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

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Abstract

MNCs are regularly suspected to use transfer pricing of intangibles to shift profits from high-tax to low-tax jurisdictions. In contrast to prior research we endogenize the location choice of intangibles in an analytical model. Furthermore, we study the corresponding optimal transfer prices. Positive spillovers lead to non-zero optimal internal royalty rates despite the absence of marginal costs of using the intangible. In general, tax avoidance is recognized to be undesirable. Without restrictions on legal tax avoidance possibilities, we find that in line with the initial intuition MNCs locate their intangibles in low-tax jurisdictions to minimize tax payments. When restrictions on tax avoidance are present, MNCs need to trade-off tax minimization and efficient spillover creating maintenance investments. Then, for a large spillover, the intangible is optimally located in the high-tax jurisdiction. This ensures efficient investments because the spillover is internalized. Therefore, despite tax avoidance incentives, intangibles exhibit a ‘home bias’. In addition, the model predicts that curtailing profit shifting possibilities harms MNCs’ overall investments.

Keywords. profit shifting, intangibles, transfer pricing, tax avoidance, location choice

JEL Classifications. F23, L24, H26, O34

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1 Introduction

Low effective tax rates of large multinational companies (MNC) and underlying profit shifting to low-tax jurisdictions have drawn public attention.\(^1\) Often transfer pricing is used to shift profits. In particular, locating intangibles in low-tax jurisdictions and subsequent royalty flows are effective means to avoid tax payments. Despite the seemingly huge tax saving benefit from locating intangibles in low-tax jurisdictions 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. (2017) 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. entities of the S&P500.

The unique nature of intangibles allows for a high discretion in its location choice and its respective transfer pricing. First, comparable transactions are not or rarely available. Second, the use of an already existing intangible entails no or negligible marginal costs. Third, an intangible is typically not exclusive in its consumption. Fourth, spillovers or network effects regularly occur (Lev, 2001). Hence, many intangibles have characteristics similar to public goods. According to Lev (2001) non-rivalry and network effects are the two major drivers of benefits from intangibles. These network effects may appear as spillovers from one division’s investments in intangibles to other divisions’ profits. For the success of decentralized firms, the internalization of these spillovers is crucial (Roberts, 2005). It is known from prior literature that transfer pricing might help to induce the internalization of spillovers. However, most of the existing research regarding transfer pricing neglects these aspect and investigates tax optimization (Bouwens et al., 2017). We extend this strand of literature incorporating both spillovers and tax optimization. Tax saving incentives may interfere with internalizing incentives of the location choice and the respective transfer pricing. In particular, we examine the following research questions: How does a positive spillover influence the firm’s optimal royalty payments for intangibles? How do profit shifting possibilities affect the firm’s investment decisions related to

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\(^1\) Especially the European Union and most member states are nowadays concerned about collecting their owing taxes (Drozdiak, 2017; Wall Street Journal, 2017).
intangibles? Is the intangible’s ownership located in the high or the low-tax jurisdiction? In particular, do firms exhibit a ‘home bias’ for their location choice of intangibles? Intangibles’ specific characteristics and inherent scope make them very attractive for profit shifting. Especially, in the light of technological evolution and increasing importance of the digital economy a change in intangible’s relevance of a firm’s success has occurred. Thus, many MNCs have the possibility to use intangibles for profit shifting. This highlights the urgent need to investigate the impacts of tax avoidance associated with intangibles. However, despite the huge tax saving potential of intangibles’ transfer pricing, most companies aim at complying with tax law (Economist, 2004; Cools and Emmanuel, 2006; Cools and Slagmulder, 2009), i.e., they refrain from tax evasion but might still engage in tax avoidance. However, the special characteristics and the rare existence of comparables makes it hard to evaluate MNC’s compliance.

In practice, the line between tax avoidance and tax evasion is blurred so that firms often face complex transfer pricing disputes with tax authorities. Moreover, tax authorities are highly aware of the role of intangibles in shifting profits (Miesel et al., 2002; Hejazi, 2006; Taylor et al., 2015) and thus might display increased scrutiny. Furthermore, due to the specific nature of intangibles disputes with the tax authority are especially complex (Graetz, 2015). In order to avoid such expensive and long lasting disputes, firms may face restrictions on tax avoidance. In particular, for an MNC using two sets of books differences between internal book income and taxable income induce increased scrutiny by tax authorities (EY, 2003). Mills (1998) finds that higher book-tax differences result in higher audit adjustments proposed by the IRS. In order to avoid creating a red flag for tax auditors, an MNC may face exogenous restrictions on their internal transfer pricing.

