[\Pi_F^{HQ}\right] = \left(1-t\right)\left[\beta\theta_D + \theta_F - \frac{k}{2}\theta_F^2\right] - \gamma_{iF}\left(\beta\theta_D + \theta_F\right) + t\gamma_r\left(\beta\theta_D + \theta_F\right).$$

Following the procedure used in section 3.8 yields:

$$\theta_D^{HQ} = \frac{1}{k} + \frac{1}{k(1-t-h)}\left[\gamma_r(t+h) - \gamma_{iD}\right] \tag{3.38}$$

and

$$\theta_F^{HQ} = \frac{1}{k} + \frac{1}{k(1-t)}\left[t\gamma_r - \gamma_{iF}\right]. \tag{3.39}$$

Headquarters expected profit is:

$$E\left[\Pi_{HQ}^{HQ}\right] = (1-t-h)\left[\theta_D - \frac{k}{2}\theta_D^2\right] + (1-t)\left[\theta_F + \beta\theta_D - \frac{k}{2}\theta_F^2\right] - h\gamma_r(\theta_F + \beta\theta_D).$$

The MNC is interested in the lowest possible external transfer price, i.e., $\underline{\gamma_r}$, in order to minimize its tax liabilities. Headquarters is interested in investment decisions maximizing overall after-tax profits:

$$FOC\theta_D : (1-t-h)(1-k\theta_D) + \beta(1-t) - h\beta\underline{\gamma_r} = 0$$

$$SOC\theta_D : (1-t-h)(-k) < 0$$

$$FOC\theta_F : (1-t)(1-k\theta_F) - h\underline{\gamma_r} = 0$$

$$SOC\theta_F : (1-t)(-k) < 0.$$

The Hessian matrix is negative definite. Thus, the FOCs determine a local maximum.

These second-best investments are induced by stipulating the following internal royalty rates:

$$\gamma_{iD}^{HQ} = \underline{\gamma_r}(t+h) - \left(1-t-h\underline{\gamma_r}\right)\beta \tag{3.40}$$

and

$$\gamma_{iF}^{HQ} = \underline{\gamma_r}(t+h). \tag{3.41}$$

In a world without restrictions on transfer pricing the foreign division always owns the intangible, i.e., $E\left[\Pi_{HQ}^{F}\right] > E\left[\Pi_{HQ}^{D}\right] > E\left[\Pi_{HQ}^{J}\right]$ and $E\left[\Pi_{HQ}^{F}\right] > E\left[\Pi_{HQ}^{HQ}\right]$.

With restrictions on transfer pricing, we have $E\left[\Pi_{HQ}^{F}\right] > E\left[\Pi_{HQ}^{J}\right]$ and $E\left[\Pi_{HQ}^{HQ}\right] > E\left[\Pi_{HQ}^{D}\right]$. Thus, either foreign or headquarters' ownership is optimal. For $\beta \leq \beta^F$, foreign ownership is optimal as $E\left[\Pi_{HQ}^{F}\right] > E\left[\Pi_{HQ}^{HQ}\right]$. For $\beta > \beta^F$, foreign ownership dominates headquarters' ownership if and only if

$$E\left[\Pi_{HQ}^{F}\right] \geq E\left[\Pi_{HQ}^{HQ}\right]$$

$$\iff \delta := E\left[\Pi_{HQ}^{F}\right] - E\left[\Pi_{HQ}^{HQ}\right] \geq 0$$

$$\iff \underbrace{\frac{1}{2k(1-t)(1-t-h)}}_{>0}\left[A\beta^2+B\beta+C\right]\geq 0,$$

where

$$A := (t-1)\left(t+\underline{\gamma_r}h-1\right)^2 < 0,$$

$$B := 2(t-1)\left[\underline{\gamma_r}h(t+h-1)+\overline{\gamma_r}(t-1)(t+h)\right] > 0, \text{ and}$$

$$C := 2\overline{\gamma_r}h(t-1)(t+h-1)+\underline{\gamma_r}h(t+h-1)(\underline{\gamma_r}h+2t-2)+\overline{\gamma_r}^2(t-1)(t^2-h^2). \quad (3.42)$$

Due to $A<0$, δ is inversely U-shaped in β. Setting δ equal to zero yields two thresholds

$$\beta_1 = \frac{1}{2A}\left[-B+\sqrt{B^2-4AC}\right] \text{ and}$$

$$\beta^{HQ} = \frac{1}{2A}\left[-B-\sqrt{B^2-4AC}\right].$$

β_1 is smaller than β^{HQ}. Using $E\left[\Pi^F_{HQ}\right] > E\left[\Pi^{HQ}_{HQ}\right]$ for $\beta=\beta^F$ and that δ is inversely U-shaped in β yields that for $\beta<\beta^{HQ}$ ($\beta>\beta^{HQ}$), $E\left[\Pi^F_{HQ}\right] > E\left[\Pi^{HQ}_{HQ}\right]$ $\left(E\left[\Pi^F_{HQ}\right] < E\left[\Pi^{HQ}_{HQ}\right]\right)$. As the example in figure 3.4 demonstrates, β^{HQ} can be smaller than 1. Thus, headquarters' ownership can become optimal. □

Proof of Corollary 3.2

As stated in the proof of proposition 3.6, the threshold β^{HQ} is determined by $A\beta^2+B\beta+C=0$ (see equations (3.42)). Define $G := A\beta^2+B\beta+C$.

$$\frac{\partial G}{\partial \beta^{HQ}} = 2A\beta^{HQ}+B < 0.$$

$$\frac{\partial G}{\partial \underline{\gamma_r}} = 2h\left[\underbrace{\beta(1-t)(1-t-h)}_{\geq 0}+\underbrace{\beta^2(1-t)(1-\underline{\gamma_r}h-t)}_{\geq 0}+\underbrace{(1-t-h)(1-\underline{\gamma_r}h-t)}_{>0}\right] > 0.$$

Using the implicit function theorem yields

$$\frac{\partial \beta^{HQ}}{\partial \underline{\gamma_r}} = -\frac{\partial G}{\partial \underline{\gamma_r}} \Big/ \frac{\partial G}{\partial \beta^{HQ}} > 0.$$

$$\frac{\partial G}{\partial \overline{\gamma_r}} = 2(1-t)\left[\underbrace{h(1-t-h)}_{>0}+\underbrace{\beta(1-t)(h+t)}_{\geq 0}+\overline{\gamma_r}(h^2-t^2)\right],$$

which is positive for $\beta \geq \beta^F$. Using the implicit function theorem yields

$$\frac{\partial \beta^{HQ}}{\partial \overline{\gamma_r}} = -\frac{\partial G}{\partial \overline{\gamma_r}} \Big/ \frac{\partial G}{\partial \beta^{HQ}} > 0.$$

$$\frac{\partial G}{\partial h} = 2\overline{\gamma_r}^2 h(1-t) + 2\overline{\gamma_r}(1-t)(1-t-2h+\beta(1-t)) +$$
$$\underline{\gamma_r}\left[\underline{\gamma_r} h(3h-2(1-t)) + 2(1+\beta)(1-t)(1-t-2h) + 2\beta^2(1-t)(1-\underline{\gamma_r}h-t)\right],$$

which is positive for $h < (1-t)/2$. Using the implicit function theorem yields

$$\frac{\partial \beta^{HQ}}{\partial h} = -\frac{\partial G}{\partial h} \Big/ \frac{\partial G}{\partial \beta^{HQ}} > 0.$$

□

Proof of Proposition 3.7

For $\beta \leq \beta^{HQ}$, the intangible is located in the foreign division. The internal transfer price is given by: $\gamma_i^F = t\overline{\gamma_r} - (1-t)\,\beta$, where γ_i^F is non-zero if there is no restriction on tax-avoidance or if restrictions are present for $\beta < \beta^F$ and $\gamma_i^F = 0$ for $\beta^F \leq \beta \leq \beta^{HQ}$. A non-zero internal royalty rate decreases with an increasing spillover:

$$\frac{\partial \gamma_i^F}{\partial \beta} = -(1-t) < 0.$$

Otherwise, if $\gamma_i^F = 0$ the internal royalty rate is unaffected.

For $\beta > \beta^{HQ}$, the intangible is held in the headquarters. The internal royalty rate for purely domestic transactions is given by: $\gamma_{iD}^{HQ} = \underline{\gamma_r}(t+h) - \left(1-t-h\underline{\gamma_r}\right)\beta$ and the internal royalty rate for cross-border transactions is $\gamma_{iF}^{HQ} = \underline{\gamma_r}(t+h)$. Thus, the internal royalty rate for purely domestic transactions decreases with an increasing spillover:

$$\frac{\partial \gamma_{iD}^{HQ}}{\partial \beta} = -(1-t) + h\underline{\gamma_r} < 0.$$

The internal royalty rate for cross-border transactions is unaffected. □

Proof of Proposition 3.8

For $\beta \leq \beta^{HQ}$, the intangible is located in the foreign division. For $\beta \leq \beta^F$, first-best investments are achievable and are given by $\theta_D^F = \frac{1}{k} + \frac{1}{k(1-t-h)}\left[(1-t)\,\beta + h\overline{\gamma_r}\right]$. If $\beta^F < \beta \leq \beta^{HQ}$ an investment distortion occurs; the distorted investment decisions of the domestic division is given by (3.33). The derivative is

$$\frac{\partial \theta_D^F}{\partial \overline{\gamma_r}} = \begin{cases} \frac{h}{k(1-t-h)} > 0 & \text{for } \beta \in \left[0, \beta^F\right] \\ \frac{t+h}{k(1-t-h)} > 0 & \text{for } \beta \in \left(\beta^F, \beta^{HQ}\right]. \end{cases}$$

Thus, curtailing profit shifting, i.e., decreasing $\overline{\gamma_r}$, leads to decreasing investments in the domestic division. The investment decision of the foreign country is shown in (3.34). The

investment incentives are unaffected and remain the same so that the MNC's overall investment decreases.

For $\beta > \beta^{HQ}$, the intangible is located in the headquarters. The investment decisions are described in (3.38) and (3.39). The derivatives with respect to the external royalty rate are:

$$\frac{\partial \theta_D^{HQ}}{\partial \underline{\gamma_r}} = \frac{-h\beta}{k\,(1-t-h)} < 0$$

and

$$\frac{\partial \theta_F^{HQ}}{\partial \underline{\gamma_r}} = \frac{-h}{k\,(1-t)} < 0.$$

Thus, curtailing profit shifting possibilities, i.e., increasing $\underline{\gamma_r}$, leads to less investments in both divisions. □

Proof of Proposition 3.9

With foreign ownership the derivative of the domestic division's investment with respect to the tax rate differential is:

$$\frac{\partial \theta_D^F}{\partial h} = \begin{cases} \frac{\overline{\gamma_r}}{k(1-t-h)^2} > 0 & \text{for } \beta \in \left[0, \beta^F\right] \\ \frac{(1-t)(\overline{\gamma_r}+\beta)}{k(1-t-h)^2} > 0 & \text{for } \beta \in \left(\beta^F, \beta^{HQ}\right]. \end{cases}$$

With foreign ownership the derivative of the foreign division's investment with respect to the tax rate differential is

$$\frac{\partial \theta_F^F}{\partial h} = 0.$$

With headquarters' ownership the derivatives of both divisions' investments with respect to the tax rate differential are

$$\frac{\partial \theta_D^{HQ}}{\partial h} = \frac{\beta(1-t)(1-\underline{\gamma_r})}{k\,(1-t-h)^2} > 0$$

and

$$\frac{\partial \theta_F^{HQ}}{\partial h} = \frac{-\underline{\gamma_r}}{k\,(1-t)} < 0.$$

□

Chapter 4

The Impact of Book-Tax Conformity on Tax-Reporting and Investment Behavior[‡]

Abstract

Book-tax differences affect firms' behavior in various ways. On the one hand, high book-tax conformity reduces the firms' reporting flexibility. On the other hand, real effects occur because taxes and corresponding tax regulation influence firms' investment behavior. In a game theoretic model, we study how investment decisions and related reporting interfere with each other when the financial statement provides a noisy signal to the tax authority. First, the firm decides on an investment amount considering subsequent reporting consequences. Subsequently, the tax authority may conduct an audit. High book-tax conformity deteriorates investment incentives. However, increasing mandatory book-tax conformity could lead to more or less tax-aggressive reporting in the form of understated tax reports. Considering both investment behavior and corresponding tax reporting, increasing mandatory book-tax conformity can either increase or decrease the firm's and the tax authority's expected payoff. Thus, our results indicate that the effect of tighter regulation regarding book-tax conformity is ambiguous and, therefore, highlight challenges governments face while designing book-tax conformity regulation.

[‡] This chapter is joint work with Alexandra Lilge (Leibniz University Hanover) and Michelle Muraz (Leibniz University Hanover)

4.1 Introduction

In the wake of accounting scandals and misreporting cases regulators discuss the alignment of the financial statement and the tax report to curb accounting manipulation and fraud. An alignment of the financial accounting rules and tax law leads to high mandatory book-tax conformity.[21] The reduced reporting discretion in simultaneously managing the financial statement and the tax report is expected to decrease the probability of accounting scandals (Watts, 2003; Hanlon and Shevlin, 2005). However, book-tax conformity is a double-edged sword. Besides the advantage of preventing firms from engaging in upwards earnings management while understating their taxable income at the same time, the governments' possibilities to induce specific firm behavior by providing tax incentives might decrease with an increasing mandatory book-tax conformity. In contrast to financial accounting rules settled in the generally accepted accounting principles (GAAP) that are typically based on conservatism and matching principles, a tax system is designed to raise the government's tax revenues, providing economic incentives or disincentives to engage in certain activities, and rewarding particular constituencies (Atwood et al., 2010). Considering the different purposes of a tax system, increasing the book-tax conformity with the aim to increase the tax revenue might be myopic. In particular, high book-tax conformity can impair investment incentives. Since profitable investments build the foundation of long-term economic growth and are therefore crucial for the welfare of an economy, the deterioration of investment incentives can be particularly harmful. This highlights the necessity to investigate the effects of regulation regarding book-tax conformity on investment behavior and related reporting.

In this study, we examine the impact of mandatory book-tax conformity on a firm's investment and tax reporting decisions when the correct financial statement provides a noisy signal to the tax authority. We investigate whether increasing book-tax conformity leads to less understated tax reports and, accordingly, to higher tax revenues for the tax authority. We are particularly interested in the following research questions: What are the consequences of a high mandatory book-tax conformity on a firm's investment decision considering that tax reporting is the outcome of a strategic interaction between the firm and the tax authority? Does high book-tax conformity lead to a higher tax revenue for the tax authority?

We study the raised research questions in a game theoretic model. Specifically, we consider a setting where a firm decides on an investment in an existing project and determines corresponding tax reporting. The project outcome is depicted in a financial statement and a tax report which are linked through an exogenous book-tax conformity. Specifically, book-tax conformity reflects similarities between GAAP and tax law. There-

[21] Book-tax conformity is jointly determined by financial accounting setters and tax regulators. Compliance with the financial accounting rules and tax law is mandatory. Therefore, we use the terms book-tax conformity and mandatory book-tax conformity interchangeably throughout the paper.

fore, the correct treatment of the project outcome for the financial statement and for tax purposes are positively correlated. Hence, observing the financial statement is informative about the correct tax treatment and, consequently, incorporated in the audit decision of a strategic tax authority.

Initially, the firm has an existing project and decides on an investment amount to increase the expected outcome of the project. The outcome of the project can be either high due to the investment or remain low if the investment fails. The project outcome is realized before the firm issues its reports. We consider public firms and assume that the financial statement is correct and publicly observable. In contrast, the firm can bias the tax report to reduce its tax liability. The tax authority observes both reports and decides whether to conduct an audit or not.

Consistent with prior theoretical and empirical work, we show that an increasing book-tax conformity induces less understated non-conforming tax reports, i.e. an understated tax report that creates a book-tax difference (Atwood et al., 2012; Blaufus et al., 2017; Chen and Gavious, 2017; Niggemann, 2018). This supports the hypothesis of Chan et al. (2013) that increasing book-tax conformity is likely to induce increasing tax payments for firms with sufficiently high financial reporting incentives. However, the above argument ignores that increasing book-tax conformity facilitates conforming understated tax reports, i.e. an understated tax report when the financial statement is low, and therefore can also decrease the revenue of the tax authority.

An increasing book-tax conformity reduces the government's possibility to provide particular investment incentives. Thus, this increase of the marginal investment costs due to a less beneficial tax treatment of the investment induces a decreasing investment amount. This, in turn, leads to a decrease in the expected tax base. Therefore, increasing book-tax conformity can either increase or decrease the expected income of the tax authority. The outcome depends on the level of baseline book-tax conformity and the tax independent investment incentives like the investment costs. For a low level of baseline book-tax conformity, the expected tax revenue increases with an increasing book-tax conformity by inducing less understated tax reports. The deterioration of the investment incentives is not severe so that the benefits of less understated tax reports outweigh the decreasing investment amount. However, if the level of baseline book-tax conformity is high, a further increase of mandatory book-tax conformity leads to a decrease of the expected income of the tax authority. In this case, the investment incentives are low because the investment is expensive due to the unfavorable tax treatment. The marginal costs of the investment increase with increasing book-tax conformity and, therefore, the firm forgoes expected pre-tax profits because a high probability for a low project outcome and a concomitant low financial statement leads to a high probability for a correct low tax report, thereby reducing the expected tax liability. However, the probability for understated conforming

tax reports also increases because a firm facing a low project outcome and a high correct tax report can better mimic a low tax report type.

Taken together, our results indicate that the effect of tightening regulation regarding book-tax conformity is ambiguous. This highlights problems regulators face while designing book-tax legislation. Governments are interested in collecting their owing taxes. Thus, countermeasures are introduced to prevent firms from tax-aggressive reporting behavior. We show that the outcome of suchlike regulation is unclear and depends on various variables like the level of baseline book-tax conformity which is inherent to current tax law and GAAP. Moreover, several potentially unobservable parameters like the firm's preferences or the investment costs influence the outcome. Hence, our results show that implementing book-tax regulations is a complex task.

We address calls of Hanlon and Heitzman (2010) and Graham et al. (2012) for research that leads to a better understanding of how tax incentives influence a firm's real investments. Therefore, we contribute to findings of Schwab and Todtenhaupt (2017); De Simone et al. (2018), and Reineke and Weiskirchner-Merten (2018) investigating the impact of tax regulation on firm's real decisions. Moreover, we add to the extant literature by endogenizing an investment decision in a tax inspection game. That is, instead of considering only reporting behavior we investigate the impact of book-tax conformity on the reporting and the investment decision of a firm simultaneously.