The objective of this paper is to shed light on the impact of intangible’s specific characteristics on the transfer pricing decisions and respective location choice. In particular, their effect on transfer pricing used for inducing adequate maintenance investments and for reducing the tax liability is considered. Regarding the unique characteristics of intangibles, we focus on missing

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2 For example, the current dispute between the Dutch government and Procter & Gamble Co induced P&G to comment on tax avoidance. P&G emphasizes that they highly regard tax compliance (Drozdiak, 2017).

3 We use the term tax avoidance to indicate tax saving behavior that is legal. Despite being legal, tax avoidance is perceived as undesirable (Guardian, 2007). This is the reason why many governments operate anti-avoidance legislations (Griffith et al., 2014).
marginal costs for using an already existing intangible, positive spillovers, non-rivalry in its consumption, and the ease of the location choice.

We use an analytical model to study the raised questions. The firm comprises headquarters, a domestic and a foreign division. The firm’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 their after-tax divisional profits, respectively. A valuable intangible (for example, a brand, a database, or a quality concept) already exists. In order to sustain an intangible’s high value, the using divisions need to invest into maintenance to increase the expected divisional profit (Roberts, 2005). For example, creating a brand or a database is usually the first step. Without maintaining the brand in each market, it might fall into oblivion. An unmaintained database might be out-of-date soon and thus useless. These maintenance investments may create positive spillovers for other divisions. When one using division invests into maintaining the intangible’s value, the other division might also benefit from this maintenance investment. This intangible is separately used by the firm’s divisions. Due to its public good characteristics the use of the intangible by one division neither harms the consumption possibilities of the other division nor marginal costs arise by its use. The domestic division’s maintenance investment also increases the foreign division’s expected profit. For example, advertisement 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. The firm’s headquarters has to decide on the intangible’s location, i.e., who legally owns the intangible, the internal royalty rate for calculating internal profits, and the external royalty rate used for determining the tax payments in each jurisdiction. Optimal location and transfer pricing choices induce the divisions to adequately invest into maintenance of the intangible. We consider a decentralized MNC. Thus, divisional managers decide on the magnitude of the maintenance investments. In fact, a narrow-minded divisional optimization can be detrimental from headquarters’ point of view. However, divisional managers are typically evaluated based on their divisions’ performance. Thus, it is crucial for the MNC’s performance to achieve goal congruence of divisional managers. This is accomplished by adequate transfer pricing.

With tax avoidance, the firm exhausts existing tax laws but tries to ensure compliance. When
a firm faces no exogenous restrictions on setting the internal royalty rate, the foreign division operating in the low-tax jurisdiction owns the intangible. The external royalty rate is straightforward 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 no incurred costs of 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 of the domestic division’s positive spillover on the foreign division’s contribution margin which is in turn internalized.

Negative internal royalty rates combined with positive external royalty rates may be perceived as non-compliant by a tax auditor. Therefore, we assume that a firm which seeks to stay tax compliant refrains from using negative internal royalty rates when positive external royalty rates are required. This non-negativeness assumption might be interpreted as surrogate for a tax avoidance restriction. In our model, any other restriction on tax avoidance will cause the same effects. When this restriction on setting the internal royalty rate is imposed, next to locating the intangible in the low-tax jurisdiction ownership by headquarters can be optimal. Specifically, for small spillovers, the intangible is optimally located in the low-tax jurisdiction. For large spillovers, locating the intangible in the high-tax jurisdiction becomes optimal. In this case the firm faces the following trade-off. On the one hand, tax saving behavior is more effective when the foreign division owns the intangible. On the other hand, better internalization of the spillover is obtained when headquarters owns the intangible. The reason is that headquarters can determine two separate internal royalty rates for the domestic and the foreign division. This allows first-best investment levels and spillovers whereas the exogenous restriction on tax avoidance results in second-best investments when the intangible is located in the low-tax jurisdiction.

Our main analysis focuses on an MNC keeping two sets of books (TSB) because empirical evidence has shown that the majority of tax effective firms decouple its transfer prices for internal and external decisions. Nevertheless, we verify that our findings regarding the ‘home bias’ remain under a one set of books (OSB) accounting system. For a low spillover the intangible is also located in the foreign division. That is, even for the most severe restriction on the internal...
transfer price, i.e., forcing MNCs to use OSB, the tax saving motive dominates the location choice for a small spillover. However, for a high spillover ownership of the intangible is optimally assigned to the high-tax domestic division. In sum, the finding that the intangible is located in the high-tax jurisdiction for a high spillover does not depend on the TSB assumption. We also obtain this finding in the OSB benchmark.

Although most effective tax avoidance is achieved when the foreign division operating in the low-tax jurisdiction owns the intangible, tax compliance considerations may induce firms to locate the intangible in the domestic, high-tax country. Thus, our findings illustrate that positive spillovers combined with tax compliance considerations may explain empirical evidence on firms’ tendencies to hold intangibles in the parent’s high-tax jurisdiction, the so-called ‘home bias’ (Karkinsky and Riedel, 2012; Griffith et al., 2014; Heckemeyer et al., 2017).