The rest of the paper proceeds as follows. First, the related literature is discussed in section 4.2. Then, the model is presented in section 4.3. Afterwards, section 4.4 provides the analysis and discussion of the equilibrium strategies of both players. This is followed by comparative statics in section 4.5. Section 4.6 concludes the paper.

4.2 Literature Review

In this section, we provide an overview of theoretical and empirical work closely related to our research. It is well known that book-tax differences may be a useful tool to convey information to shareholders without incurring corresponding tax consequences. Mills and Newberry (2001) have shown that firms with a positive income account for positive book-tax differences while loss-making firms tend to have negative book-tax differences.

Prior research has shown that book-tax differences affect tax auditors' behavior. Sansing (1993) examines how different information influences taxpayers' and tax auditors' behavior whereas Mills (1998) shows a positive association between book-tax differences and proposed IRS audit adjustments. The results indicate that book-tax differences serve as red flags for tax auditors. This finding is in line with work of Badertscher et al. (2009); Mills (1996); Mills and Sansing (2000) and Chen and Gavious (2017) who show that positions with high book-tax differences are more likely to be scrutinized within a tax audit.

Niggemann (2018) finds that a departure from high book-tax conformity increases the tax non-compliance. In line with empirical evidence of Ayers et al. (2010); Chan et al. (2010), and Hanlon et al. (2008), this indicates that high book-tax conformity might mitigate understated tax reports. Nevertheless, Atwood et al. (2010) also document that this can come at the cost of reduced accuracy of the financial statement. They state that increasing book-tax conformity may reduce the earnings quality. In contrast, Desai (2005); Evers et al. (2016), and Lev and Nissim (2004) argue that a one book system, i.e., a financial statement and a tax report which coincide, would offer less discretion for opportunistic reporting behavior and, therefore, induces a higher earnings quality. However, the information required by tax authorities differs substantially from the information needed by investors who are the primary recipients of financial accounting information (Atwood et al., 2010). Thus, increasing book-tax conformity necessarily exacerbates the trade-off between the different information requirements. Ali and Hwang (2000) show that earnings are less value relevant when book-tax conformity is high. This suggests that in such cases less information is transmitted to the financial statement users.

Despite the potentially harmful effect on the earnings quality, the findings of Lang et al. (2012); Tang (2015), and Watrin et al. (2014) indicate that managers will less often engage in earnings management when book-tax conformity is low because the incentive to smooth the taxable income carry over to smoother accounting earnings for high book-tax conformity. Contrary, Blaylock et al. (2017) find that higher book-tax conformity increases the cost of equity whereas the cost of debt does not change. They conclude that high book-tax conformity is associated with more earnings management.

Although the effect of an increasing book-tax conformity on earnings management for financial statement purposes appears equivoval, the results regarding tax evasion tend to be less ambiguous. The findings of Atwood et al. (2012) and Chen and Gavious (2017) suggest that an increasing book-tax conformity is associated with less tax evasion. Blaufus et al. (2017) have shown that an increasing book-tax conformity can lead to more or less understated tax reports. We contribute to their findings showing that reduced reporting discretion results in lower investment amounts when real effects are considered. Accordingly, increasing book-tax conformity may lead to decreasing expected tax revenues for the tax authority. High book-tax conformity deteriorates investment incentives. Thus, governments face a trade-off while designing regulation regarding the book-tax conformity.

Closely related to our work are the studies of Blaufus et al. (2017), Mills and Sansing (2000) and Mills et al. (2010). These papers investigate different information environments and the resulting inferences from book-tax differences. Mills and Sansing (2000) consider the use of financial statement information in a tax audit. Blaufus et al. (2017) include a strategic statutory auditor in the aforementioned setting. Basically, our focus is different. While these papers are particularly concerned with the signaling effect of book-tax differences, we investigate the impact of book-tax conformity on a firm's investment

decision while acknowledging that the financial statement alters the tax authority's beliefs regarding the correct tax treatment of the project outcome.

4.3 Model Description

We consider two risk-neutral players, namely, a firm and a tax authority. Initially, the firm has an existing project with a low project outcome. The firm decides on an investment amount for this existing project to achieve a high project's outcome. Then, the firm releases a financial statement and a tax report. The project outcome is depicted in both reports. Nevertheless, due to particularities in GAAP and tax law, the treatment of the project outcome for the financial statement and the tax report can differ. For example, corporate tax shelters may induce favorable tax treatment of investments. Alternatively, the firm could decide whether an expenditure must be expensed or capitalized in the financial statement and the tax report (see Mills and Sansing, 2000). Subsequently, the tax authority decides whether to conduct a tax audit or not.

In particular, the firm decides on an investment amount $a > 0$ in the existing project to maximize its expected after-tax income, considering potential tax audits. After the investment takes place the project outcome b can either remain low ($\underline{b}$) or a high project outcome ($\overline{b}$) is realized through the firm's investment effort. The investment is costly $\frac{za^2}{2}$ where $z > 0$ denotes the unit costs of the investment. We assume that z is sufficiently large to ensure that $a \leq 1$ holds true. The investment amount a determines the probability of obtaining a high project outcome, i.e., $P(\overline{b}) = a$ and $P(\underline{b}) = (1-a)$, respectively.[22] That is, an investment shifts probability mass from the low $\underline{b}$ to the high project outcome $\overline{b}$. After the project outcome is realized, the firm releases a financial statement and a tax report. Since we are not interested in strategic interdependencies with a statutory auditor, we assume that the project outcome and the corresponding financial statement coincide. That is, we suppress the possibility that a high project outcome leads to a low financial statement due to certain financial accounting rules. In addition, the firm has no incentive to bias the financial statement because the financial statement of public firms is always audited and publicly observable. Presuming a perfect audit technology, false reports are always detected and corrected. Hence, the disclosed financial statement displays the correct financial accounting treatment of the project outcome. Correspondingly, the project outcome and the concomitant financial statement are $b \in \{\underline{b}, \overline{b}\}$, with $\overline{b} > \underline{b} > 0$.

Considering the tax report, the correct treatment of the project outcome can also be either high or low, i.e., $t \in \{\underline{t}, \overline{t}\}$, with $\overline{t} > \underline{t} > 0$. However, the correct tax treatment of the project outcome is private information to the firm. Thus, the firm can either issue a correct tax report of the project outcome or bias the tax report. When the tax report $\hat{t}$ and the financial statement differ a book-tax difference arise. On the one hand, differences

[22] For example, an investment in equipment could induce higher productivity. Consequently, the probability of high profits increases.

between the financial accounting rules and tax law can induce book-tax differences. On the other hand, a book-tax difference can occur because the firm biases the tax report. In line with prior work of Blaufus et al. (2017), we refer to the true project outcome (b,t) as the firm's type. Hence, the firm can be of four types: $\{(\underline{b},\underline{t}),(\overline{b},\underline{t}),(\overline{b},\overline{t}),(\underline{b},\overline{t})\}$.

Since both the tax report and the financial statement describe the same underlying economics, similarities between the financial accounting rules and the tax law lead to a positive but imperfect correlation between the tax report and the financial statement. This correlation is captured by the level of mandatory book-tax conformity c, where c is exogenously and jointly determined by tax regulators and financial statement standard setters. To ensure a positive correlation between the financial statement and the tax report, we assume $\frac{1}{2} < c < 1$. Therefore, the conditional probabilities are $P(\overline{t}|\overline{b}) = P(\underline{t}|\underline{b}) = c$ and $P(\overline{t}|\underline{b}) = P(\underline{t}|\overline{b}) = (1-c)$. Thus, a high level of mandatory book-tax conformity increases the probability of conforming reports, i.e., both the financial statement and the tax report are either high or low at the same time whereas a low level of book-tax-conformity increases the probability of non-conforming reports, i.e., a book-tax difference arise when the financial statement is high and the tax report is low or vice versa.

The tax authority observes the firm's tax report $\hat{t}$ and the financial statement and decides based on these reports whether to conduct an audit or not while facing audit costs k. Throughout the analysis, we assume that the audit costs are not prohibitively high to ensure the tax authority's audit incentives. We capture the tax authority's decision whether to conduct an audit or not using a binary variable

$$x_{TA} = \begin{cases} 1 & \text{if an audit takes place,} \\ 0 & \text{if no audit takes place.} \end{cases}$$

We assume a perfect audit technology. That is, if an audit is conducted the tax authority always observes the correct tax treatment of the project outcome and detects biased tax reports. Since the correct financial statement of the project outcome is publicly observable, the tax authority updates its beliefs regarding a true high or low tax report depending on the level of book-tax conformity c and the observed financial statement. When tax evasion is detected, the tax report is corrected and the firm is forced to pay an additional penalty δ. The timing of the game is illustrated in figure 4.1.

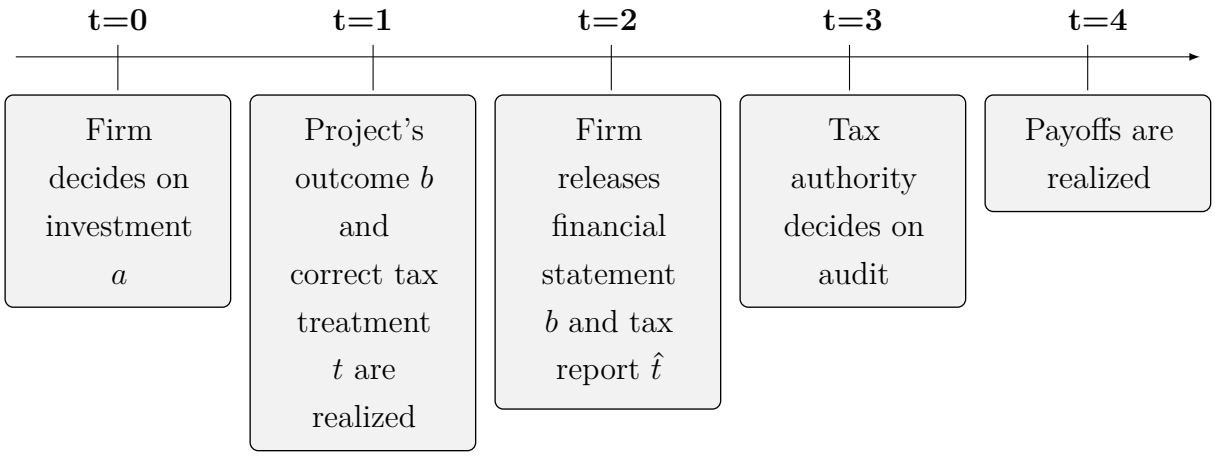

Figure 4.1: Timeline

The tax authority is interested in high tax revenues comprising the firm's tax liability and potential penalties due to detected tax evasion. Thus, the tax authority's decision problem can be written as

$$max_{x_{TA}\in\{0,1\}}\mathbb{E}[x_{TA}] = \hat{t} + x_{TA}\left(max\left\{t-\hat{t},0\right\}\frac{t-\hat{t}+\delta}{t-\hat{t}} - k\right).$$

Considering potential penalties due to a detected understated tax report, the firm maximizes

$$\max_{a,\hat{t}}\mathbb{E}[\Pi_F(a)] = a(\mu\bar{b} - \omega T_{\bar{b}}) + (1-a)(\mu\underline{b} - \omega T_{\underline{b}}) - \frac{za^2}{2},$$

with μ and ω as positive weighting factors indicating the firm's preferences regarding the financial statement and the tax report. These preferences are common knowledge to all players. We consider the case of $\mu > \omega$, implying that the firm is more sensitive to the financial statement. This is representative for large firms where investment and reporting decisions are typically delegated to managers whose variable compensation is commonly based on the financial statement (Blaufus et al., 2017). $T_{\bar{b}}$ and $T_{\underline{b}}$ denote the expected tax liability including expected penalties with a high or low financial statement respectively. Thereby, the expected tax liability depends on the firm's tax reporting decision and the tax authority's auditing decision. That is, issuing a correct tax report leads to a tax liability which is always equivalent to the report. However, in the case of an understated tax report, the expected tax liability depends on the tax authority's audit decision. The tax liability in the case of a biased tax report are depicted in table 4.1.

Reporting/ Audit Decision	$x_{TA} = 1$	$x_{TA} = 0$
$\bar{t}$, $\hat{t} = \underline{t}$	$\bar{t} + \delta$	$\underline{t}$
$\underline{t}$, $\hat{t} = \bar{t}$	$\underline{t}$	$\bar{t}$

Table 4.1: Firm's tax liability depending on the audit and reporting decisions

4.4 Equilibrium Analysis

The decision of the tax authority takes place after the firm has released its financial statement and its tax report. However, the tax authority observes only the outcome of the chosen tax reporting strategy. The firm's strategy itself, i.e., whether a correct or biased tax report was sent, remains concealed. Therefore, the reporting decision of the firm and the audit decision of the tax authority can be seen as strategically simultaneous (Crawford and Sobel, 1982). The model is solved using backward induction. First, the firm's reporting and the tax authority's auditing strategy are determined. Then, anticipating subsequent behavior the firm decides on an investment amount in an existing project to maximize its expected after-tax income.

4.4.1 Dominated Strategies

We now turn to the equilibrium analysis. Recall that the firm is interested in a high project outcome, a concomitant high financial statement and a low tax report to achieve a low tax liability. Accordingly, the firm never benefits from biasing a low correct tax report $\underline{t}$ of the project outcome. A true $\underline{t}$ will never be corrected upon audit. In contrast, the tax authority is interested in maximizing the tax revenue comprising the firm's tax liability and the potential penalty due to a detected understated tax report. Therefore, a high tax report, i.e., $\bar{t}$, will never be audited because an audit is a costly task and no additional tax revenue can be generated. This is summarized in lemma 4.1.

Lemma 4.1. *The following actions will not occur in equilibrium:*

1. *The firm will never bias a correct tax report* $\hat{t} = \underline{t}$.
2. *The tax authority will never audit a tax report* $\hat{t} = \bar{t}$.

The game tree depicted in figure 4.2 displays those strategies which are not dominated.

4.4.2 Equilibrium Strategies

Considering extremely high or low tax audit costs would cause pure-strategy equilibria. However, we focus on more realistic mixed-strategy equilibria where the firm and the tax authority apply probabilistic tax reporting and auditing strategies. Therefore, we assume throughout the analysis that $k < \bar{t} - \underline{t} + \delta$ holds true. Then, the firm randomizes between

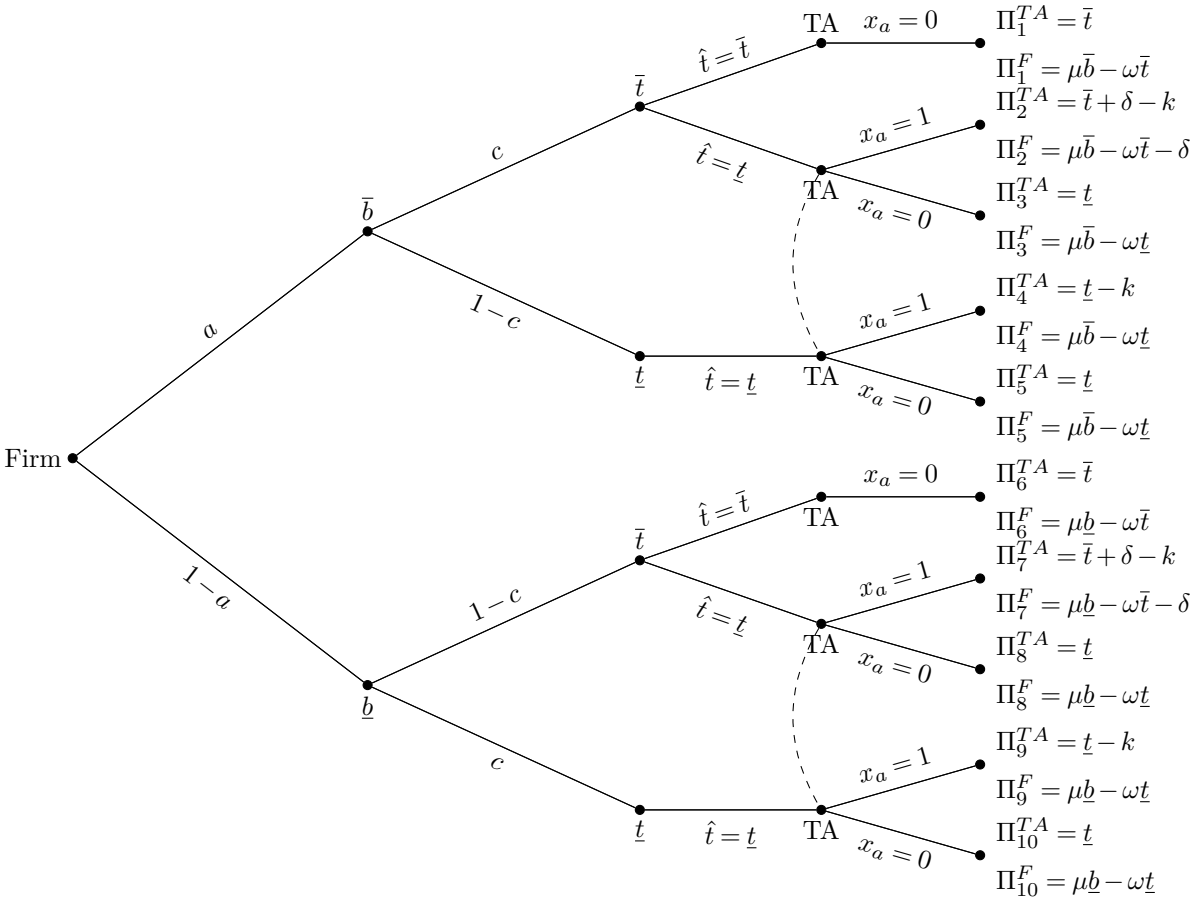

Figure 4.2: Game tree without dominated strategies

understating a correct tax treatment $\bar{t}$ and a truthful report. The tax authority, in turn, audits a tax report $\hat{t} = \underline{t}$ with a positive probability.

Proposition 4.1. *The equilibrium strategies of the tax authority and the firm are as follows:*

1. *The tax authority audits a tax report $\hat{t} = \underline{t}$ with probability $\gamma = \frac{\omega(\bar{t}-\underline{t})}{\omega(\bar{t}-\underline{t})+\delta}$.*
2. *The firm of type $(\bar{b},\bar{t})$ understates the tax report with probability $\phi = \frac{(1-c)k}{c(\bar{t}-\underline{t}+\delta-k)}$.*
3. *The firm of type $(\underline{b},\bar{t})$ understates the tax report with probability $\eta = \frac{ck}{(1-c)(\bar{t}-\underline{t}+\delta-k)}$.*
4. *The misreporting probability is higher in terms of conforming reports, i.e., $\phi < \eta$.*

Proof. See appendix. □

The tax authority's audit probability and the firm's tax reporting strategy are in line with prior theoretical work. In particular, proposition 4.1 replicates equilibrium behavior in a standard tax inspection game which is well known in the literature (e.g. Mills and Sansing, 2000; Blaufus et al., 2017). Moreover, proposition 4.1 shows that the tax authority's audit incentives and the firm's reporting incentives are reflected in the respective equilibrium strategy. In particular, for high preferences of the firm regarding the tax report ω or high tax savings in the case of an understated tax report, i.e. high $\bar{t} - \underline{t}$, an understated tax report seems especially worthwhile. However, higher incentives to understate the tax report, in turn, are incorporated in the tax authority's audit probability. Accordingly, high penalties in the case of a detected understated tax report lead to a low probability of an understated tax report. Anticipating this, the tax authority audits low tax reports less frequently when the penalty is high. Furthermore, proposition 4.1 shows that the equilibrium strategies also depend on the level of mandatory book-tax conformity, i.e., on the correlation between GAAP and tax law. Basically, the firm's tax reporting strategy depends on the project outcome, i.e., whether the investment in the existing project was a success or a failure. Moreover, the firm considers that the financial statement is informative regarding the correct tax treatment of the project outcome. Therefore, the expected tax consequences depend on both the expected project outcome and the book-tax conformity. Observing a low financial statement indicates that a tax report $\hat{t} = \underline{t}$ might be correct with a high probability because the financial statement and the tax report are strongly correlated. Therefore, a firm with negative book-tax differences, i.e., type $(\underline{b},\bar{t})$, can better mimic a low-conforming type, i.e., $(\underline{b},\underline{t})$ rather than a high non-conforming type, i.e., type $(\bar{b},\bar{t})$ can mimic a firm with positive book-tax differences, i.e., $(\bar{b},\underline{t})$. Therefore, a conforming understated report occurs more frequently than a non-conforming understated tax report, i.e., $\phi < \eta$.

With a high level of mandatory book-tax conformity, the probability of an understated tax report can either increase or decrease depending on the project outcome. The

tax authority updates its beliefs regarding the true type of the firm dependent on the observed financial statement. That is, observing a high financial statement $\overline{b}$ the tax authority anticipates that a high tax report is more likely for a high book-tax conformity c. Consequently, a report $\hat{t} = \underline{t}$ is understated with a high probability. Therefore, the firm understates its tax report less frequently to ensure the tax authority's indifference condition. For a financial statement $\underline{b}$, the probability of a low correct tax report increases with increasing mandatory book-tax conformity. Therefore, the tax audit incentives decrease and the firm of type $(\underline{b},\overline{t})$ can better mimic a low conforming type for a high level of mandatory book-tax conformity.

Corollary 4.1. *Increasing mandatory book-tax conformity leads to less understated non-conforming tax reports, i.e., the probability of a report $(\overline{b},\hat{t} = \underline{t})$ decreases, while the probability of conforming understated tax reports, i.e., $(\underline{b},\hat{t} = \underline{t})$, increases with book-tax conformity.*

Proof. See appendix. □

4.4.3 The Effect of Book-Tax Conformity Neglecting Real Effects

Prior theoretical work has focused on the effects of book-tax conformity on firms' reporting behavior. Disentangling the occurring effects is appealing because it allows investigating the impact of tighter book-tax regulation on a single aspect. Nevertheless, empirical work draws conclusions regarding the impact of increasing book-tax conformity on a firm's tax payments (Chan et al., 2013). To provide a theoretical foundation for empirical research regarding book-tax conformity we conduct an analysis considering both reporting and real effects. First, we investigate the effect of book-tax-conformity neglecting real effects to draw inferences regarding firms' reporting behavior. In particular, we investigate the effect of book-tax conformity on the expected tax revenue without endogenizing the firm's investment decision. In contrast to prior research, we consider the possibility that the probability of a high project outcome and a concomitant high financial statement varies. That is, instead of assuming a high or a low financial statement are equally likely, we acknowledge that the probability of a high financial statement depends on the underlying project.

Empirical findings of Atwood et al. (2012) and Chen and Gavious (2017) indicate that high book-tax conformity induces less tax evasion. With decreasing understated tax reports the tax revenue is expected to increase. Therefore, prior research hypothesizes that increasing book-tax conformity is beneficial for the tax authority because the expected tax revenues increase. In terms of an inspection game and in line with prior work of Blaufus et al. (2017), we interpret the ex ante probability of an understated tax report as a measure for tax evasion:

$$Prob(\hat{t} = \underline{t} | t = \overline{t}) = a \cdot c \cdot P\{\overline{b},\hat{t} = \underline{t}) \mid (\overline{b}, t = \overline{t})\} + (1-a)(1-c) \cdot P\{(\underline{b},\hat{t} = \underline{t}) \mid (\underline{b},\overline{t})\}.$$

Whether the firm's tax reporting strategy leads to more or less understated tax reports, i.e., more or less tax evasion, depends on the project outcome. High book-tax conformity induces more truthful tax reporting for a high conforming type of the firm, i.e., $(\overline{b},\overline{t})$, whereas the opposite is true for a low non-conforming type of the firm, i.e., $(\underline{b},\overline{t})$. That is, increasing book-tax conformity can lead to more tax evasion in terms of more understated conforming reports. Therefore, the impact of increasing book-tax conformity on the ex ante expected tax revenue for the tax authority is ambiguous and can lead to increasing or decreasing ex ante expected tax revenues. Consequently, the effect of increasing mandatory book-tax conformity depends on the probability of a high project outcome and a concomitant high financial statement. This result is summarized in lemma 4.2.

Lemma 4.2. *The probabilities for a correct high tax report and the expected tax revenue are increasing (decreasing) with increasing book-tax conformity if a high project outcome and a concomitant high financial statement occur with a high (low) probability, i.e., for* $a > \frac{1}{2}$ *(for* $a < \frac{1}{2}$*).*

Proof. See appendix. □

In line with empirical findings of Atwood et al. (2012) and Chen and Gavious (2017), this result suggests that high book-tax conformity can induce less tax evasion. Nevertheless, the effect of book-tax conformity is ambiguous and depends on the probability of success or failure of the firm's project. Thereby, increasing the mandatory book-tax conformity can either have a beneficial or a detrimental effect on the tax authority's expected tax revenue. On the one hand, firms can face projects which lead to a high outcome and a concomitant high financial statement with a high probability. In the case of a high financial statement, increasing book-tax conformity eliminates uncertainty regarding the correct tax report. In particular, for a high financial statement and perfectly correlated reports, the tax authority knows with certainty that the tax report must be also high. Therefore, increasing mandatory book-tax conformity limits the firm's reporting discretion in case of a high financial statement. On the other hand, firms can face projects which lead with a high probability to a low project outcome and a concomitant low financial statement. In this case, an increasing mandatory book-tax conformity leads to decreasing expected tax revenues of the tax authority. This result occurs because the probability of a correct low tax report is increasing in book-tax conformity for a low financial statement. The expected tax revenue and the probability of an understated tax report depending on book-tax conformity are depicted in figure 4.3.

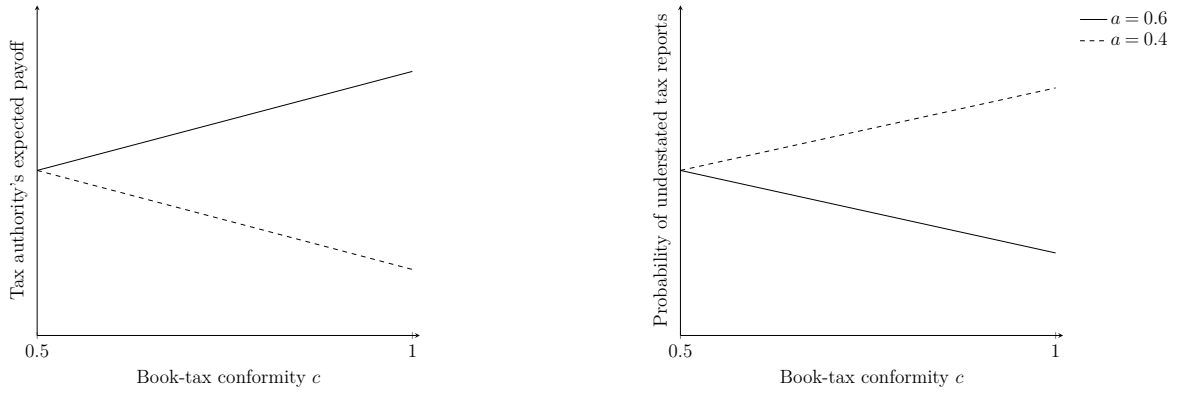

Figure 4.3: Expected tax revenue and the probability of an understated tax report depending on book-tax conformity c (plotted for $(\bar{t}-\underline{t}) = (2-1)$, $\delta = 1.25$, $k = 0.75$)

In the next section, we endogenize the investment decision and analyze the corresponding effects of increasing mandatory book-tax conformity.

4.4.4 Optimal Investment Decision

Basically, an investment in an existing project typically influences the project outcome because additional capital or personally costly effort will generally increase the probability of success. The probability of a high financial statement increases with increasing investment amount because we assume a perfect correlation between the financial statement and the project outcome. The firm decides on the investment amount to achieve a high project outcome and a concomitant high financial statement considering investment costs and subsequent tax reporting consequences. In equilibrium, both the tax authority and the firm are indifferent whether to conduct an audit or not and whether to report the taxable income truthful or untruthful. Therefore, the firm's expected payoff in the case of a truthful tax report equals its expected payoff in the case of an untruthful tax report. As a consequence, the expected tax liability depends on the probability of a low or a high financial statement and the level of mandatory book-tax conformity. The firm's ex ante expected payoff incorporating equilibrium behavior is given by

$$\mathbb{E}[\Pi_F(a)] = a\left(\mu\bar{b} - \omega(c\bar{t} + (1-c)\underline{t})\right) + (1-a)\left(\mu\underline{b} - \omega(c\underline{t} + (1-c)\bar{t})\right) - \frac{za^2}{2}. \tag{4.1}$$

Thus, the firm maximizes its expected payoff by investing

$$\begin{aligned} \frac{\partial \mathbb{E}[\Pi_F(a)]}{\partial a} &= \mu(\bar{b}-\underline{b}) - c\omega\bar{t} - (1-c)\omega\underline{t} + (1-c)\omega\bar{t} + c\omega\underline{t} - za \overset{!}{=} 0 \\ \iff a^* &= \frac{\mu(\bar{b}-\underline{b}) + (1-2c)\omega(\bar{t}-\underline{t})}{z} \geq 0. \end{aligned} \tag{4.2}$$

The firm always invests a positive amount a if the firm is more sensitive to the financial statement, i.e., $\mu(\bar{b}-\underline{b}) \geq \omega(\bar{t}-\underline{t})$.

Proposition 4.2. *The firm maximizes its after-tax profit choosing an investment amount* a^*.

Proof. See appendix. □

The investment amount decreases if the investment becomes costlier. Therefore, high mandatory book-tax conformity is detrimental for the investment incentives because a high expected tax liability must be considered.

Corollary 4.2. *Investment incentives are deteriorated by a high level of mandatory book-tax conformity.*

Proof. See appendix. □

Firms let potential pre-tax profits forgo by accepting a high probability of a low project outcome if the benefit gained by a high investment in the existing project is devoured by a high tax liability. This occurs independently of the height of the firm's preferences regarding the financial statement. In summary, the firm achieves a low tax liability due to two different effects. First, the firm can use tax reporting discretion and minimize the tax liability issuing an understated tax report. Second, the firm can choose a low investment amount because high mandatory book-tax conformity leads to a high expected tax liability since tax-related investment incentives cannot be provided. Both effects are crucial to evaluate the consequences of a varying level of mandatory book-tax conformity.

4.5 Comparative Statics

In this section, we analyze the impact of a varying level of mandatory book-tax conformity on the firm's and the tax authority's expected payoff. First, we consider the firm's expected payoff. Maximizing the expected payoff the firm chooses an investment amount a^* and applies a tax reporting strategy depending on the project outcome to minimize the expected tax liability. Inserting the optimal investment amount a^* in the firm's expected payoff yields

$$\begin{aligned}\mathbb{E}[\Pi_F(a^*)] =& a^*\mu\bar{b} + (1-a^*)\mu\underline{b} - \frac{z{a^*}^2}{2} - \omega(a^*(c\bar{t} + (1-c)\underline{t}) + (1-a^*)(c\underline{t} + (1-c)\bar{t}) \\ \Leftrightarrow& \underbrace{\frac{1}{2z}\left(2z\mu\underline{b}\mu^2(\bar{b}-\underline{b})^2 - (1-2c)^2\omega^2(\bar{t}-\underline{t})^2\right)}_{\text{Exp. Pre-tax Profit}(\Pi_F^{pre-tax})} \\ & \underbrace{- \frac{\omega}{z}\left(z(c\underline{t} + (1-c)\bar{t}) - (1-2c)(\bar{t}-\underline{t})(\mu(\bar{b}-\underline{b}) - (1-2c)\omega(\bar{t}-\underline{t}))\right)}_{\text{Exp. Tax Liability}(\Pi_F^{tax})}. \end{aligned} \tag{4.3}$$

The effect of increasing mandatory book-tax conformity on the firm's expected payoff, therefore, depends on the effect on the firm's expected pre-tax profits and on the expected tax liability. Interestingly, increasing book-tax conformity leads to decreasing expected pre-tax profits of the firm:

$$\frac{\partial \Pi_F^{pre-tax}}{\partial c} = \frac{1}{2z}\left(-(8c-4)\omega^2(\bar{t}-\underline{t})^2\right) < 0. \tag{4.4}$$

This occurs because the investment decision is based on the after-tax profit of the investment. With high book-tax conformity, an investment becomes costlier due to a less favorable tax treatment. Thus, the optimal investment amount decreases because the marginal costs increase with increasing book-tax conformity. Therefore, the probability of a high project outcome, i.e., a high pre-tax profit, is low.

While increasing book-tax conformity always leads to decreasing expected pre-tax profits, the effect on the expected tax liability is ambiguous. Increasing book-tax conformity can increase or decrease the probability of an understated tax report depending on the probability of a high project outcome. Differentiating the expected tax liability with respect to c yields

$$\frac{\partial \Pi_F^{tax}}{\partial c} = \frac{\omega}{z}\left(-z(\bar{t}-\underline{t}) + 2\mu(\bar{b}-\underline{b})(\bar{t}-\underline{t}) - (8c-4)\omega(\bar{t}-\underline{t})^2\right). \tag{4.5}$$

Whether the expected tax liability is increasing or decreasing in the book-tax conformity depends on the level of baseline mandatory book-tax conformity. That is,

$$\frac{\partial \Pi_F^{tax}}{\partial c} \begin{cases} > 0 & \text{if } c < \overline{c}_{TA} = \frac{2\mu(\bar{b}-\underline{b})+4\omega(\bar{t}-\underline{t})-z}{8\omega(\bar{t}-\underline{t})}, \text{ and} \\ < 0 & \text{otherwise.} \end{cases} \tag{4.6}$$

1. For a low level of baseline book-tax conformity, i.e., $c < \overline{c}_{TA}$, the tax-based investment incentives are high because, for a high project outcome, a preferential tax treatment occurs with high probability. Consequently, the firm chooses a high investment amount and a correct high tax report is understated with positive probability. For a marginal increase of book-tax conformity, the investment incentives are still sufficient to induce an investment amount which leads with a high probability to a high project outcome and a concomitant high financial statement. However, increasing book-tax conformity increases the probability of a correct high tax report. Thus, the tax authority's audit incentives also increase. Anticipating higher audit incentives, the firm understates the tax report less frequently. Thereby, the expected tax liability is increasing in case of increasing book-tax conformity.

2. For a high level of baseline book-tax conformity, i.e., $c \geq \overline{c}_{TA}$, the tax-based investment incentives are low because, for a high project outcome, a preferential tax

treatment occurs with low probability. Investment incentives are low and an increasing mandatory book-tax conformity additionally harms the investment incentives. Thereby, a low optimal investment amount results so that a low project outcome and a concomitant low financial statement occur with high probability and make a low correct tax report more likely. Therefore, the audit incentives decrease and the firm understates the tax report more frequently. Therefore, the expected tax liability is decreasing with increasing book-tax conformity.[23]

With an ambiguous effect on the expected tax liability, the overall effect of increasing book-tax conformity on the firm's expected payoff depends on the baseline level of mandatory book-tax conformity

$$\frac{\partial \Pi_F}{\partial c} > 0 \text{ for } c > \overline{c}_F = \frac{2\mu(\overline{b} - \underline{b}) + 2\omega(\overline{t} - \underline{t}) - z}{4\omega(\overline{t} - \underline{t})}. \tag{4.7}$$

That is, the effect of a decreasing expected tax liability outweighs the effect of decreasing pre-tax profits when the baseline level of book-tax conformity exceeds $\overline{c}_F$. Thus, for sufficiently low level of baseline book-tax conformity, i.e., $c < c_F$, the firm's expected payoff is decreasing. This can occur due to two different reasons. On the one hand, the firm's expected pre-tax profit is always decreasing in c independent of the level of the baseline book-tax conformity. On the other hand, the expected tax liability can increase in the book-tax conformity for a low level of baseline book-tax conformity. Both effects lead to a decreasing expected payoff of the firm. Nevertheless, the expected tax liability can also decrease with increasing book-tax conformity. However, the marginal benefit from a decreasing expected tax liability cannot outweigh the marginal loss from a decreasing expected pre-tax profit. In sum, the expected payoff of the firm decreases for a low level of baseline book-tax conformity.

For a high level of baseline book-tax conformity, i.e., $c > \overline{c}_F$, the firm's expected payoff is increasing with increasing book-tax conformity. The decreasing expected pre-tax profits are outweighed by sufficiently high expected tax savings.