The model predicts lower internal royalty rates for higher spillovers. That is, an increase in the spillover does not increase the internal royalty rates. The rates either decrease or are unaffected. The intuition is as follows. If the spillover is high the indirect effect of the domestic division’s investment on the foreign division’s contribution margin becomes more important. Thus, increasing discrepancies between internal and external royalty rates are approved by the headquarters because compliance becomes relatively less important. The choice of the external royalty rate used for determining the taxable profit is unaffected by the spillover.

By defining tax compliant external royalty rates, tax authorities and governments determine the firms’ possibilities to engage in profitable profit shifting. In line with prior research our findings indicate that curtailing profit shifting possibilities, harms domestic investment incentives (Desai et al., 2006; Hong and Smart, 2010; Juranek et al., 2018). When the firm optimally locates the intangible in the domestic, high-tax country, less profit shifting possibilities also diminish the foreign division’s investment incentives. Hence, restricting profit shifting possibilities harms overall investments. With smaller profit shifting possibilities (i) the direct marginal benefits from the foreign division’s maintenance investments and (ii) the marginal benefits from the domestic division’s investment spillover on the foreign division’s profit decrease. While the direct and the spillover benefits diminish, the maintenance investment costs are unaffected by profit shifting possibilities. Therefore, headquarters optimally induces lower investment levels in both divisions. If the intangible is optimally located in the low-tax jurisdiction, curtailing the profit
shifting possibilities does not affect the foreign division’s investment level. The reason is that
taxable profit is shifted from the high-tax to the low-tax jurisdiction. The domestic division’s
contribution margin is unaffected by the foreign division’s investment as we only consider a
one-sided spillover. Thus, less profit shifting possibilities solely reduce the direct marginal
benefits from the domestic division’s investment on its profit. As before, the maintenance in-
vestment costs are unaffected. In sum, restricting profit shifting possibilities never results in
higher investment levels in the high and the low-tax jurisdiction.

Hall and Jorgenson (1967) already illustrate that taxes affect the attraction of additional capital
investment. Our findings show that curtailing profit shifting possibilities harms firms’ incentives
to invest in intangible maintenance. This effect is relevant for policy makers. Moreover, this
result is in line with Desai et al. (2006) and Hong and Smart (2010). They have already shown
that tax planning leads to less tax revenues in the high-tax jurisdiction. But their results also
indicate that tax avoidance may have offsetting effects on real investments which are attractive to
governments. Basically, their focus is quite different. While we focus on the firm’s perspective
their main concern is governments’ optimal behavior.

The literature on transfer pricing for intangibles (with tax considerations) is scarce. Johnson
(2006) examines three transfer pricing methods for intangibles, that is royalty-based transfer
pricing, negotiated transfer pricing, and royalty-based transfer pricing with renegotiation. In
the studied setting, two divisions consecutively create the intangible. Her results highlight that
royalty-based transfer pricing with renegotiation can achieve first-best investment incentives
when the investments are either quasi-independent or substitutes. As we strongly concentrate
on tax compliance and negotiated transfer prices are perceived as potentially harming tax com-
pliance, our analysis is restricted to royalty-based transfer pricing. We add to the findings of
Johnson (2006) by focusing on the location choice of and royalty payments for an already exist-
ing intangible which can be used by each firm division to generate profit. Our results highlight
that spillovers affect internal transfer prices, that firm’s pursuit of tax compliance combined
with positive spillovers may result in a ‘home bias’ in the intangible’s location choice, and that
restricting profit shifting possibilities never results in higher investment levels.

De Simone and Sansing (2014) investigate if cost sharing arrangements serve to shift intellectual
property offshore to low-tax jurisdictions when spillovers from marketing intangibles occur.
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 owning division. Hence, spillovers are neglected in their considerations. Furthermore, they take into account the possibility that the tax authority can retroactively change transfer prices using the commensurate with income standard. In contrast to De Simone and Sansing (2014), we investigate the location choice of an already existing intangible rather than its development because empirical findings indicate that an intangibles’ development and subsequent location choice can be easily disentangled (Karkinsky and Riedel, 2012).

Most closely related to our work are De Waegenaere et al. (2012). They model firms’ patent race by making research and development investments and subsequent production of tangible assets. During the production of the tangible assets the intangible is exploited. Furthermore, the production requires a non-deductible investment. 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 can confirm their results showing that narrowing the arm’s length range harms the overall investments of the MNC. We contribute to their findings because we endogenize the optimal location choice of an intangible once developed.