The effect on the tax authority's expected payoff, however, depends on the threshold $\overline{c}_{TA}$. An increasing expected tax liability is beneficial for the tax authority. When the baseline level of book-tax conformity is sufficiently small, i.e., $c < \overline{c}_{TA}$, the firm's expected tax liability increases and, consequently, the tax authority's expected payoff increases. On the other hand, with a sufficiently high level of baseline book-tax conformity, i.e.,

[23] Depending on the firm's investment incentives like the investment costs z and the preferences about the financial statement μ, it is feasible that the expected tax liability is always increasing or decreasing in book-tax conformity. That is, for high investment costs or low preferences about the financial statement investment incentives are so low that the firm always chooses a low investment amount and an increasing book-tax conformity always decreases the expected tax liability ($\overline{c}_{TA} < 0.5 < c$). For low investment costs or high preferences about the financial statement, investment incentives are high. Consequently, deteriorated investment incentives due to increasing book-tax conformity can be neglected and the expected tax liability always increases due to less understated tax reports ($c < 1 < \overline{c}_{TA}$).

$c > \overline{c}_{TA}$, the tax authority's expected payoff is decreasing due to the decreasing expected tax liability resulting from the forgoing of expected pre-tax profits of the firm. The effects of increasing book-tax conformity on the firm's and the tax authority's expected payoff are summarized in lemma 4.3.

Lemma 4.3. *1. For a low (high) level of baseline book-tax conformity, i.e., $c < c^F$ ($c > c^F$) the firm's expected payoff is decreasing (increasing) with increasing book-tax conformity.*

2. For a low (high) level of baseline book-tax conformity, i.e., $c < c^{TA}$ ($c > c^{TA}$) the tax authority's expected payoff is increasing (decreasing) with increasing book-tax conformity.

Proof. See appendix. □

The threshold values of the firm and the tax authority which determine whether the firm's and the tax authority's expected payoff increase or decrease with increasing book-tax conformity do not coincide. When the baseline level of book-tax conformity exceeds $\overline{c}_{TA}$ an increasing book-tax conformity always decreases the expected tax liability and, therefore, decreases the tax authority's expected payoff. However, a decreasing expected tax liability is not necessarily associated with an increasing expected payoff of the firm due to decreasing expected pre-tax profits. That is, an increasing tax authority's expected payoff is not always associated with a decreasing firm's expected payoff and vice versa. The difference between the threshold values is given by

$$\overline{c}_F - \overline{c}_{TA} = \frac{2\mu(\overline{b} - \underline{b}) - z}{8\omega(\overline{t} - \underline{t})}. \tag{4.8}$$

This shows that the threshold $\overline{c}_{TA}$ is always greater than $\overline{c}_F$ for high investment costs, i.e., $z > 2\mu(\overline{b} - \underline{b})$. Nevertheless, for high investment costs both thresholds are always smaller than 0.5, i.e., $\overline{c}_F < \overline{c}_{TA} < 0.5 < c$. Thus, the expected tax liability is decreasing with increasing book-tax conformity. This effect outweighs the effect of decreasing expected pre-tax profits. Consequently, the tax authority's expected payoff is decreasing while the firm's expected payoff increases.

Contrary, with low investment costs, i.e., $z < 2\mu(\overline{b} - \underline{b})$, the threshold $\overline{c}_{TA}$ is smaller than $\overline{c}_F$ where $0.5 < \overline{c}_{TA} < \overline{c}_F < 1$ results. The effect of varying book-tax conformity in the case of low investment costs is depicted in figure 4.4.

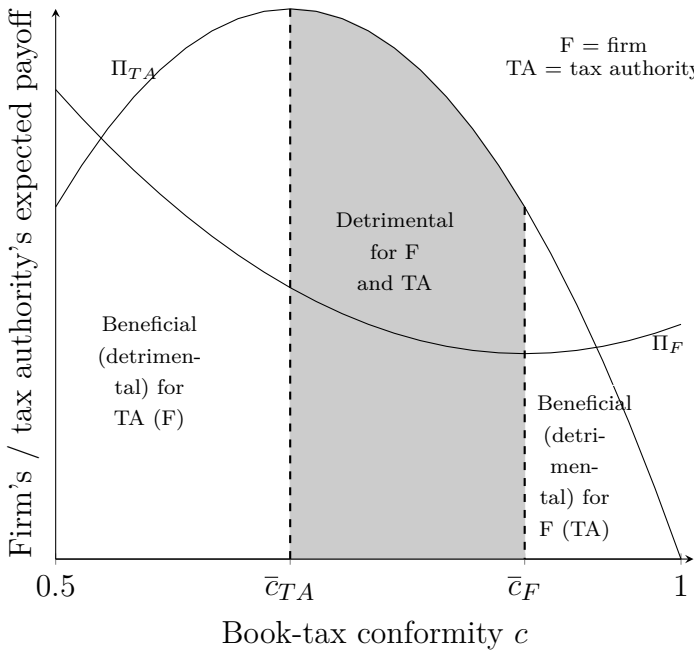

Figure 4.4: Expected tax revenue and expected firm payoff depending on book-tax conformity c (plotted for $\mu = 2$, $\omega = 1$, $(\overline{b} - \underline{b}) = (\overline{t} - \underline{t}) = (2 - 1)$, $z = 2.5$, $\delta = 1.25$, $k = 0.75$).

With a sufficiently low (high) level of baseline book-tax conformity an increasing (decreasing) tax authority's expected payoff is always associated with a decreasing (increasing) firm's expected payoff. Interestingly, for an intermediate level of baseline book-tax conformity both the tax authority's and the firm's expected payoff decrease with increasing book-tax conformity. Due to the less favorable tax treatment the firm chooses a low investment amount, thereby, reducing the expected tax liability. However, the effect of decreasing expected pre-tax profits outweighs the effect of a decreasing expected tax liability leading to a decreasing firm's expected payoff. The results are summarized in Proposition 4.3.[24]

Proposition 4.3. *Increasing mandatory book-tax conformity*

1. *increases (decreases) the tax authority's (firm's) expected payoff for* $z < z_{TA}$ *or* $z \in [z_{TA}, \overline{z}]$ *and* $c < \overline{c}_{TA}$,
2. *decreases both the tax authority's and the firm's expected payoff for* $z \in [z_{TA}, z_F]$ *and* $c > \overline{c}_{TA}$ *or* $z \in [z_F, \overline{z}]$ *and* $c \in [\overline{c}_{TA}, \overline{c}_F]$, *and*
3. *decreases (increases) the tax authority's (firm's) expected payoff for* $z \in [z_F, \overline{z}]$ *and* $c > \overline{c}_F$ *or* $z > \overline{z}$.

Proof. See appendix. □

[24] The threshold values for z are stated in the appendix.

4.6 Conclusion

Allowing firms to reveal relevant information to investors without facing monetary consequences like a higher tax liability is the primary benefit of book-tax differences (Atwood et al., 2010). Moreover, tax authorities can influence firm behavior in their favor, for instance by tax exemptions and tax deductibility. These measures necessarily lead to book-tax differences because GAAP reporting aims at providing relevant information to investors instead of inducing certain behavior. This highlights the comparative advantage of book-tax differences relative to simply lowering the tax rate to increase firms' after-tax profits. At first sight, one might infer that lowering the tax rate provides higher investment incentives due to the additional after tax-income.

Recently, the U.S. Tax Cuts and Jobs Act of 2017 was intended to significantly increase labor supply and business investments. The substantially decreased corporate tax rate endows firms with higher funds which can be invested in profitable economic growth. However, up to now, no considerable effect is recognized. Moreover, CEOs argue that corporate tax cuts would not substantially increase investments (The New York Times, 2017). The additional after-tax income is used for other forms of spending. Thus, instead of omnidirectional tax benefits, a design that could provide specific investment incentives might do a better job. Book-tax differences might be an appropriate means. However, governments and supranational organizations are concerned with large book-tax differences because book-tax differences also provide large reporting discretion. In particular, low mandatory book-tax conformity can foster opportunistic reporting behavior of taxpayers. Specifically, firms can bias their taxable income downwards while engaging in upwards earnings manipulation. Accordingly, regulators consider opportunities to better align financial statements and tax reports to curtail tax evasion by means of book-tax differences. Nevertheless, reducing book-tax differences counteracts the possibility to incentivize specific firm behavior. In particular, high book-tax conformity does not allow for regulation affecting only taxpayers' behavior without considering the consequences resulting from the investors' reaction on altered information provided by GAAP reporting. Moreover, whether a financial statement which is driven by accounting standards that are intended to induce specific behavior provides information meeting the criteria of decision usefulness and relevance is at least questionable and needs careful consideration. Due to the aforementioned countervailing effects, a prosperous debate regarding the minimization of book-tax differences is prevalent. However, the consequences of tightening regulation regarding the allowance of book-tax differences are widely unexplored.

We argue that prior research regarding book-tax differences neglects effects on firms' decision making beyond pure reporting decisions. In contrast, we study firms' investment behavior considering that both the tax report and the financial statement are affected. Increasing book-tax conformity is detrimental for investment decisions by providing fewer

incentives due to less preferential tax treatment. Prior work (Atwood et al., 2012; Chen and Gavious, 2017) suggest that an increasing mandatory book-tax conformity induces less tax-aggressive reporting. Therefore, they conclude that high book-tax conformity might be beneficial. In line with prior research, we show that high book-tax conformity leads to less understated non-conforming tax reports. Nevertheless, our results indicate that investigating solely reporting behavior in the context of book-tax differences seems to be myopic. In particular, the joint consideration of reporting and investment behavior shows that increasing book-tax conformity can either increase or decrease tax authority's expected tax revenue depending on the level of baseline book-tax conformity because firms might be willing to forgo pre-tax profits. Therefore, the expected tax liability might decrease. Thus, the effect of increasing book-tax conformity depends on the tax-independent investment incentives and the level of baseline book-tax conformity because increasing mandatory book-tax conformity affects both the firm's investment decision and the corresponding expected tax liability. Interestingly, for an intermediate level of baseline book-tax conformity, an increasing book-tax conformity is detrimental for both the firm's and the tax authority's expected payoff.

Recently, governments and tax authorities seek to curtail book-tax differences. Our analysis demonstrates that the consequences of increasing book-tax conformity depend on several, potentially unobservable parameters. This emphasizes the complexity that legislators, tax authorities, and supranational organizations like the European Union need to consider when designing regulation regarding book-tax conformity. Regulators should bear in mind the trade-off between providing investment incentives and inducing less tax-aggressive reporting. Thus, the real effects of increasing mandatory book-tax conformity should be considered instead of solely focusing on reporting behavior.

4.7 Appendix

Proof of Proposition 4.1

Never auditing report $\hat{t} = \overline{t}$ and never overstating report $\hat{t} = \underline{t}$ simply follows from the tax authority's and firm's preferences.

The tax authority's equilibrium audit probability for report $\hat{t} = \underline{t}$ can be derived from the indifference of the firm between truthful and untruthful reporting. The firm of type $(b, \overline{t})$ is indifferent between truthful and understated reports for

$$\begin{aligned} \mu b - \gamma(\omega\overline{t} + \delta) - (1-\gamma)\omega\underline{t} &= \mu b + \omega\overline{t} \\ \Leftrightarrow \gamma &= \frac{\omega(\overline{t} - \underline{t})}{\omega(\overline{t} - \underline{t}) + \delta}. \end{aligned}$$

The firm's equilibrium reporting probability can be derived from the indifference of the tax authority between auditing and not auditing report $\hat{t} = \underline{t}$. This is given for a high financial statement $(\overline{b})$ for

$$\begin{aligned} c\phi(\overline{t} + \delta - k) + c(1-\phi)\overline{t} + (1-c)(\underline{t} - k) &= (c\phi + (1-c))\underline{t} + c(1-\phi)\overline{t} \\ \Leftrightarrow \phi &= \frac{(1-c)k}{c((\overline{t} - \underline{t}) + \delta - k)}. \end{aligned}$$

The tax authority is indifferent between auditing and not auditing the report $\hat{t} = \underline{t}$ given $\underline{b}$ for

$$\begin{aligned} c(\overline{t} - k) + (1-c)\eta(\overline{t} + \delta - k) + (1-c)(1-\eta)\overline{t} &= (1-c)(1-\eta)\overline{t} + (c + (1-c)\eta)\overline{t} \\ \Leftrightarrow \eta &= \frac{ck}{(1-c)((\overline{t} - \underline{t}) + \delta - k)}. \end{aligned}$$

The firm of type $\underline{b}$ understates more often:

$$\phi = \frac{(1-c)k}{c((\overline{t} - \underline{t}) + \delta - k)} < \eta = \frac{ck}{(1-c)((\overline{t} - \underline{t}) + \delta - k)} \Leftrightarrow (1-c) < c.$$

Proof of Corollary 4.1

The firm of type $\overline{b}$ understates $\overline{t}$ with probability ϕ. Differentiating the probability ϕ with respect to c shows that the probability of an understatement decreases with higher book-tax-conformity:

$$\frac{\partial \phi}{\partial c} = \frac{-k}{c^2(\overline{t} - \underline{t} + \delta - k)} < 0.$$

The firm of type $\underline{b}$, instead, understates $\bar{t}$ with probability η. Differentiating with respect to c reveals that the probability of an understatement increases with higher book-tax conformity:

$$\frac{\partial \eta}{\partial c} = \frac{k}{(1-c)^2(\bar{t}-\underline{t}+\delta-k)} > 0.$$

Proof of Lemma 4.2

In mixed-strategies the expected tax revenue can be written as

$$\begin{aligned}\Pi_{TA}[a] =& (ac\phi + (1-a)(1-c)\eta + a(1-c) + (1-a)c)\,\underline{t} \\ &+ (ac(1-\phi) + ((1-a)(1-c)(1-\eta))\,\bar{t}.\end{aligned}$$

Inserting the equilibrium probabilities ϕ and η and differentiate with respect to c yields

$$\frac{\partial \Pi_{TA}}{\partial c} = (a-(1-a))\left(1+\frac{k}{(\bar{t}-\underline{t}+\delta-k)}\right)(\bar{t}-\underline{t})$$

with

$$\frac{\partial \Pi_{TA}}{\partial c}\begin{cases} <0 & \text{if } a<0.5, \\ =0 & \text{if } a=0.5 \text{ and} \\ >0 & \text{if} a>0.5. \end{cases}$$

The expected probability of misreporting and the probability of low tax reports can be written as

$$\begin{aligned}P(\hat{t}=\underline{t}|t=\bar{t}) &= ac\phi + (1-a)(1-c)\eta \text{ and} \\ P(\underline{t}) &= ac\phi + (1-a)(1-c)\eta + a(1-c) + (1-a)c\end{aligned}$$

Given the equilibrium probabilities ϕ and η and differentiate with respect to c yields

$$\begin{aligned}\frac{\partial P(\hat{t}=\underline{t}|t=\bar{t})}{\partial c} &= ((1-a)-a)\,\frac{k}{(\bar{t}-\underline{t}+\delta-k)} \text{ and} \\ \frac{\partial P(\underline{t})}{\partial c} &= ((1-a)-a)\,\frac{\bar{t}-\underline{t}+\delta}{(\bar{t}-\underline{t}+\delta-k)}\end{aligned}$$

with

$$\frac{\partial P(\hat{t}=\underline{t}|t=\bar{t})}{\partial c}, \frac{\partial P(\underline{t})}{\partial c}\begin{cases} <0 & \text{if } a>0.5, \\ =0 & \text{if } a=0.5 \text{ and} \\ >0 & \text{if} a<0.5. \end{cases}$$

Proof of Proposition 4.2

The firm maximizes the expected after-tax payoff:

$$\mathbb{E}[\Pi_F(a)] = a\left(\mu\bar{b} - \omega(c\bar{t} + (1-c)\underline{t})\right) + (1-a)\left(\mu\underline{b} - \omega(c\underline{t} + (1-c)\bar{t}\right) - \frac{za^2}{2}.$$

Firm chooses investment amount to maximize after-tax profit:

$$FOCa : \mu(\bar{b} - \underline{b}) - c\omega\bar{t} - (1-c)\omega\underline{t} + (1-c)\omega\bar{t} + c\omega\underline{t} - za = 0.$$

The second order condition

$$SOCa = (-z)$$

is negative so that a determines a local maximum. Therefore, the optimal investment level is

$$a^* = \frac{\mu(\bar{b} - \underline{b}) + (1-2c)\omega(\bar{t} - \underline{t})}{z}.$$

Proof of Corollary 4.2

Differentiating the optimal investment level a^* with respect to c yields

$$\frac{\partial a^*}{\partial c} = \frac{-2\omega(\bar{t} - \underline{t})}{z} < 0.$$

The tax valuation $\bar{t}$ always exceeds the valuation $\underline{t}$ so that higher book-tax-conformity always leads to less investment expenditure.

Proof of Lemma 4.3

In equilibrium, inserting the optimal investment amount a^* in the firm's expected payoff can be written as:

$$\mathbb{E}[\Pi_F(a^*)] = \underbrace{\frac{1}{2z}\left(2z\mu\underline{b} + \mu^2(\bar{b} - \underline{b})^2 - (1-2c)^2\omega^2(\bar{t} - \underline{t})^2\right)}_{\text{Exp. Pre-tax Profit}(\Pi_F^{pre-tax})}$$
$$\underbrace{- \frac{\omega}{z}\left(z(c\underline{t} + (1-c)\bar{t}) - (1-2c)(\bar{t} - \underline{t})(\mu(\bar{b} - \underline{b}) - (1-2c)\omega(\bar{t} - \underline{t}))\right)}_{\text{Exp. Tax Liability}(\Pi_F^{tax})}.$$

Differentiating the expected pre-tax profit with respect to c reveals:

$$\frac{\partial \Pi_F^{pre-tax}}{\partial c} = \frac{1}{2z}\left(-(8c-4)\omega^2(\bar{t} - \underline{t})^2\right) < 0.$$

The expected tax liability is increasing or decreasing in the book-tax conformity depending on the baseline level of book-tax conformity:

$$\frac{\partial \Pi_F^{tax}}{\partial c} = \frac{\omega}{z}\left(-z(\bar{t}-\underline{t}) + 2\mu(\bar{b}-\underline{b})(\bar{t}-\underline{t}) - (8c-4)\omega(\bar{t}-\underline{t}^2\right)$$

with

$$\frac{\partial \Pi_F^{tax}}{\partial c}\begin{cases} > 0 & \text{if } c < \overline{c}_{TA} = \frac{2\mu(\bar{b}-\underline{b})+4\omega(\bar{t}-\underline{t})-z}{8\omega(\bar{t}-\underline{t})} \text{ and} \\ < 0 & \text{if } c > \overline{c}_{TA} = \frac{2\mu(\bar{b}-\underline{b})+4\omega(\bar{t}-\underline{t})-z}{8\omega(\bar{t}-\underline{t})}. \end{cases}$$

Differentiating the firm's expected payoff with respect to c reveals that the effect of decreasing expected tax-liability outweighs the effect of decreasing pre-tax profits whenever the baseline level of book-tax conformity exceeds a critical threshold $\overline{c}_F$:

$$\frac{\partial \Pi_F}{\partial c}\begin{cases} > 0 & \text{if } c > \overline{c}_F = \frac{2\mu(\bar{b}-\underline{b})+2\omega(\bar{t}-\underline{t})-z}{4\omega(\bar{t}-\underline{t})} \text{ and} \\ < 0 & \text{if } c < \overline{c}_F = \frac{2\mu(\bar{b}-\underline{b})+2\omega(\bar{t}-\underline{t})-z}{4\omega(\bar{t}-\underline{t})}. \end{cases}$$

In equilibrium, the tax authority's expected payoff can be written as

$$\begin{aligned}\Pi_{TA}(a) =& \underbrace{(ac\phi + (1-a)(1-c)\eta)}_{P(\hat{t}=\bar{t})}\bar{t} \\ &+ \underbrace{(a(1-c) + ac(1-\phi) + (1-a)c + (1-a)(1-c)(1-\eta))}_{P(\hat{t}=\underline{t})}\underline{t}.\end{aligned}$$

Inserting the optimal investment expenditure a^* as well as the equilibrium probabilities ϕ and η yields

$$\begin{aligned}\Pi_{TA}(a^*) =& \frac{1}{z}(z(\bar{t} - c(\bar{t}-\underline{t})(1+\frac{k}{\bar{t}-\underline{t}+\delta-k})) \\ &- (1-2c)(\bar{t}-\underline{t})(\mu(\bar{b}-\underline{b}) + (1-2c)\omega(\bar{t}-\underline{t}))(1+\frac{k}{\bar{t}-\underline{t}+\delta-k})).\end{aligned}$$

Differentating with respect to c reveals

$$\frac{\partial \mathbb{E}[\Pi_{TA}(a^*)]}{\partial c} = \frac{(\bar{t}-\underline{t})(\delta+\bar{t}-\underline{t})(2\mu(\bar{b}-\underline{b}) + 4\omega(\bar{t}-\underline{t})(1-2c) - z)}{(\bar{t}-\underline{t}+\delta-k)z}.$$

Rearranging gives

$$\frac{\partial \mathbb{E}[\Pi_{TA}(a^*[c])]}{\partial c}\begin{cases} > 0 & \text{if } c < \overline{c}_{TA} = \frac{2\mu(\bar{b}-\underline{b})+4\omega(\bar{t}-\underline{t})-z}{8\omega(\bar{t}-\underline{t})} \text{ and} \\ < 0 & \text{if } c > \overline{c}_{TA} = \frac{2\mu(\bar{b}-\underline{b})+4\omega(\bar{t}-\underline{t})-z}{8\omega(\bar{t}-\underline{t})}\ . \end{cases}$$

Proof of Proposition 4.3

For comparison of the firm's and the tax authority's expected payoffs the order of both critical thresholds is needed:

$$\overline{c}_F - \overline{c}_{TA} = \frac{2\mu(\overline{b}-\underline{b}) - z}{8\omega(\overline{t}-\underline{t})}$$

with

$$\overline{c}_F - \overline{c}_{TA} \begin{cases} < 0 & \text{if } z > 2\mu(\overline{b}-\underline{b}) \text{ and} \\ > 0 & \text{if } z < 2\mu(\overline{b}-\underline{b}) \ . \end{cases}$$

Whenever the relevant thresholds ($\overline{c}_{TA}$, $\overline{c}_F$) fall out of the feasible region for the book-tax conformity ($c \in [0.5, 1)$ the baseline level of book-tax conformity exceeds or falls below the critical threshold. One can show that depending on the investment costs z the following holds:

$$\overline{c}_{TA} = \frac{2\mu(\overline{b}-\underline{b}) + 4\omega(\overline{t}-\underline{t}) - z}{8\omega(\overline{t}-\underline{t})} \begin{cases} \leq 0.5 & \text{if } z \geq \overline{z} = 2\mu(\overline{b}-\underline{b}) \text{ and} \\ \in (0.5, 1) & \text{if } z \in (z_{TA} = 2\mu(\overline{b}-\underline{b}) - 4\omega(\overline{t}-\underline{t}), \overline{z}) \text{ and} \\ \geq 1 & \text{if } z \leq z_{TA} \text{ and} \end{cases}$$

$$\overline{c}_F = \frac{2\mu(\overline{b}-\underline{b}) + 2\omega(\overline{t}-\underline{t}) - z}{4\omega(\overline{t}-\underline{t})} \begin{cases} \leq 0.5 & \text{if } z \geq \overline{z} = 2\mu(\overline{b}-\underline{b}) \text{ and} \\ \in (0.5, 1) & \text{if } z \in (z_F = 2\mu(\overline{b}-\underline{b}) - 2\omega(\overline{t}-\underline{t}), \overline{z}) \text{ and} \\ \geq 1 & \text{if } z \leq z_F. \end{cases}$$

Comparison of the thresholds for z reveals that

$$z_{TA} < z_F < \overline{z}.$$

Consequently, the following cases can be summarized:

1. $z < z_{TA}$ so that with increasing book-tax conformity the tax authority's expected payoff increases and the firm's expected payoff decreases,

2. $z_{TA} < z < z_F$ with

   (a) $c < \overline{c}_{TA}$ so that with increasing book-tax conformity the tax authority's expected payoff increases and the firm's expected payoff decreases or

   (b) $\overline{c}_{TA} < c$ so that with increasing book-tax conformity the tax authority's expected payoff decreases and the firm's expected payoff decreases,

3. $z_F < z < \overline{z}$ with

   (a) $c < \overline{c}_{TA}$ so that with increasing book-tax conformity the tax authority's expected payoff increases and the firm's expected payoff decreases or

   (b) $\overline{c}_{TA} < c < \overline{c}_F$ so that with increasing book-tax conformity the tax authority's expected payoff decreases and the firm's expected payoff decreases,

   (c) $\overline{c}_F < c$ so that with increasing book-tax conformity the tax authority's expected payoff decreases and the firm's expected payoff increases and

4. $\overline{z} < z$ so that with increasing book-tax conformity the tax authority's expected payoff decreases and the firm's expected payoff increases.

Chapter 5

International Transfer Pricing and Capacity Planning[†]

Abstract

We study how international transfer pricing regulation affects multinationals' capacity and quantity decisions. Tight transfer pricing regulation curbs multinationals' tax reporting discretion. However, multinationals can realize tax-saving benefits by adapting strategic and operational decisions which might be not pursued by tax authorities. We analyze the impact of cost-plus transfer prices where multinationals can solely affect the cost basis used to calculate the transfer price by its capacity decision. When market uncertainty is present a multinational tends to exhibit excessive capacity because a higher transfer price generates tax-saving benefits. We analyze the effect of taxes and tax regulation on this tendency. We show that the absolute level of capacity is not informative about the probability to exhibit excessive capacity without observing the multinational's organizational form. Nevertheless, for any organizational form, our results show that taxes and transfer pricing regulation increase the probability that multinationals display excessive capacity and are thus, a potential antecedent for organizational slack. This highlights that focusing solely on reporting aspects does not show the full impact of regulation, as real effects remain in the dark.

[†] This chapter is joint work with Katrin Weiskirchner-Merten (Vienna University of Economics and Business)

5.1 Introduction

According to OECD estimates, about one-third of the international trade occurs within multinational companies (MNCs) (Lanz and Miroudot, 2011). This creates a huge potential for MNCs to realize tax savings by means of transfer pricing. MNCs evidently use transfer pricing schemes to shift profits from high-tax to low-tax countries (Blouin et al., 2018; De Simone et al., 2017; Klassen et al., 2017). However, profit shifting deprives governments of tax income so that in recent years, international transfer pricing has been scrutinized by several governments and international organizations. Following the OECD's base erosion and profit shifting (BEPS) project, substantially revised transfer pricing guidelines have been published in 2017 (OECD, 2017). As a consequence, nowadays, MNCs have little scope to legally shift profits through exploiting transfer pricing reporting discretion. Nevertheless, MNCs can still realize tax-saving benefits by adapting strategic and operational decisions.[25]

We examine the impact of international transfer pricing regulation on an MNC's capacity planning and subsequent quantity decision. We consider different organizational forms of the MNC to derive inferences regarding the tax-induced capacity planning and the interdependence with the resulting quantity decision. Empirical evidence by Baersch et al. (2018) documents the predominant use of cost-plus transfer prices by MNCs. Moreover, when no market for an intermediate product exists, the OECD transfer pricing guidelines highlight the cost-plus method as the most useful (OECD, 2017). The guidelines demand the use of full costs plus an appropriate markup where the arm's length requirement needs to be considered. For an MNC with an upstream division in a low-tax jurisdiction and a downstream division in a high-tax jurisdiction, the markup allows the MNC to legally shift profits to the low-tax country while remaining perfectly compliant with the transfer pricing regulation. Moreover, the OECD transfer pricing guidelines explicitly allow the consideration of costs of excessive capacity in the compliant transfer price. We are particularly interested in the following research questions: Does the use of a cost-plus transfer price considering costs of excessive capacity induce an MNC to install excessive capacity? How is the capacity decision of the MNC affected by taxes and transfer pricing regulation? Is the capacity decision informative regarding the MNC's excessive capacity?

We study the raised questions in an analytical model. The downstream division sells a final product in a monopolistic market and purchases an intermediate product from the upstream division as an input factor. The quantity of the intermediate product is chosen after having the installed capacity observed. That is, at the time the quantity decision

[25] The statutory auditing literature posits that real earnings management does not violate generally accepted accounting principles and is consequently not scrutinized (Roychowdhury, 2006; Cohen et al., 2008). Similar, the adaption of operational decisions due to tax motives is in accordance with tax law and therefore not pursued by tax auditors.

is made, the costs for installing capacity are sunk (Balakrishnan and Sivaramakrishnan, 2002). The intermediate product is transferred at a cost-plus transfer price. We study the impact of tax and transfer pricing regulation on the MNC's quantity and capacity decisions for three different organizational forms. First, the headquarters makes both the capacity and the quantity decision (centralization). Second, the headquarters decides on the capacity and delegates the quantity decision to the downstream division (partial delegation). Third, the headquarters additionally delegates the capacity decision to the upstream division (full delegation).

We assume an exogenously given markup that cannot be manipulated and consider a one set of books setting, i.e., the MNC uses a single transfer price for tax reporting and internal decision making. An MNC can disentangle internal quantity decisions from the external reporting using two different transfer prices (Baldenius et al., 2004). Nevertheless, finding two sets of books might indicate that the reported transfer price is solely caused by tax optimization. Therefore, firms that prioritize preventing disputes with the tax authority above tax minimization increasingly refrain from keeping two sets of books. This is reflected in a recent study by Klassen et al. (2017) which reports that only a minority of large US multinationals calculates different transfer prices for external reporting and internal decision making. Baersch et al. (2018) find similar results for German MNCs. Furthermore, Haak et al. (2017) provide theoretical insights that using a single transfer price for different tasks can present equilibrium behavior when the MNC considers the threat of a potential tax audit.

The analysis shows that taxes and transfer pricing regulation are incorporated in an MNC's capacity planning and the subsequent quantity decision. In particular, excessive capacity may comprise a profit shifting benefit. The markup is applied to the full costs including costs of excessive capacity so that a higher share of the MNC's profit is shifted to the low-tax jurisdiction. However, wasted capacity is costly so that the tax-saving effect is not strong enough to induce the MNC to install excessive capacity when no uncertainty regarding the demand for the final product is prevalent. Nevertheless, when uncertainty regarding the demand for the final product is present an MNC typically exhibits excessive capacity. We investigate how this tendency is affected by taxation and transfer pricing regulation. Our model shows that taxes and corresponding regulation increase the probability to exhibit excessive capacity. Moreover, our results highlight that the absolute level of capacity is not informative about the probability to exhibit excessive capacity because this crucially depends on the organizational form of the MNC.

Under delegated capacity decision the arm's length requirement provides investment incentives to the upstream division because the markup leads to overcompensation of the upstream division's costs. Therefore, the upstream division installs the highest possible capacity which can be incorporated in the transfer price. This result confirms the common complaint by downstream divisions that full costs include provisions for organizational

slack (Eccles and White, 1988). In an extension of our model, we show that this effect is mitigated when more than one downstream division asks for the intermediate product. This occurs because a cost-plus transfer price induces interdependence between the otherwise independent downstream divisions' final product markets. Thus, the expected quantities are lower. This is incorporated in the capacity decision.

Full-cost transfer pricing is usually associated with allowing inefficiency costs from production to be passed on to the downstream division (Zimmerman, 2017, p.188). This creates organizational slack (Cyert and March, 1956) which has a bad connotation because the MNC incurs costs without any apparent benefits. Our findings allow a different view on organizational slack in the manifestation of excessive capacity. In the studied setting, the MNC's tendency to install excessive capacity is increased by taxation and government's intervention regarding profit shifting. That is, organizational slack may occur in response to taxes and transfer pricing regulation. This might be an unintended and undesirable consequence. In particular, governments are concerned with inefficiencies like organizational slack because the social welfare of an economy is affected.

Our findings contribute to the literature in three ways. First, by depicting the impact of taxes and transfer pricing regulation on the MNC's capacity decision, we address calls for more research to better understand how tax incentives affect MNC's real investments (Hanlon and Heitzman, 2010). Schwab and Todtenhaupt (2017) find that real responses of domestic firms to tax incentives abroad exist. Their results indicate that the possibility to shift profits to low-tax jurisdictions lowers the MNC's cost of capital in the high-tax countries and increases investment there. De Simone et al. (2018) investigate the relation between tax-motivated income shifting and investment decisions. In particular, they state that higher tax-aggressiveness is associated with greater investments and more produced products but a lower investment efficiency. Reineke and Weiskirchner-Merten (2018) show that profit shifting possibilities influence MNCs' investment decisions related to intangibles. In line with these findings, we highlight that international transfer pricing regulation can induce MNCs to excessively invest in production capacity. Janeba (2000) provides a related insight. He shows that MNCs might hold more capacity than necessary to induce tax competition among governments. The MNC can threaten to serve the market at least partially from a plant in a different tax jurisdiction. Janeba (2000) illustrates that the MNC either underinvests or overinvests depending on the capacity costs. He considers imperfect competitive markets and shows that MNCs may hold excessive capacity to influence the entry or output choice of other oligopolists. In contrast to Janeba (2000), we neither consider the possibility of the MNC to threaten the government nor oligopolistic market conditions but incorporate uncertainty regarding demand in the analysis.

Second, we add to the literature on transfer pricing and capacity decisions (Balakrishnan, 1995; Gavious, 1999; Wielenberg, 2000; Göx, 2001; Göx and Schiller, 2007; Dutta and Reichelstein, 2010; Göx, 2010). While this literature studies the design of transfer

prices when the headquarters or the upstream division decides on capacity, we study the impact of cost-plus transfer prices as determined by transfer pricing regulation on the MNC's capacity decision.

Third, we contribute to the literature on organizational slack. Cyert and March (1956) note that organizational resources in excess of the minimum required for maintenance of the system give rise to a form of organizational slack. According to this, our finding of excessive capacity is a form of organizational slack. Antle and Eppen (1985) establish that rationing and slack with regard to investments are both manifestations of ex post inefficiencies that arise in response to information asymmetry and divergent objectives among members of the firm, i.e., when an agency problem exists. They examine a setting with one manager who has private information about the investment project's profitability. Antle and Fellingham (1990) complement these findings showing that organizational slack can be reduced in a repeated investment context using multi-period contracts. The impact of a public information system on the setting examined by Antle and Eppen (1985) is studied by Antle and Fellingham (1995). The additional information curbs the organizational slack. Arya et al. (1996) extend the model of Antle and Eppen (1985) to a multi-manager setting and highlight that organizational slack might still occur as best response. While our finding of excessive capacity is also an ex post inefficiency, the slack increases in response to taxation and the transfer pricing regulation. Thus, we identify another potential antecedent for organizational slack.

The remainder of the paper proceeds as follows. In the next section, the model is described. In section 5.3 a benchmark case is presented. In particular, we consider the first-best solution without uncertainty. Section 5.4 investigates the capacity and quantity decisions for different organizational forms of the MNC whereas section 5.5 analyzes how taxes and transfer pricing regulation affect these choices. The impact of several downstream divisions on the upstream division's capacity decision under full delegation is discussed in section 5.6. Section 5.7 concludes.

5.2 Model Description

We consider a divisionalized MNC operating in different tax jurisdictions. Specifically, the MNC consists of an upstream division located in a low-tax jurisdiction where its income is taxed at a rate t and a downstream division, which is in a high-tax jurisdiction where an income tax rate $t+h$ prevails, with $0 \leq t$, $h \leq 1$ and $t+h \leq 1$.

The upstream division produces and supplies an intermediate product to the downstream division which utilizes the intermediate product as an input in a final product sold externally. No market exists for the intermediate product. The upstream division faces variable production costs of c which are verifiable to all parties. The downstream division pays the transfer price p_r per unit to the upstream division. Without loss of generality, the production costs of the high-tax downstream division for further processing the inter-

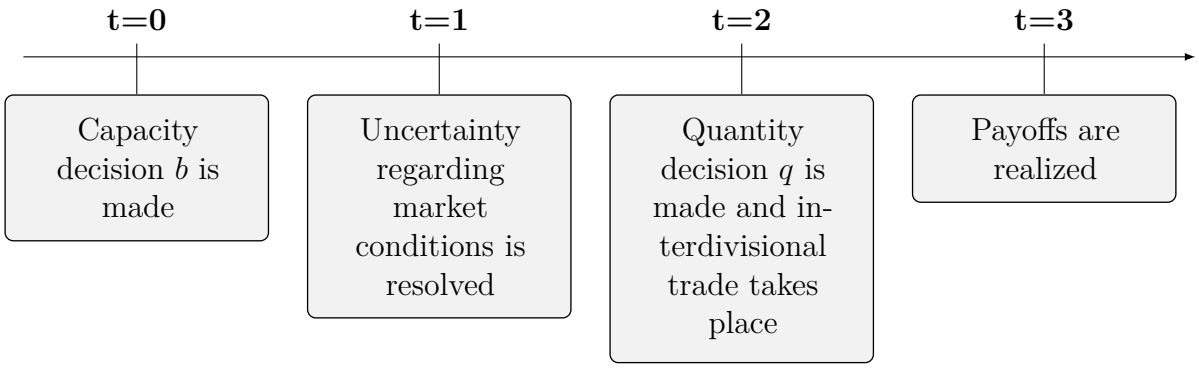

Figure 5.1: Timeline

mediate product is set equal to zero. As depicted in the timeline in figure 5.1, we consider a single period comprising four dates. Before producing the intermediate product and transferring it to the downstream division, capacity needs to be installed at $t = 0$. After the realization of the market conditions in $t = 1$, production and interdivisional trade take place at $t = 2$.