Recently, Juranek et al. (2018) investigate how different methods in determining an arm’s length price influence MNC’s investment decisions when the intangible is located in a low-tax jurisdiction. Moreover, they are interested in the appropriateness of a source tax in order to reduce profit shifting via royalties. In line with their results we can show that curtailing profit shifting possibilities might be harmful for domestic investments. We add to their findings because we endogenize MNC’s location choice for the intangible. Furthermore, we incorporate two different transfer prices for the possibly conflicting objectives. Thus, our results show that even in case of decoupled transfer prices and thus reduced trade-off in the pricing decision investments decrease if profit shifting possibilities are reduced and compliance is an issue. For a high spillover and restrictions on tax avoidance we find in line with the empirically documented ‘home bias’ that locating the intangible in the high-tax country can become optimal. In this case optimal investments can be achieved because of the internalization of the spillover effect.
of intangibles.
The rest of the paper proceeds as follows. In the next section, the model is presented. Afterwards, section 3 presents a benchmark case when the governments do not levy taxes. Section 4 discusses the location choice of the intangible when tax related restrictions on internal royalty rates are either absent or present. Then, the effects of curtailing profit shifting possibilities on the divisions’ investments are studied in section 5. Finally, in section ?? we investigate whether our results regarding the ‘home bias’ are preserved under a OSB accounting system. Section 7 concludes the paper.

2 Model Description

We consider an MNC operating in a low-tax and a high-tax jurisdiction. The MNC comprises a headquarters and two divisions. In contrast to prior research, we endogenize the MNC’s choice where to locate an intangible. In line with former work of Juranek et al. (2018) we neglect initial invention and innovation of the intangible without loss of generality. We are interested in the implications of transfer pricing and MNC’s maintenance investments which are independent of R&D investments. Moreover, according to Karkinsky and Riedel (2012) the development of an intangible and its actual location are independent. In particular, we investigate if the intangible should be located in the low-tax country while transfer pricing compliance is an issue. We assume the foreign division operates in the low-tax jurisdiction. Its income is taxed with the tax rate $t$. We assume headquarters and the domestic division to be located in the high-tax jurisdiction, where their income is taxed with a tax rate $t + h$, where $0 < t, h < 1$ and $t + h < 1$. Hence, the MNC faces a tax rate differential, captured by $h$. In order to maximize its profits this tax rate differential can be used to save taxes. Both divisions generate profits using an intangible. These profits can be extended by maintenance investments of each division $j$ with $j = 1, 2$. The maintenance investments are costly $c_j = \frac{k_j}{2} \theta_j^2$ with $j = 1, 2$ and not verifiable to the headquarters. This is a standard assumption in the literature (Johnson, 2006). Thus, it is

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4 An intangible is not necessarily part of the firm’s balance sheet. Hence, these investments are expensed rather than capitalized and depreciated. However, we assume that these maintenance investments are necessary to sustain the intangible’s value.
not possible that the headquarters administers the magnitude of the maintenance investments.\footnote{For the sake of simplicity we assume that each division has additional operations generating revenues and costs. Hence, the investment expenditures $c_j$ cannot be inferred.} These costs reduce the investing division’s taxable income. We assume that $k$ is sufficiently large in order to ensure that $0 \leq \theta_j \leq 1$ holds true. The divisions decide whether to invest or not. Moreover, they decide about the magnitude of the investment. If an investment takes place, division $j$ generates direct contribution margin $x_j$. Where $x_j = x_H = 1$ is realized with probability $\theta_j$. Otherwise, the investing division faces the baseline revenue which we normalize without loss of generality to $x_j = x_L = 0$. Figure 1 depicts the divisions’ investment decisions $\theta_j$.

![Figure 1: Divisions investment decision $\theta_j$, where $j = 1, 2$](image)

We assume that the investment of the high-tax division has a spillover $\beta$ with $0 \leq \beta \leq 1$ on the contribution margin of the foreign division (indirect effect on contribution margin).\footnote{All results hold true if we consider bilateral spillovers as long as the domestic spillover exceeds the foreign spillover. Thus, for the sake of convenient notation we normalize the spillover from the foreign division’s investment on the domestic division’s profits to zero.} In line with Bouwens et al. (2017), we model a linear spillover. Hence, the total contribution margin of the low-tax division is $M_2 = x_2 + \beta x_1$ whereas the contribution margin of the domestic division 1 is determined solely by its own investments, i.e., $M_1 = x_1$.