When demand uncertainty is resolved, the downstream division faces a monopolistic market for its final product with revenue function $R(q) = (a - \frac{1}{2}q)q$. The market conditions are represented by the realization a of a random variable A having density $f(a)$ and cumulative distribution function F. The support of A is a closed interval of the positive real line and a is uniformly distributed in $[\underline{a}, \overline{a}]$.

To ensure that our results do not depend on the considered organizational structure of the MNC, we examine different organizational forms. In particular, we consider centralization, partial delegation, and full delegation. Depending on the organizational form, either the headquarters or the divisions decide on the transferred quantity and the installed capacity. First, under centralization, the headquarters decides on the capacity that is installed in the upstream division and on the quantity that is sold externally. Second, we consider the case that the realization of the market demand is solely learned by the downstream division and is not verifiable to the headquarters. This informational advantage of the downstream division provides a basic rationale for delegating the quantity decision to the downstream division (Dutta and Reichelstein, 2010). With partial delegation, the headquarters decides on the capacity which is installed in the upstream division but delegates the quantity decision to the better informed downstream division. Third, the headquarters might not have the necessary technical expertise to decide on the installed capacity (Dutta and Reichelstein, 2010). Since the major tasks of the upstream division are providing, maintaining, and operating the production capacity which is needed to produce the intermediate product, managers of the upstream division typically have the necessary technical expertise. Therefore, under full delegation, the upstream division decides on the installed capacity while the downstream division determines the quantity.

Installing capacity is costly. In line with Dutta and Reichelstein (2010) and Wielenberg (2000), we assume that $k > 0$ denotes the unit cost of capacity installed. Each unit of capacity enables the production of one intermediate product. Each final product comprises one unit of the intermediate product. The cash expenditure of installing $b \geq 0$ units of capacity is given by $b \cdot k$.

In line with the OECD guidelines, the transfer price p_r is set using the cost-plus method. Accordingly, the production's full costs plus an appropriate markup $\gamma > 1$ meet the arm's length requirement. Typically, the intermediate product's full costs include costs of excessive capacity that may result because the market demand is uncertain when the capacity is set up. This is reflected by the common practice of firms to treat setup costs as a constant per unit and to include fixed costs in the applicable transfer price (Bolander et al., 1999). Thus, the compliant arm's length transfer price is given by

$$p_r = \left[c + \frac{k \cdot b}{q} \right] \gamma,$$

where $b \geq q$. Depending on the realization of the market conditions a and the installed capacity b, q can either be produced or not. When the optimal q is smaller than b, the MNC exhibits excessive capacity. Otherwise, the upstream division operates at full capacity so that $q = b$. As a consequence, the transfer price p_r is a function of the quantity transferred to the downstream division (for further explanation, see Baldenius et al., 2004, footnote 18). That is, the transferred quantity affects the transfer price.

Since we are interested in MNCs' transfer pricing when the reporting discretion is restricted due to tight transfer pricing regulation, we assume that the MNC uses the reported arm's length transfer price also for internal decisions. Prior research has stated that finding a different internal transfer price during a tax audit might indicate purely tax-driven transfer prices. This is contrary to the situation where reporting discretion is curbed. Therefore, following the findings of Klassen et al. (2017), Baersch et al. (2018), and Haak et al. (2017), we focus on a one set of books transfer pricing regime.

5.3 Benchmark: First-Best without Risk

This section provides a benchmark to illustrate the role of uncertainty and delegation of the capacity and quantity decision to the respective division. In particular, we examine the capacity and quantity decisions and the resulting transfer price when the headquarters observes the market conditions before the production capacity is installed. Then, the headquarters sets the quantity that is sold on the external market. Moreover, it determines the capacity which is installed in the upstream division, i.e., we consider the first-best solution without uncertainty. The headquarters maximizes its overall after-tax

profit which is given by

$$\Pi_{HQ} = (1-t-h)\left(a-\frac{1}{2}q\right)q + hp_r q - (1-t)(cq+kb). \tag{5.1}$$

Through the transfer pricing scheme, the installed capacity affects the transfer price which in turn influences the quantity decision. Therefore, the headquarters simultaneously decides on the capacity which is installed in the upstream division and the quantity sold by the downstream division. The headquarters' quantity decision is as follows

$$q_{FB} = \frac{(1-t-h)a + hp_r - (1-t)(c+k)}{1-t-h}, \tag{5.2}$$

where $q_{FB} > 0$ for $a > \frac{(c+k)(1-t-h\gamma)}{1-t-h}$. Throughout the paper, we assume $\gamma < (1-t)/h$.[26]

From a pure tax perspective, the headquarters would prefer a high transfer price because profits can be shifted from the high-tax to the low-tax country. Tight transfer pricing regulation and enforcement avoid the use of reporting discretion to manipulate the transfer price upwards. However, ceteris paribus an increasing capacity increases the applicable arm's length price because the cost-plus method requires full costs as the cost basis to calculate the compliant arm's length transfer price. Thus, excessive capacity allows the MNC to shift more profits to the low-tax jurisdiction of the upstream division by increasing the transfer price p_r per unit transferred. Thereby, the tax liability is reduced. However, installing excessive capacity is costly without obtaining any benefits from the final product market. The costs exceed the profit shifting benefits from an increasing transfer price so that in the first-best solution no excessive capacity is installed. The headquarters installs the capacity $b_{FB} = q_{FB}$ in the upstream division and produces q_{FB} in the downstream division. Therefore, the transfer price reduces to $p_r = \gamma(c+k)$ because the upstream division operates at full capacity. Additionally, without any market uncertainty, including costs for excessive capacity would hardly be justifiable in a tax audit because tax auditors scrutinize transfer prices that are artificially high due to tax-saving motives. Lemma 5.1 summarizes these results.

Lemma 5.1. *In a situation without uncertainty, the headquarters installs no excessive capacity, i.e., $b_{FB} = q_{FB}$, in the upstream division. The first-best quantity q_{FB} is produced and transferred at transfer price $p_r = \gamma(c+k)$ to the downstream division.*

Proof. See appendix. □

[26] Considering typical tax rates encountered in practice, having a markup γ larger than $(1-t)/h$ seems very unlikely. For example, for $t = 0.2$ and $h = 0.1$, the markup γ would need to be at least 8. This is a 700% markup on the direct and indirect production cost. Given the examples stated in the OECD transfer pricing guidelines (OECD, 2017) and the typical profitability rates of listed companies, a markup higher than about 50% is most improbable meeting the arm's length requirement.

5.4 Capacity Planning under Tax Regulation

As the benchmark case shows, in a world without market uncertainty no excessive capacity is installed because the profit shifting benefit is not strong enough to outweigh the costs for installing excessive capacity. However, real-world decisions are typically made under uncertainty. For example, market conditions may depend on the success or failure of an advertising campaign or on changing customer taste. Thus, in a more realistic setting, capacity needs to be installed before the actual demand is known with certainty. Taking uncertainty into account, the MNC's capacity decision may either lead to rationing or organizational slack in the form of excessive capacity. We are interested in the effects caused by taxation and corresponding regulation, i.e., the arm's length requirement, on an MNC's quantity and capacity decisions. In particular, we investigate if taxes and transfer pricing regulation intensify an MNC's tendency to install excessive capacity under uncertainty for different organizational forms of the MNC.

As stated above, the costs of excessive capacity affect the applicable arm's length price and ultimately the allocation of profits between the participating tax jurisdictions. Thus, the tax rate differential lowers the costs of excessive capacity because tax savings can be generated by incorporating the excessive capacity in the transfer price. Nevertheless, no tax auditor is willing to accept costs of excessive capacity which purely arise due to tax-planning motives. Therefore, only reasonable levels of excessive capacity can be included in the cost basis used to calculate the cost-plus transfer price. However, uncertainty disguises the motives which have led to excessive capacity. Therefore, it might be hard for a tax auditor to identify reasonable levels of excessive capacity that arise in response to uncertainty. The remaining part of the excessive capacity is due to the profit shifting effect realized through excessive capacity.

5.4.1 Centralization

First, we investigate centralization. After uncertainty is resolved and the market conditions are observed by all parties, the headquarters dictates the quantity which is sold externally to maximize the overall after-tax profit. Working backwards, the analysis starts with determining the optimal quantity at date two when the capacity has been installed and the market conditions have been observed.

The headquarters determines the quantity according to equation (5.1). Depending on the realized market size a, two scenarios occur:

1. The realized market conditions are such that the installed capacity is sufficient to produce the quantity that maximizes the overall after-tax profit of the firm, i.e.,[27]

$$q^C(a) = a - \frac{c(1-t-h\gamma)}{1-t-h}, \tag{5.3}$$

[27] The superscripts indicate the organizational form throughout the analysis.

where $q \geq 0$ for $a > \frac{c(1-t-h\gamma)}{1-t-h}$. To ensure positive quantities throughout the analysis, we assume $\underline{a} > \frac{c(1-t-h\gamma)}{1-t-h}$ holds true. This quantity can be produced for a realization of a that is within the interval $a \in \left[\underline{a}, a^C\right]$, where $a^C = b^C + \frac{c(1-t-h\gamma)}{1-t-h}$ is obtained by rearranging $q^C = b^C$.

2. Otherwise, the market conditions are such that the MNC would prefer to sell more final products than the installed capacity allows. That is, the upstream division operates at full capacity. Consequently, $q^C = b^C$ results for a realization $a \in \left(a^C, \overline{a}\right]$.

Inserting these quantities and taking the expectation of the headquarters overall after-tax profit with respect to the random variable a yields the expected profit at date zero:

$$\begin{aligned} E\left[\Pi_{HQ}^C\right] = &\int_{\underline{a}}^{a^C} \frac{(c(1-t-h\gamma) - a(1-t-h))^2 - 2bk(1-t-h)(1-t-h\gamma)}{2(1-t-h)} dF(a) \\ &+ \int_{a^C}^{\overline{a}} b\left((1-t-h)\left(a - \frac{b}{2}\right) - (c+k)(1-t-h\gamma)\right) dF(a) \end{aligned} \tag{5.4}$$

Then, the headquarters maximizes the expected profit depicted in equation (5.4) with respect to the capacity b. Thus, the first order condition

$$\begin{aligned} \frac{\partial E\left[\Pi_{HQ}^C\right]}{\partial b} = \frac{1}{\overline{a}-\underline{a}} \Bigg[&\frac{b^2}{2}(1-t-h) + (1-t-h\gamma)\left[k\underline{a} + bc + \frac{1-t-h\gamma}{2(1-t-h)}c^2\right] \\ &+ \overline{a}\left[(1-t-h)\left(\frac{a}{2} - b\right) - (c+k)(1-t-h\gamma)\right]\Bigg] \end{aligned} \tag{5.5}$$

determines a local maximum. Rearranging the first order condition with respect to b yields the optimal capacity which the headquarters installs at date zero under centralization:

$$b^C = \overline{a} - c\frac{1-t-h\gamma}{1-t-h} - \sqrt{\frac{2k(\overline{a}-\underline{a})(1-t-h\gamma)}{1-t-h}}. \tag{5.6}$$

Proposition 5.1 summarizes these findings.

Proposition 5.1. *For $k < \frac{(\overline{a}-\underline{a})(1-t-h)}{2(1-t-h\gamma)} =: k^C$, and centralized decision making the headquarters installs b^C in the upstream division whereas q^C (b^C) final products are sold externally for $a \in \left[\underline{a}, a^C\right]$ $\left(a \in \left(a^C, \overline{a}\right]\right)$. Excessive capacity occurs with the probability $F\left(a^C\right) < 1$.*

Proof. See appendix. □

5.4.2 Partial Delegation

Second, we consider partial delegation, i.e., the headquarters delegates the quantity decision to the downstream division whereas the capacity decision remains in the head-

quarters' sphere of competence. Such an organizational form prevails when the downstream division is better informed compared to the headquarters. Typically, the market conditions a which determine the market size of the downstream division's final product market may be difficult to observe by the headquarters because the headquarters is not able to verify those market conditions (Wielenberg, 2000). After capacity is installed in the upstream division and the uncertainty regarding the market conditions is resolved, the downstream division determines demand according to

$$q^P = \underset{q \geq 0}{\operatorname{argmax}} \left\{ \Pi_D = (1-t-h) \left[\left(a - \frac{1}{2} q \right) q - p_r q \right] \right\}. \tag{5.7}$$

Thus, the downstream division's quantity decision is as follows:

$$q^P = a - c\gamma. \tag{5.8}$$

We assume that this quantity is always positive, i.e., $\underline{a} > c\gamma$, and can either be fulfilled with the installed capacity for market conditions $a \in \left[\underline{a}, a^P\right]$, where $a^P = b^P + c\gamma$ is obtained by rearranging $q^P = b^P$. Otherwise, $q^P = b^P$ results if the market conditions are such that the capacity is not sufficient to produce the required quantity, i.e., for $a \in \left(a^P, \overline{a}\right]$.

Inserting these quantities and taking the expectation of the headquarters overall after-tax profit with respect to the random variable a yields the headquarters expected after-tax profit with partial delegation at date zero

$$\begin{aligned} E\left[\Pi_{HQ}^P\right] = &\int_{\underline{a}}^{a^P} \left[\frac{1-t-h}{2} \left(a^2 - c^2\gamma^2 \right) - (1-t-h\gamma) \left(c(a-c\gamma) + k \cdot b \right) \right] dF(a) \\ &+ \int_{a^P}^{\overline{a}} \left[(1-t-h) \left(ab - \frac{b^2}{2} \right) - b(c+k)(1-t-h\gamma) \right] dF(a). \end{aligned} \tag{5.9}$$

Then, the headquarters maximizes the expected profit depicted in equation (5.9) with respect to the capacity at date zero. Thus, the first order condition

$$\begin{aligned} \frac{\partial E\left[\Pi_{HQ}^P\right]}{\partial b} = \frac{1}{\overline{a} - \underline{a}} \Bigg[&\overline{a} \left[(1-t-h) \left(\frac{\overline{a}}{2} - b \right) - (c+k)(1-t-h\gamma) \right] \\ &- \frac{1-t-h}{2} \left(c^2\gamma^2 - b^2 \right) + (1-t-h\gamma) \left(c(b+c\gamma) + \underline{a}k \right) \Bigg] \end{aligned} \tag{5.10}$$

determines a local maximum. Rearranging the first order condition with respect to b yields the optimal capacity which the headquarters installs under partial delegation

$$\begin{aligned} b^P = &\frac{1}{1-t-h} \\ &\left[\overline{a} - c(1-t-h\gamma) - \sqrt{(1-t)^2 c^2 (\gamma-1)^2 + 2k(\overline{a} - \underline{a})(1-t-h\gamma)(1-t-h)} \right]. \end{aligned} \tag{5.11}$$

Proposition 5.2 summarizes these findings.

Proposition 5.2. *For* $k < \frac{2c(1-t)(\gamma-1)+(\overline{a}-\underline{a})(1-t-h)}{2(1-t-h\gamma)}$*, the headquarters installs capacity* b^P *in the upstream division with partial delegation. The downstream division asks for* q^P *units of the intermediate product which can (not) be produced with the installed capacity for a realization of the market conditions* $a \in \left[\underline{a}, a^P\right]$ $\left(a \in \left(a^P, \overline{a}\right]\right)$*. Excessive capacity occurs with probability* $F\left(a^P\right) < 1$*.*

Proof. See appendix. □

5.4.3 Full Delegation

Lastly, we consider a setting with fully delegated decisions. Upstream divisional managers may have more technical expertise than the headquarters because the production technology is settled in the foreign division. In a situation where only the upstream division is in a position to install and maintain the production technology, the capacity decision is necessarily delegated to the upstream division (Dutta and Reichelstein, 2010). Maintaining the assumption that the headquarters is not able to verify the realized market conditions, the downstream division decides on the quantity which is sold externally. Thus, the downstream division's quantity decision is depicted in equation (5.8). Depending on the realized market conditions and the corresponding requested quantity, the upstream division operates at full capacity or exhibits excessive capacity. In particular, for $a \in \left[\underline{a}, a^F\right]$, with $a^F = b^F + c\gamma$, the produced quantity is $q^P = q^F$ whereas for $a \in \left(a^F, \overline{a}\right]$, only $q^F = b^F$ can be produced. That is, the installed capacity is too low to fulfill the quantity which maximizes the downstream division's after-tax profit for the realized market demand.

Inserting these quantities and taking the expectation of the upstream division's after-tax profit with respect to the random variable a yields the upstream division's expected after-tax profit at date zero

$$\begin{aligned} E\left[\Pi_U^F\right] = &\int_{\underline{a}}^{a^F} (1-t)(\gamma-1)(c(a-c\gamma)+k\cdot b)dF(a) \\ &+ \int_{a^F}^{\overline{a}} (1-t)(\gamma-1)(c+k)bdF(a). \end{aligned} \tag{5.12}$$

The first order condition with respect to the capacity b

$$\frac{\partial E\left[\Pi_U^F\right]}{\partial b} = (1-t)(\gamma-1)\left[k + c\left(F\left(\overline{a}\right) - F\left(a^F\right)\right)\right] > 0 \tag{5.13}$$

is always positive. Consequently, the upstream division installs as much capacity as can be considered in the transfer price. The upper bound of the considerable capacity is determined by the transfer pricing guidelines. They only allow reasonable amounts of excessive capacity to be incorporated in the cost basis to calculate the cost-plus transfer

price. Installing capacity beyond the capacity which is needed to meet the requested quantity for the best market conditions, i.e., $a = \overline{a}$, will never be considered reasonable. Thus, no tax auditor would be willing to accept costs for excessive capacity in the transfer price when the capacity exceeds $\overline{a} - c\gamma$. Without the possibility to incorporate the costs of excessive capacity in the transfer price each additional unit capacity is detrimental for the upstream division because installing capacity is costly. Thus, the foreign division installs

$$b^F = \overline{a} - c\gamma. \tag{5.14}$$

The markup requirement stipulated in the transfer pricing regulation leads to overcompensation of the foreign division because the upstream division earns the markup on the excessive capacity. Moreover, the upstream division bears no risk related to its capacity decision because the transfer pricing design compensates the upstream division for the whole capacity including excessive capacity. Proposition 5.3 summarizes the findings for full delegation.

Proposition 5.3. *With uncertainty and full delegation of the quantity and capacity decision, the upstream division installs the maximum capacity which can be considered in the transfer price b^F. This always leads to excessive capacity, i.e., $F\left(a^F\right) = 1$. The downstream division sells q^F externally.*

5.4.4 Comparison of the Organizational Forms

We now turn to the comparison of the quantity and the capacity decisions resulting under the different organizational forms. On the one hand, delegating the capacity decision naturally affects the extent of the installed capacity. On the other hand, delegating the quantity decision also affects the installed capacity. Thus, the MNC's choice of its organizational form affects the probability to have excessive capacity.

Not surprisingly, delegating the quantity decision to the downstream division leads to a lower quantity compared to a situation where the headquarters decides on the quantity, i.e., $q^C > q^P = q^F$. This well-known result occurs because we consider a one set of books setting and we are interested in the MNC's behavior when tight transfer pricing regulation curbs its reporting discretion. The headquarters cannot affect the downstream division's quantity decision by using an appropriate transfer pricing mechanism. Therefore, the tax rate differential is not internalized and goal congruence cannot be achieved. Hence, with a delegated quantity decision the quantity sold externally is too low to maximize the headquarters overall after-tax profit.

This, in turn, affects the installed capacity. In particular, with partial delegation, the MNC installs less capacity compared to centralized decision making even though the capacity decision remains in the headquarters' sphere of competence. However, the smaller quantity q^P lowers the optimal capacity necessary to produce the expected quantity of

the intermediate product, i.e., $b^C > b^P$. For small costs of installing an additional unit of capacity[28], i.e., $k < k^{CF}$, the headquarters installs a higher capacity with centralized decision making than the upstream division, i.e., $b^C > b^F$. This occurs because the centralized quantity decision is higher due to the internalized tax rate differential, $q^C > q^F$. This is reflected in the capacity decision. However, for high costs of capacity, i.e., $k > k^{CF}$, the headquarters installs a smaller capacity than the upstream division. The reason is that the upstream division is not bothered by the costs of capacity because it gets fully compensated for those costs. This is also the reason why the installed capacity with partial delegation is always smaller than the capacity with full delegation, i.e., $b^P < b^F$.

Considering uncertainty regarding the market conditions, the capacity decision typically leads to a positive probability of excessive capacity. The headquarters finds installing full capacity too expensive because it trades off the expected costs of excessive capacity against the opportunity costs of lost sales in case of a capacity that is too low to serve the realized demand. The organizational form influences the quantity and the corresponding capacity decision and, thus, affects the probability to exhibit excessive capacity. In particular, proposition 5.3 shows that delegating the capacity decision to the upstream division always induces excessive capacity whereas the headquarters' capacity decision does not necessarily induce excessive capacity, i.e., $F\left(a^F\right) > F\left(a^C\right)$ and $F\left(a^F\right) > F\left(a^P\right)$. Interestingly, the probability to exhibit excessive capacity is higher with partial delegation compared to a situation with centralized decisions, i.e., $F\left(a^P\right) > F\left(a^C\right)$, even though the capacity is smaller under partial delegation than with centralization. However, with partial delegation the quantity sold externally is also lower due to the lacking internalization of the tax rate differential. The headquarters compensates the too low quantity under partial delegation by increasing the probability of meeting the quantity requested by the downstream division. These results indicate that the absolute level of capacity is not informative about the probability to exhibit excessive capacity unless the organizational form of the MNC is known.

Proposition 5.4. *The absolute level of capacity is not informative about the probability to exhibit excessive capacity.*

Proof. See appendix. □

Since we are interested in the effects caused by taxation and the corresponding regulation we also consider the MNC's quantity and capacity decision in a no-tax world. This enables us to isolate tax effects that arise due to the tax-saving benefit of excessive capacity. Without transfer pricing regulation the MNC is free to design its transfer prices. Thus, no markup requirement needs to be considered. Then, in a world without taxes, the MNC's organizational form of centralization or partial delegation does not affect the

[28] The threshold k^{CF} is stated in the appendix.

MNC's quantity and capacity decisions. The reason is that we assume the same information endowment for each organizational form. With centralized decision making, the headquarters also determines the quantity after observing the market conditions. Thus, without taxes the resulting quantity decision and consequently the capacity decision coincide.

Corollary 5.1. *In a world without taxes and tax-induced markup requirement, the quantity decision reduces to* $q_{NT}(a) = a - c$*. For centralization and partial delegation, an altered quantity affects the capacity decision and the probability that market demand cannot be fulfilled, i.e.,* $b_{NT} = \overline{a} - c - \sqrt{2k(\overline{a} - \underline{a})}$ *and* $F(a_{NT}) < 1$*, where* $a_{NT} = \overline{a} - \sqrt{2k(\overline{a} - \underline{a})}$*.*[29]

In addition, there is no markup requirement which overcompensates the upstream division for the installed capacity and, in turn, leads to the highest acceptable capacity. A transfer pricing scheme that compensates the upstream division only for its costs is not appropriate to incentivize the upstream division to install capacity. In particular, the upstream division is indifferent between installing capacity or not because it can never earn a positive income. This result is in line with prior research which shows that markups are essential for the upstream division to have investment incentives (Baldenius et al., 1999; Sahay, 2003). Corollary 5.1 summarizes these findings.

Corollary 5.2. *In a world without taxes and a markup requirement, the upstream division is indifferent among every possible level of capacity to produce the required quantity* q_{NT} *because it is fully compensated but does not earn rents. Thus, the markup requirement stipulated in the transfer pricing regulation provides investment incentives for the upstream division.*

Proof. See appendix. □

5.5 Excessive Capacity Created by Tax Regulation

In the following, we investigate how varying tax rates and markups affect the MNC's tendency to install excessive capacity. An increasing markup increases the transfer price whereas increasing tax rates affect the after-tax profits of the divisions and thus, the overall profit of the MNC. First, with centralization the headquarters decides on the quantity and the capacity. An increasing markup or a higher tax rate differential affects the attractiveness of profit shifting to the low-tax country. Therefore, the quantity increases because higher profit shifting benefits can be realized through internal trade. These tax-saving benefits outweigh the price decline resulting from a higher quantity on the final product market. Correspondingly, the installed capacity increases due to the higher expected quantity of the intermediate product. Interestingly, an increasing tax rate t also increases

[29] The subscript NT highlights the no-tax case, whereas the absence of NT as subscript denotes tax world considerations.

the quantity with centralization. This result occurs because an increasing tax rate t lowers the marginal costs of producing an additional unit of the intermediate product since the variable costs are tax deductible. Moreover, a higher t also lowers the after-tax costs of installing capacity because of the tax deductibility. At the same time, the marginal revenue of the downstream division decreases due to the increased tax rate but not to the same extent. Therefore, the headquarters increases the quantity sold on the final product market. This, in turn, leads to increasing capacity for an increasing tax rate t. The probability to exhibit excessive capacity increases for both an increasing markup and for increasing tax rates because the increase in the capacity is higher than the increase in the expected quantity. This occurs because the capacity is affected twice. On the one hand, the increased expected quantity is considered. On the other hand, installing capacity is less costly.

Second, we consider the resulting effects for partial delegation. An increasing markup increases the transfer price. Thus, the intermediate product becomes costlier for the downstream division. Therefore, the quantity decreases with an increasing markup. Consequently, less capacity is needed to serve the expected demand for the intermediate product. However, with an increasing markup, the capacity can either increase or decrease. This occurs because the profit shifting benefits increase with an increasing markup so that installing high capacity is less costly. Thus, if the tax-saving benefit dominates an increasing capacity occurs in response to an increasing markup even though less capacity is necessary to produce the expected demand for the intermediate product because the quantity sold externally decreases. This happens for a large market size $\overline{a}$. In this case, the expected quantity is high and therefore, an increasing markup has hardly any effect on the quantity so that the tax-saving benefit dominates. Otherwise, the decreasing quantity becomes the driving force and the installed capacity decreases. However, the tax-saving benefit is always present, so that for both an increasing and a decreasing capacity the probability to exhibit excessive capacity increases for an increasing markup and for increasing tax rates.

Lastly, full delegation is analyzed. Obviously, the quantity decreases, as stated for partial delegation. Additionally, the upstream division does not consider the tax-saving benefit. However, the capacity needed to meet the requested quantity for the best market conditions decreases. This is the capacity installed by the upstream division. Therefore, an increasing markup leads to a decreasing capacity under full delegation. The tax rates do not affect the delegated decisions because the tax rate differential is not internalized by the divisions and is, therefore, not considered.

The effects of taxes and transfer pricing regulation on the MNC's quantity and capacity decision as well as the corresponding probabilities of excessive capacity are summarized in table 5.1.

	q^C	$q^P = q^F$	b^C	b^P	b^F	$F\left(a^C\right)$	$F\left(a^P\right)$	$F\left(a^F\right)$
$\frac{\partial}{\partial \gamma}$	> 0	< 0	> 0	> 0 for large $\overline{a}$ < 0 otherwise	< 0	> 0	> 0	-
$\frac{\partial}{\partial h}$	> 0	-	> 0	> 0	-	> 0	> 0	-
$\frac{\partial}{\partial t}$	> 0	-	> 0	> 0	-	> 0	> 0	-

Table 5.1: Effect of marginal changes in tax rates and tax regulation (tax rate t, tax rate differential h, and markup γ) on the quantity decision q, the capacity decision b, and on the probability of excessive capacity $F(a)$ under centralization, partial delegation, and full delegation. The superscript indicates the organizational form.

The comparative statics depicted in table 5.1 and the findings in corollary 5.1 show that the existence of taxes and the markup requirement stipulated in the transfer pricing regulation lead to a higher probability of the MNC to exhibit excessive capacity under centralization and partial delegation. For full delegation, corollary 5.2 illustrates that the upstream division is indifferent among every possible level of capacity when no taxes and transfer pricing regulation exist. Contrary, with taxes and the markup requirement, the upstream division installs so much capacity that the MNC always exhibits excessive capacity. That is, taxes and transfer pricing regulation induce a higher probability to exhibit excessive capacity under full delegation.

Proposition 5.5. *Taxes and transfer pricing regulation increase the probability to exhibit excessive capacity for each considered organizational form of the MNC. Therefore, taxes and transfer pricing regulation are a potential antecedent for organizational slack.*

Proof. See appendix. □

5.6 Discussion of Full Delegation with Several Downstream Divisions

The above analysis illustrates that the upstream division installs the maximum needed capacity so that the MNC always exhibits excessive capacity with a delegated capacity decision. The installed capacity does not affect the downstream division's quantity decision because the fixed costs are not decision-relevant. That is, all fixed costs are transferred to the downstream division irrespective of the quantity decision. When the intermediate product is transferred to more than one downstream division, the portion of fixed costs allocated to each downstream division by applying the cost-plus transfer price depends on the downstream divisions' quantity decisions. In particular, the transfer price with n downstream divisions is

$$p_r = \left[c + \frac{k \cdot b}{\sum_{i=1}^{n} q_i}\right] \gamma, \tag{5.15}$$

where $n \geq 2$ is a natural number.

We consider the following adaptions to our model. Each downstream division faces a monopolistic market for its final product. The revenue functions are $R(q_i) = (a_i - \frac{1}{2}q_i)q_i$ for $i = 2, \ldots, n$. The market parameters a_i capture the overall economic situation in all final product markets so that $a_1 = \ldots = a_i = \ldots = a_n = a$.[30] Therefore, we neglect the indices. Each downstream division decides on the quantity to maximize its own after-tax income. Therefore, considering the transfer price, the downstream divisions determine demand according to

$$q_i = \underset{q_i \geq 0}{\operatorname{argmax}} \left\{ \Pi_{D_i} = (1-t-h) \left[\left(a - \frac{1}{2}q_i \right) q_i - p_r q_i \right] \right\}. \tag{5.16}$$

The transfer price of equation (5.15) creates interdependence among the downstream divisions' profits. If a single downstream division chooses a smaller quantity than all other downstream divisions, this division has to bear a smaller portion of the fixed costs. This reduction in the allocated fixed costs exceeds the negative effect resulting from a lower quantity sold on the external market. However, the downstream divisions are considered rational so that all downstream divisions produce a lower quantity than without the interdependence created by the cost-plus transfer price. This finding is similar to a Cournot competition, where the total quantity sold on the final product market does not equal the monopoly quantity. In the Cournot competition, the producer rent would be higher if the firms could enforceably agree on the monopoly quantity. Our finding regarding the quantity with several downstream divisions is similar. Each downstream divisions' profit would be larger if neither downstream division lowered the quantity due to the interdependence created by the transfer price. However, considering the interdependence, each downstream division produces the same small quantity and, thus, bears the same portion of the fixed costs. This is depicted in figure 5.2 and reflected in each downstream division's first order condition and respective quantity decision. The first order condition is

$$\frac{\partial \Pi_{D_i}}{\partial q_i} = (1-t-h) \left(a - q_i - c\gamma - \frac{kb\gamma \sum\limits_{j \neq i} q_i}{\left(\sum\limits_i q_i \right)^2} \right), \tag{5.17}$$

which leads to the following quantity decision q of each of the $n \geq 2$ downstream divisions[31]

$$q = \frac{1}{2} \left[a - c\gamma + \sqrt{(a-c\gamma)^2 - \frac{4kb\gamma(n-1)}{n^2}} \right]. \tag{5.18}$$

[30] Comparable qualitative results can be obtained with different market parameters $a_1 \neq \ldots \neq a_i \neq \ldots \neq a_n$. However, the basic insights are also present with equal market parameters.

[31] The second order condition for a local maximum is met for $b < \frac{(a-c\gamma)^2 n^2}{4\gamma k(n-1)}$.

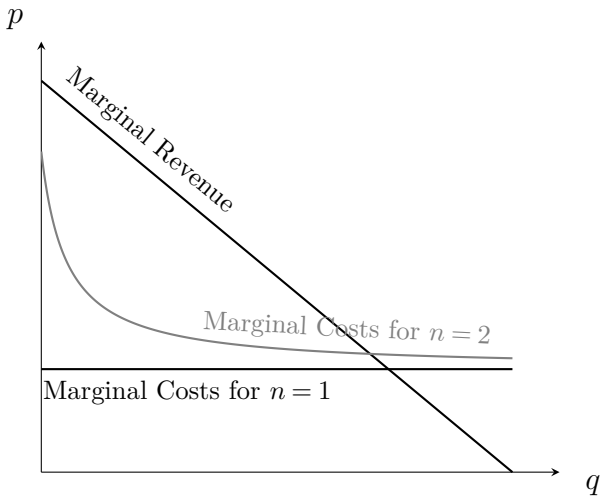

Figure 5.2: Marginal revenue of a single downstream division, marginal costs for one downstream division, and marginal costs of a single downstream division when the MNC comprises two downstream divisions (plotted for $t = 0.15$, $h = 0.2$, $a = 900$, $c = 300$, $k = 25$, $\gamma = 1.5$, and $b = 1,014$)

The interdependence created by the transfer price induces each downstream division's quantity choice to depend on the installed production capacity b. Note that for $n = 1$ the quantity in equation (5.18) equals the quantity for the setting with one downstream division and delegated quantity decision (equation (5.8)). Interestingly, the quantity effect caused by the interdependence is strongest for two downstream divisions. With an increasing number of downstream divisions, this effect decreases and for a large number of downstream divisions, the quantity of each downstream division converges towards the quantity with one downstream division.[32]

Depending on the realized market conditions these quantities can be produced with the installed capacity if $a < \frac{b}{n} + c\gamma + \frac{\gamma k(n-1)}{n} =: a^n$. For realizations of the market conditions $a \in (a^n, \overline{a}]$, the installed capacity is not sufficient to produce the requested quantities. Since we assume that all divisions face the same market conditions, the upstream division allocates the capacity equitably between all downstream divisions. Thus, for a good realization of the market conditions, each downstream division receives $\frac{b}{n}$ intermediate products.

For the capacity decision, the upstream division faces a trade-off. On the one hand, a high capacity b results in a high upstream division profit due to the markup on the costs of installing capacity, i.e., $(\gamma - 1)bk$. The upstream division always obtains the markup on the fixed costs because of the cost-plus transfer price. On the other hand, a high capacity b induces the downstream divisions to lower the quantity (see equation (5.18)).

[32] $\frac{\partial q^n}{\partial n} = \frac{n-2}{n^3} \cdot \frac{kb\gamma}{\sqrt{(a-c\gamma)^2 - \frac{4kb\gamma(n-1)}{n^2}}}$. q of equation (5.18) determines a local maximum for $b < \frac{(a-c\gamma)^2 n^2}{4\gamma k(n-1)}$ so that $\frac{\partial q^n}{\partial n}$ is positive, zero, or negative for $n > 2$, $n = 2$, and $n = 1$, respectively.

This negatively affects the upstream division's profit resulting from the markup on the variable costs, i.e., $(\gamma-1)nqc$. This is depicted in the upstream division's first order condition with respect to b:[33]

$$\frac{\partial E\left[\Pi_U^F\right]}{\partial b} = \underbrace{\frac{(1-t)(\gamma-1)}{\overline{a}-\underline{a}}}_{>0}\left(\underbrace{k(\overline{a}-\underline{a})+c(\overline{a}-a^n)}_{>0}+\underbrace{\int_{\underline{a}}^{a^n} nc\frac{\partial q}{\partial b}da}_{<0}\right). \tag{5.19}$$

Contrary to the setting with one downstream division, the upstream division also encounters costs of installing excessive capacity. The following example illustrates that this negative effect may induce the upstream division to install less than the maximum capacity which can be incorporated in the transfer price. Consequently, the upstream division does not always exhibit excessive capacity.