Due to the specific features of intangibles the boundaries of ownership are blurred. In particular, the non-rivalry in consumption allows that both divisions use the intangible without facing scarcity. Hence, neither opportunity costs nor marginal costs occur. Thus, at a first glance it seems to be optimal that all participating parties use the intangible at zero costs. This formerly discussed result (see for example Boos (2003)) might be myopic. The owning division has the
right to decide whether other parties are allowed to use the intangible or not. Moreover, due to
the spillover the domestic division’s investment affects the contribution margin of the foreign
division. Hence, in most cases a non-zero royalty payment induces better results. 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). In line with former findings, we assume that the MNC keeps TSB.\(^7\)
The MNC faces a higher degree of freedom choosing TSB. Firms may also decide to use the
same transfer price internally and for tax purposes (see for example Göx and Schiller (2006),
Raimondos-Møller and Scharf (2002), Schjelderup and Sorgard (1997), and Haak et al. (2017)).
Even though a single transfer price for different purposes can be an equilibrium strategy (Haak
et al., 2017) many firms use separate transfer prices for internal and tax objectives (Springsteel,
1999). Thus, the firm disentangles the royalty rates for internal and external purposes. In
particular, investment decisions might be adapted by an internal royalty rate $\gamma_i$ whereas the
external royalty rate $\gamma_r \in [\underline{\gamma}_r, \bar{\gamma}_r]$ with $0 < \underline{\gamma}_r < \bar{\gamma}_r < 1$ serves for the tax reporting. This range
reflects the acceptable arm’s length royalty rates. Thus, there is at first no trade-off inherent to
the transfer pricing decisions. In line with the transfer pricing literature we assume exogenous
boundaries for the arm’s length range (see for example Baldenius et al. (2004)). 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.\(^8\)

The timing of the game is depicted in figure 2.

\begin{figure}
\centering
\begin{tabular}{cccc}
\hline
$t=0$ & $t=1$ & $t=2$ & $t=3$
\hline
Location choice for existing intangible & HQ determines $\gamma_i$ and $\gamma_r$ & Division 1 and 2 decide on $\theta_1$ and $\theta_2$, respectively & Payoffs are realized
\hline
\end{tabular}
\caption{Timeline}
\end{figure}

Based on empirical findings that the development and the subsequent location choice are inde-

\(^7\) In section ??, we crosscheck whether our findings regarding the ‘home bias’ remain under OSB.
\(^8\) Juranek et al. (2018) investigate how different transfer pricing methods and the possibly differing arm’s length
ranges influence profit shifting with intangibles.
ependent (Karkinsky and Riedel, 2012; Schwab and Todtenhaupt, 2017) we assume that MNCs anticipate the consequences of their location choice. Hence, the location choice takes place ex ante and no relocation occurs. Once developed, the headquarters locates the intangible in order to maximize its overall after-tax profits. Thus, the headquarters has different strategy choices. On the one hand, it can decide that one of its two divisions legally owns the intangible. On the other hand, it can centralize the ownership or decide that both divisions jointly own the intangible. That is, we consider four possibilities for the intangible’s location. Either, the domestic division, the foreign division, both divisions jointly, or headquarters centrally owns the intangible. However, the price setting competence remains in headquarters control. Hence, we consider an administered transfer pricing environment. An alternative setting would be that the participating divisions negotiate on the royalty rates. Especially in the light of the findings of Johnson (2006) who shows that renegotiable royalty rates may lead to first-best investment this might seem reasonable. However, firms that prioritize compliance tend to refrain from negotiated transfer pricing (Cools and Emmanuel, 2006; Cools and Slagmulder, 2009). Since we are interested in tax compliance motives we do not consider the possibility of negotiated royalty rates. Independent of the legal ownership, the headquarters chooses the transfer prices, i.e., the internal and the external royalty rate, in order to maximize the overall after-tax profit.

3 Benchmark: No-tax world

We now turn to the analysis of the location choice. As a first 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 imputed to locate their intangibles solely to reduce their tax liability. If we do not incorporate any restrictions in the transfer pricing the MNC is free to design its royalty scheme in order to maximize the overall profit. First-best investments cannot be achieved if the domestic division owns the intangible because the spillover is not taken into account during the maintenance investment decision. Basically, the royalty payment from the foreign division leads to an internalization of the indirect effect on the 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 in a no-tax world. This negative effect can easily be avoided as the following analysis shows. Legal ownership can be assigned to the foreign division. Thus, the domestic division pays royalties to gain access to the intangible and expects the following profit:

\[
E \left[ \Pi_{1,NT}^{d2} \right] = (1 - \gamma) \theta_1 - \frac{k}{2} \theta_1^2
\]

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

\[
E \left[ \Pi_{2,NT}^{d2} \right] = \theta_2 + \theta_1 (\beta + \gamma) - \frac{k}{2} \theta_2^2.
\]

Headquarters’ expected profit comprises both divisional profits:

\[
E \left[ \Pi_{HQ,NT}^{d2} \right] = E \left[ \Pi_{1,NT}^{d2} \right] + E \left[ \Pi_{2,NT}^{d2} \right].
\]

Hence, the division’s investment decisions are given by:

\[
\theta_{1,NT}^{d2} = \frac{1 - \gamma}{k}
\]

and

\[
\theta_{2,NT}^{d2} = \frac{1}{k}.
\]

Thus, the investment incentives of the foreign division are not affected by a 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 \( \gamma_{NT}^{d2} = -\beta \) induces first-best investments. For economic reasons this royalty rate is negative. Such a negative royalty rate 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.