Example 5.1. *For a tax rate $t = 0.15$ in the low-tax jurisdiction, a tax rate differential $h = 0.2$, a minimum prohibitive price $\underline{a} = 800$, a maximum prohibitive price $\overline{a} = 1,000$, variable costs $c = 300$, capacity costs $k = 25$, a markup $\gamma = 1.5$, and $n = 2$ downstream divisions, the upstream division installs capacity of $b = 1,014$.*[34] *The threshold for the market condition capturing the extent of excessive capacity a^n is 976. That is, for a large prohibitive price a, the MNC operates at full capacity.*

Proposition 5.6. *With more than one downstream division, full delegation does not necessarily result in the MNC always exhibiting excessive capacity.*

5.7 Conclusion

It is mandatory for MNCs to set tax-compliant transfer prices when they report their taxable income. However, transfer prices are frequently used to shift profits from high-tax to low-tax jurisdictions (Blouin et al., 2018; De Simone et al., 2017; Klassen et al., 2017; Clausing, 2003; Jacob, 1996), so that transfer prices are scrutinized by governments and international organizations. As a result, the profit shifting possibilities by means of transfer pricing diminished because tight regulation devours most of the reporting discretion inherent to transfer pricing. Thus, a promising way which is left to still realize tax-saving benefits for MNCs is the adaption of strategic and operational decisions.

Our model highlights that without market uncertainty, excessive capacity is never installed. However, in more realistic scenarios where the market conditions are not known when the capacity needs to be installed, MNCs' tend to exhibit excessive capacity. Taxes,

[33] $\frac{\partial q}{\partial b} = \frac{-k\gamma(n-1)}{n^2\sqrt{(a-c\gamma)^2-\frac{4kb\gamma(n-1)}{n^2}}}$. q of equation (5.18) determines a local maximum for $b < \frac{(\underline{a}-c\gamma)^2n^2}{4\gamma k(n-1)}$ so that $\frac{\partial q}{\partial b}$ is negative.

[34] In this example, the downstream divisions' second order condition regarding the quantity decision is negative for $b < 3,267$.

transfer pricing regulation, and its consequences are incorporated in MNCs' capacity and quantity decisions. Our results show that taxes and the transfer pricing regulation increase the probability to exhibit excessive capacity. However, excessive capacity is costly and, therefore, a manifestation of an ex post inefficiency that arises in response to taxation and transfer pricing regulation. Thus, we identify taxes and transfer pricing regulation as a potential antecedent for organizational slack.

Additionally, we show that the absolute level of capacity is not informative about the probability to exhibit excessive capacity because this crucially depends on the organizational form of the MNC. Different organizational forms result in differences in the quantity and capacity decisions. This finding might help tax auditors to evaluate the extent of the excessive capacity that occurs in response to uncertainty and is therefore economically justifiable. Typically, MNCs need to demonstrate in their transfer pricing documentation that the excessive capacity is reasonable. For example, the excessive capacity needs to be in accordance with that of comparable firms. However, the amount of capacity installed in other firms might be also biased because of a potential tax-saving benefit and might therefore provide a poor benchmark. Specifically, the capacity planning of MNCs facing no or at least a small tax rate differential tends to be unbiased. These MNCs provide a meaningful benchmark to show which part of the excessive capacity occurs in response to uncertainty and is therefore economically reasonable.

Despite triggering higher probabilities of excessive capacity, transfer pricing regulation provides investment incentives to the upstream division. In particular, the upstream division installs the highest possible capacity because the markup requirement stipulated in the transfer pricing guidelines leads to overcompensation of the costs of excessive capacity. However, this effect is mitigated when more than one downstream division is considered.

Our results show that tax regulation affects MNCs' behavior in a non-trivial way. Therefore, considering solely reporting behavior in the context of counteracting profit shifting seems myopic. In particular, transfer pricing regulation might have unintended and detrimental effects on MNCs' strategic and operational decisions. As a consequence, the findings are highly relevant for tax auditors, legislators, and supranational units like the EU and the OECD.

5.8 Appendix

Proof of Lemma 5.1

The headquarters maximizes the total after-tax profit of the MNC as stated in equation (5.1) with regard to $q \geq 0$ and $b \geq 0$ while considering the constraint $q \leq b$. Because of the linearity of the constraint function, the constraint qualification is satisfied. Thus, the Kuhn-Tucker maximum conditions are necessary for an optimal solution. The total after-tax profit of the MNC is differentiable and concave in the non-negative orthant. According to the Kuhn-Tucker sufficiency theorem, capacity and quantity decisions satisfying the Kuhn-Tucker maximum conditions give a global maximum. In sum, the Kuhn-Tucker maximum conditions are necessary and sufficient for a maximum.

For the quantities in equation (5.2) and $b = q_{FB}$, all Kuhn-Tucker maximum conditions are satisfied. □

Proof of Proposition 5.1

The headquarters maximizes the total after-tax profit of the MNC as stated in equation (5.1) with regard to $q \geq 0$:

$$FOCq^C : (1-t-h)\left(a-q^C\right)+hc\gamma-(1-t)c=0.$$

Solving this first order condition with respect to q^C yields the quantity under centralization stated in equation (5.3). The second order condition

$$SOCq^C : (1-t-h)(-1)<0$$

is negative so that q^C determines a local maximum. Considering the uncertainty regarding the market conditions the headquarters decides on capacity according to equation (5.5). Solving this equation yields two possible capacity levels:

$$b_-^C = \overline{a}-c\frac{1-t-h\gamma}{1-t-h}-\sqrt{\frac{2k(\overline{a}-\underline{a})(1-t-h\gamma)}{1-t-h}},$$

$$b_+^C = \overline{a}-c\frac{1-t-h\gamma}{1-t-h}+\sqrt{\frac{2k(\overline{a}-\underline{a})(1-t-h\gamma)}{1-t-h}}.$$

The SOC with respect to b is given by:

$$SOCb^C : \frac{1}{(\overline{a}-\underline{a})}\left(b^C-\overline{a}+c(1-t-h\gamma)\right).$$

The SOC is negative (positive) for b_-^C (b_+^C) so that

$$b^C = \overline{a} - c\frac{1-t-h\gamma}{1-t-h} - \sqrt{\frac{2k(\overline{a}-\underline{a})(1-t-h\gamma)}{1-t-h}}$$

determines a local maximum.

To ensure $\underline{a} < a^C$ the costs of capacity needs to be smaller than $k < \frac{(\overline{a}-\underline{a})(1-t-h)}{2(1-t-h\gamma)} =: k^C$.

□

Proof of Proposition 5.2

With delegated quantity decision, the downstream division maximizes its after-tax profit according to equation (5.7):

$$FOCq^P : (1-t-h)(a-q^P-c\gamma) = 0.$$

Solving this first order condition with respect to q^P yields the quantity the downstream division implements as stated in equation (5.8). The second order condition

$$SOCq^P : (1-t-h)(-1) < 0$$

is negative so that q^P determines a local maximum.

Considering the subsequent quantity decision of the downstream division and taking into account uncertainty regarding the market conditions, the headquarters decides on capacity according to equation (5.10). Solving this equation yields two possible capacity levels:

$$b_-^P = \frac{1}{1-t-h} \left[\overline{a} - c(1-t-h\gamma) - \sqrt{1-t)^2c^2(\gamma-1)^2 + 2k(\overline{a}-\underline{a})(1-t-h\gamma)(1-t-h)}\right],$$

$$b_+^P = \frac{1}{1-t-h} \left[\overline{a} - c(1-t-h\gamma) + \sqrt{1-t)^2c^2(\gamma-1)^2 + 2k(\overline{a}-\underline{a})(1-t-h\gamma)(1-t-h)}\right].$$

The SOC with respect to b is given by:

$$SOCb^P : \frac{1}{(\overline{a}-\underline{a})}\left((1-t-h)(b^P-\overline{a}) + c(1-t-h\gamma)\right).$$

and negative (positive) for b_-^P (b_+^P) so that

$$b^P = \frac{1}{1-t-h} \left[\overline{a} - c(1-t-h\gamma) - \sqrt{(1-t)^2c^2(\gamma-1)^2 + 2k(\overline{a}-\underline{a})(1-t-h\gamma)(1-t-h)}\right]$$

determines a local maximum. $b^P > 0$ if and only if $k < \frac{2c(1-t)(\gamma-1)+(\overline{a}-\underline{a})(1-t-h)}{2(1-t-h\gamma)}$. □

Proof of Proposition 5.4

The capacity that is installed under centralized decision making exceeds the capacity installed with a partial delegation organization if and only if:

$$\overline{a} - c\frac{1-t-h\gamma}{1-t-h} - \sqrt{\frac{2k(\overline{a}-\underline{a})(1-t-h\gamma)}{1-t-h}} > \frac{1}{1-t-h}$$

$$\left[\overline{a} - c(1-t-h\gamma) - \sqrt{1-t)^2c^2(\gamma-1)^2 + 2k(\overline{a}-\underline{a})(1-t-h\gamma)(1-t-h)}\right]$$

$$\iff k < k^C.$$

Thus, $b^C > b^P$ holds true.

The capacity installed under centralized decision making exceeds the capacity installed with full delegation if and only if:

$$\overline{a} - c\frac{1-t-h\gamma}{1-t-h} - \sqrt{\frac{2k(\overline{a}-\underline{a})(1-t-h\gamma)}{1-t-h}} > \overline{a} - c\gamma$$

$$\iff k < \frac{c^2(1-t)^2(\gamma-1)^2}{(1-t-h)2(1-t-h\gamma)(\overline{a}-\underline{a}} =: k^{CF}$$

Thus, for small cost of capacity, i.e., $k < k^{CF}$, the capacity with centralized decision making is larger compared to the capacity that is installed with delegated decisions, i.e., $b^C > b^F > b^P$ whereas with high costs of capacity, i.e. $k^{CF} < k < k^C$, the capacity decision of the upstream division is higher because the decision of the upstream division is not affected by the costs of capacity, $b^F > b^C > b^P$. However, with full delegation the MNC exhibits always excessive capacity whereas the probability for excessive capacity for centralized decision making is smaller than with delegated decisions, i.e.,

$$F(\overline{a}) = F\left(a^F\right) > F\left(a^P\right) > F\left(a^C\right) > F(\underline{a}).$$

The order of the organizational forms' installed capacity and the order of the organizational forms' probability for excessive capacity do not correspond. Consequently, the absolute level of capacity is not informative about the probability to exhibit excessive capacity. □

Proof of Corollary 5.2

As stated in equation (5.13) the first order condition of the foreign division is always positive. Thus, the foreign division installs the highest acceptable capacity. However, considering the no-tax case, i.e., $t = h = 0$ and $\gamma = 1$, the foreign division's first order

condition with respect to b is:

$$\frac{\partial E\left[\Pi^{F}_{U,NT}\right]}{\partial b} = 0.$$

Thus, the upstream division is indifferent among any possible level of capacity because it cannot earn positive rents. Hence, the markup requirement stipulated in the transfer pricing regulation provides investment incentives for the upstream division. □

Proof of Proposition 5.5

With centralization, the derivative of the quantity with respect to the markup is:

$$\frac{\partial q^{C}}{\partial \gamma} = \frac{ch}{1-t-h} > 0,$$

with respect to the tax rate differential:

$$\frac{\partial q^{C}}{\partial h} = \frac{c(1-t)(\gamma-1)}{(1-t-h)^{2}} > 0,$$

and with respect to the tax rate t:

$$\frac{\partial q^{C}}{\partial t} = \frac{ch(\gamma-1)}{(1-t-h)^{2}} > 0.$$

With centralization, the derivative of the capacity with respect to the markup is:

$$\frac{\partial b^{C}}{\partial \gamma} = \frac{ch}{1-t-h} + \frac{(\overline{a}-\underline{a})kh}{\sqrt{2(\overline{a}-\underline{a})k(1-t-h\gamma)(1-t-h)}} > 0,$$

with respect to the tax rate differential:

$$\frac{\partial b^{C}}{\partial h} = \frac{c(1-t)(\gamma-1)}{(1-t-h)^{2}} + \frac{(\overline{a}-\underline{a})k(1-t)(\gamma-1)}{(1-t-h)\sqrt{2(\overline{a}-\underline{a})k(1-t-h\gamma)(1-t-h)}} > 0,$$

and with respect to the tax rate t:

$$\frac{\partial b^{C}}{\partial t} = \frac{ch(\gamma-1)}{(1-t-h)^{2}} + \frac{(\overline{a}-\underline{a})kh(\gamma-1)}{(1-t-h)\sqrt{2(\overline{a}-\underline{a})k(1-t-h\gamma)(1-t-h)}} > 0.$$

With centralization, the derivative of the probability to exhibit excessive capacity with respect to the markup is:

$$\frac{\partial F\left(a^{C}\right)}{\partial \gamma} = \frac{\partial F\left(a^{C}\right)}{\partial a^{C}} \cdot \frac{\partial a^{C}}{\partial \gamma} = \frac{\partial F\left(a^{C}\right)}{\partial a^{C}} \cdot \frac{(\overline{a}-\underline{a})kh}{\sqrt{2(\overline{a}-\underline{a})k(1-t-h\gamma)(1-t-h)}} > 0,$$

with respect to the tax rate differential:

$$\frac{\partial F\left(a^C\right)}{\partial h} = \frac{\partial F\left(a^C\right)}{\partial a^C} \cdot \frac{\partial a^C}{\partial h} = \frac{\partial F\left(a^C\right)}{\partial a^C} \cdot \frac{(\overline{a}-\underline{a})k(1-t)(\gamma-1)}{(1-t-h)\sqrt{2(\overline{a}-\underline{a})k(1-t-h\gamma)(1-t-h)}} > 0,$$

and with respect to the tax rate t:

$$\frac{\partial F\left(a^C\right)}{\partial t} = \frac{\partial F\left(a^C\right)}{\partial a^C} \cdot \frac{\partial a^C}{\partial t} = \frac{\partial F\left(a^C\right)}{\partial a^C} \cdot \frac{(\overline{a}-\underline{a})kh(\gamma-1)}{(1-t-h)\sqrt{2(\overline{a}-\underline{a})k(1-t-h\gamma)(1-t-h)}} > 0.$$

With a delegated quantity decision, the derivative of the quantity with respect to the markup is:

$$\frac{\partial q^P}{\partial \gamma} = -c < 0,$$

whereas the tax rates do not affect the downstream division's quantity decision:

$$\frac{\partial q^P}{\partial h} = \frac{\partial q^P}{\partial t} = 0.$$

With partial delegation, the derivative of the capacity with respect to the markup is:

$$\frac{\partial b^P}{\partial \gamma} = \frac{ch}{1-t-h} + \frac{(\overline{a}-\underline{a})kh(1-t-h) - c^2(1-t)^2(\gamma-1)}{(1-t-h)\sqrt{2(\overline{a}-\underline{a})k(1-t-h\gamma)(1-t-h)+c^2(\gamma-1)^2(1-t)^2}} \gtrless 0,$$

with respect to the tax rate differential:

$$\frac{\partial b^P}{\partial h} = \frac{c(1-t)(\gamma-1)}{(1-t-h)^2} + \frac{(\gamma-1)\left((\overline{a}-\underline{a})k(1-t-h)+c^2(1-t)^2(\gamma-1)\right)}{(1-t-h)^2\sqrt{2(\overline{a}-\underline{a})k(1-t-h\gamma)(1-t-h)+c^2(\gamma-1)^2(1-t)^2}} > 0,$$

and with respect to the tax rate t:

$$\frac{\partial b^P}{\partial t} = \frac{h(\gamma-1)}{(1-t-h)^2}\left[c + \frac{k(\overline{a}-\underline{a})(1-t-h) - (1-t)^2c^2(\gamma-1)}{\sqrt{(1-t)^2c^2(\gamma-1)^2+2k(1-t-h\gamma)(\overline{a}-\underline{a})(1-t-h)}}\right] > 0.$$

With partial delegation, the derivative of the probability to exhibit excessive capacity with respect to the markup is:

$$\frac{\partial F\left(a^P\right)}{\partial \gamma} = \frac{\partial F\left(a^P\right)}{\partial a^P} \cdot \frac{\partial a^P}{\partial \gamma} =$$

$$\frac{\partial F\left(a^P\right)}{\partial a^P} \cdot \left[\frac{c(1-t)}{1-t-h} - \frac{c^2(1-t)^2(\gamma-1) - (\overline{a}-\underline{a})kh(1-t-h)}{(1-t-h)\sqrt{2(\overline{a}-\underline{a})k(1-t-h\gamma)(1-t-h)+c^2(\gamma-1)^2(1-t)^2}}\right] > 0$$

with respect to the tax rate differential:

$$\frac{\partial F\left(a^P\right)}{\partial h} = \frac{\partial F\left(a^P\right)}{\partial a^P} \cdot \frac{\partial a^P}{\partial h} =$$

$$\frac{\partial F\left(a^P\right)}{\partial a^P} \cdot \frac{(1-t)(\gamma-1)}{(1-t-h)^2}\left[c + \frac{c^2(1-t)+(\overline{a}-\underline{a})k(1-t-h)}{\sqrt{2(\overline{a}-\underline{a})k(1-t-h\gamma)(1-t-h)+c^2(\gamma-1)^2(1-t)^2}}\right] > 0$$

and with respect to the tax rate t:

$$\frac{\partial F\left(a^P\right)}{\partial t} = \frac{\partial F\left(a^P\right)}{\partial a^P} \cdot \frac{\partial a^P}{\partial t} =$$

$$\frac{\partial F\left(a^P\right)}{\partial a^P} \cdot \frac{h(\gamma-1)}{(1-t-h)^2}\left[c - \frac{c^2(1-t)(\gamma-1)-(\overline{a}-\underline{a})k(1-t-h)}{\sqrt{2(\overline{a}-\underline{a})k(1-t-h\gamma)(1-t-h)+c^2(\gamma-1)^2(1-t)^2}}\right] > 0.$$

With full delegation the derivative of the capacity with respect to the markup is:

$$\frac{\partial b^F}{\partial \gamma} = -c < 0.$$

whereas the the tax rates do not affect the upstream division's capacity decision:

$$\frac{\partial b^F}{\partial h} = \frac{\partial d^F}{\partial t} = 0.$$

With full delegation, the derivative of the probability to exhibit excessive capacity is not affected by an increasing markup and increasing tax rates:

$$\frac{\partial F\left(a^F\right)}{\partial \gamma} = \frac{\partial F\left(a^F\right)}{\partial h} = \frac{\partial F\left(a^F\right)}{\partial t} = 0.$$

□

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