The same result is achieved if the headquarters owns the intangible. Then, both divisions have to pay royalties in order to get access to the intangible. However, optimal investments can

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9 The proof for all four considered ownership settings is in the appendix.

10 The superscript indicates which division owns the intangible in the considered situation. The subscript NT highlights the no-tax cases. Whereas missing NT signals tax world considerations.
be achieved if the foreign division uses the intangible free of charge. Thus, the headquarters asks for a zero royalty $\gamma_{NT}^{2} = 0$. Furthermore, the headquarters pays an investment subsidy, i.e., $\gamma_{NT}^{1} = -\beta$ to the domestic division to induce spillover’s internalization. Hence, optimal investments in both divisions require a redistribution of profits. Notably, in a no-tax world without any restrictions concerning the royalty rate, profit shifting is necessary to induce first-best maintenance investments to sustain or raise the intangible’s high value.

With joint ownership an investment subsidy might be profit enhancing. However, no subsidy can be found which 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, no royalties are paid. Therefore, first-best investments cannot be induced. Thus, centralized or foreign ownership dominates joint ownership.

**Proposition 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.

## 4 Location Choice of Intangibles

The no-tax benchmark has shown that the MNC is indifferent between locating the intangible in the domestic headquarters or abroad. Moreover, the benchmark highlights that non-zero royalty rates are optimal although marginal costs for the intangible’s use are zero. The reason is inducing the internalization of the spillover.

### 4.1 No Restriction on Tax Avoidance

Without taxes either the foreign division or the headquarters should own the intangible. This result is not preserved in a tax-world. With taxes the foreign division’s ownership dominates centralization.\(^\text{11}\) Specifically, the expected profits are given by:

\[
E \left[ \Pi_{1}^{2} \right] = (1 - t - h) \left[ \theta_{1} - \frac{k}{2} \theta_{1}^{2} \right] - \gamma_{1} \theta_{1} + \gamma_{r} \theta_{1} (t + h)
\]

\(^{11}\) All proofs are in the appendix.
The overall after-tax profit contains a tax savings position. Thus, it takes the following form:

\[ E \left[ \Pi^2_{d2} \right] = (1-t) \left[ \theta_2 + \beta \theta_1 - \frac{k}{2} \theta_2^2 \right] + \gamma \theta_1 - t \gamma \theta_1. \]  

(1)

Obviously, the MNC is interested in the highest possible external transfer price, i.e., \( \overline{\gamma}_r \), in order to maximize its tax savings. The divisions choose their investment levels in order to maximize their own after-tax profits. These investment decisions are given by:

\[ \theta^d_{12} = \frac{1}{k} + \frac{1}{k (1-t-h)} \left[ \overline{\gamma}_r (t + h) - \gamma \right] \]  

(2)

and

\[ \theta^d_{22} = \frac{1}{k}. \]  

(3)

Thus, stipulating the following internal royalty rate induces first-best investments:

\[ \gamma^d_{12} = \overline{\gamma}_r t - (1-t) \beta. \]  

(4)

Since we do not consider restrictions on tax avoidance this internal royalty rate might become negative. Hence, the foreign division subsidizes the investment of the domestic division. It is beneficial to make the domestic division internalize the spillover and thus the indirect effect on the foreign division’s contribution margin. Appropriate investment incentives are provided to the domestic division to optimally exploit the spillover. Hence, the under-investment problem is alleviated. If taxes are taken into account an additional effect next to internalizing the spillover occurs. The MNC is interested in minimizing its tax payments. Not surprisingly it is always beneficial in this setting when the foreign division owns the intangible. This result is straightforward. In addition to the internalization problem, tax savings can be generated by shifting profits from the high-tax to the low-tax jurisdiction.

### 4.2 Restriction on Tax Avoidance and Resulting Home Bias

It is straightforward that restrictions on tax avoidance as well as tax rates are incorporated in the location choice and respective transfer pricing decision. In particular, Hyde and Choe (2005) have stated that a connection between the tax environment and the internal transfer pricing
policy exists. Moreover, a large discrepancy between the internal and external royalty rate may raise tax auditors’ attention (Mills, 1998). In particular, a positive external royalty rate (because it can be chosen only within the boundaries of the arm’s length range) and a negative internal royalty rate may strongly indicate profit shifting behavior. Especially in the light of the recent BEPS project, arm’s length compliance has become a major concern of multinationals. The MNCs are interested in minimizing their tax payments and at the same time compliance is a crucial objective in order to prevent legal disputes with the tax authorities (Cools et al., 2008). Moreover, if the MNC uses a single transfer price for internal and external purposes a negative royalty rate is impossible due to arm’s length restrictions and the awareness of tax auditors of profit shifting incentives for MNCs. Hence, we assume that internal royalty rates have to be non-negative in cross-border transactions. We use this non-negativeness requirement for the internal royalty rate to display tax avoidance restrictions. However, this surrogate for restrictions is chosen for the sake of simplicity and convenient presentation and is not necessary to obtain our results. Merely the existence of restrictions on tax avoidance is needed. This interdependence between the internal and the external royalty rate makes an investment subsidy of the owning division impossible. In particular, tax savings can be generated by allocating the intangible to the low-tax division. However, the arm’s length principle has to be considered for external reporting purposes within a tax-world. If compliance is an issue an investment subsidy cannot be imposed because of the interdependence between the internal and the external royalty rate. Then, it is no longer straightforward that the foreign division owns the intangible.

For a low spillover, namely \( \beta < \frac{\gamma n_{1}}{1-n_{1}} := \beta^{d_{2}} \), optimal investments can be achieved. If the spillover is high, i.e., \( \beta > \beta^{d_{2}} \), first-best investments cannot be achieved when the foreign division owns the intangible. Restrictions on tax avoidance curtail the MNC’s internal pricing possibilities. Here these restrictions require the internal royalty rate to be non-negative. While the arm’s length principle requires a positive external royalty rate, an investment subsidy might be interpreted as strong tax savings behavior. Thus, the MNC has to balance the conflicting objectives of tax minimization and investment incentives. This trade-off occurs despite the decoupling of internal and external transfer prices. Compliance creates an interdependence between the internal and the external transfer price. Thus, the MNC is not free to choose the
internal royalty rate to induce first-best investments if compliance is an issue. Centralization can be used to provide first-best investment incentives 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.\footnote{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 carry forwards.} Thus, a large discrepancy between the internal and the external royalty rate for the domestic division does not indicate tax avoidance motives due to the missing tax rate differential.

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

\[
E \left[ \Pi_i^C \right] = (1 - t - h) \left[ \theta_1 - \frac{k}{2} \theta_1^2 \right] + \theta_1 \left[ \gamma_r (t + h) - \gamma_{i1} \right]
\]

and

\[
E \left[ \Pi_2^C \right] = (1 - t) \left[ \theta_2 + \beta \theta_1 - \frac{k}{2} \theta_2^2 \right] + (\theta_2 + \beta \theta_1) \left[ \gamma_r t - \gamma_{i2} \right].
\]

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

\[
E \left[ \Pi_{HQ}^C \right] = (1 - t - h) \left[ \theta_1 - \frac{k}{2} \theta_1^2 \right] + (1 - t) \left[ \theta_2 + \beta \theta_1 - \frac{k}{2} \theta_2^2 \right] - h \gamma_r \left( \theta_2 + \beta \theta_1 \right).
\]

Obviously, the headquarters chooses \( \gamma_r \) in order to minimize its tax liability while complying with the arm’s length principle. The headquarters is able to discriminate the royalty rates because the restriction on tax avoidance is relevant only in cross-border transactions. The domestic division has to pay an internal royalty rate of:

\[
\gamma_{i1}^C = \gamma_r (t + h) - \beta \left( 1 - t - h \gamma_r \right).
\]

The domestic division faces a royalty agreement which can become either positive or negative. However, the domestic government’s income is not affected. Thus, tax avoidance cannot be alleged to the MNC. The foreign division is incentivized with the following internal royalty rate
in case of a centralized ownership of the intangible:

\[ \gamma^c_{i2} = \gamma_c(t + h). \]

If the indirect effect of the investment of the domestic division on the contribution margin of the foreign division is high, i.e., \( \beta > \beta_d^{d2} \), centralization might become preferable. The intuition is as follows. If the intangible is owned by the foreign division and the spillover is high no first-best investments are achievable. However, tax savings might be generated because profits are shifted to the low-tax jurisdiction. But a high spillover leads to severe investment distortions if the domestic division is not forced to internalize this spillover. Hence, appropriate investment incentives become more important relative to a situation with a low spillover. Centralization leads to first-best investments because it allows to subsidize the domestic division’s investment. This is possible because the subsidy is not targeted by a tax auditor because the taxable income of the domestic jurisdiction remains untouched. Furthermore, because of the missing tax avoidance motive in the domestic trade the MNC is no longer forced to use a single royalty rate to align the investment incentives of the divisions. In particular, the under-investment problem of the domestic division can be circumvented by an investment subsidy if necessary. Nevertheless, the foreign division has to pay positive internal royalty rates. Thus, compliance is not eroded due to large discrepancies between internal and external royalty rates. Moreover, the MNC has strong arguments that their internal transfer price for cross-border transactions is set due to compliance motives rather than tax avoidance.

### 4.3 Royalty Rates and Location Choices

Our analysis has shown that in a no-tax world the MNC is indifferent between locating the intangible in the high-tax headquarters or offshore. Both location choices allow the implementation of first-best investments. In a tax world, besides the internalization of the spillover, MNCs aim to minimize taxes within the legal boundaries. Thus, without taking into account restrictions on tax avoidance, the MNC locates the intangible in the foreign low-tax jurisdiction. This result is in line with the public recognition that large MNCs locate intangibles in tax havens in order to minimize their tax liability.

When tax compliance is an issue, the MNC refrains from aggressive tax avoidance. Hence, it
trades off effective profit shifting and appropriate investment incentives. However, for a low spillover the result of locating the intangible offshore is preserved. The ownership of the intangible is assigned to the foreign division and profits are shifted effectively. An investment distortion is less severe for a low spillover. Hence, the tax saving possibilities drive the location choice. However, if the spillover is high and restrictions on tax avoidance are present, an investment distortion is detrimental. In this case the intangible is located at the firm’s headquarters. Thus, first-best investments can be achieved because the spillover is internalized. Our findings are summarized in proposition 2 and illustrated in figure 3.

**Proposition 2.** Without restrictions on tax avoidance the intangible is located in the foreign division. With restrictions on tax avoidance and

- a low spillover, i.e., \( \beta < \beta^C \), the intangible is located in the low-tax foreign division
- a large spillover, i.e., \( \beta > \beta^C \), the intangible is located centrally in the high-tax jurisdiction.

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

![Figure 3: Expected Firm Profits with Foreign (d2) and Centralized (C) Ownership under Restriction on Tax Avoidance (plotted for \( \gamma_r = 0.1, \gamma_T = 0.5, t = 0.2, h = 0.15, \) and \( k = 3 \))](image)

Empirical findings suggest that intangibles might be located in the high-tax headquarters’ jurisdiction although tax rate differentials are present and profit shifting might reduce the tax liability of the MNC (Karkinsky and Riedel, 2012; Heckemeyer et al., 2017). They conclude that the so called ’home bias’ is hard to explain. Potentially, part of this bias stems from positive spillovers and compliance motives. We have shown that a centralized ownership of an intangible might
be preferable. In particular, for a high spillover, i.e., $\beta > \beta^C$, and restrictions on tax avoidance, the intangible’s ownership is centralized in the headquarters although the headquarters operates in the high-tax country. Our results are depicted in figure 4.

![Diagram of Ownership of the Intangible](image_url)

**Figure 4: Ownership of the Intangible**

The threshold $\beta^C$ determines the minimum spillover which is needed in order to locate the intangible in the high-tax jurisdiction. This threshold is increasing in the lower bound of the arm’s length range $\gamma_r$. An increase in $\gamma_r$ decreases the MNC’s profit shifting possibilities under centralized ownership whereas the MNC’s profit under foreign ownership is unaffected. Thus, in order to induce the MNC to centrally locate the intangible in the high-tax jurisdiction the investment incentives need to become more important. This is the case for a higher spillover.

**Proposition 3.** The threshold level of the spillover $\beta^C$ is increasing in the lower bound of the arm’s length range $\gamma_r$.

When the upper bound of the arm’s length range $\overline{\gamma_r}$ increases, the MNC’s profit shifting possibilities under foreign ownership raise. The arm’s length price $\overline{\gamma_r}$ does not affect the MNC’s...
profit under centralized ownership. This means, foreign ownership becomes more attractive whereas the MNC’s profit under centralized ownership is unaffected. Thus, a higher minimum spillover is required to make the centralized ownership optimal.

**Proposition 4.** The threshold level of the spillover $\beta_C$ is increasing in the upper bound of the arm’s length range $\gamma_r$.

A higher tax rate differential implies higher profit shifting incentives. With foreign ownership the MNC can optimally exploit legal tax saving possibilities. This is not possible with centralized ownership. Hence, foreign ownership becomes more attractive. However, whereas foreign ownership results in distorted investment decisions centralized ownership allows first-best investments. In order for centralized ownership to still outweigh the increasing benefits of foreign ownership due to a raise in the tax rate differential, the minimum spillover $\beta_C$ has to increase.

**Proposition 5.** The threshold level of the spillover $\beta_C$ is increasing in the tax differential $h$ for $h < (1 - t)/2$.

## 5 Profit Shifting Effects on Investments

The equilibrium outcome depends on several parameters. In the following we investigate how our results are affected by varying exogenous factors. If the foreign division owns the intangible the design of the transfer pricing scheme is twofold. On the one hand, for a low spillover the domestic division pays a royalty fee for the use of the intangible. On the other hand, if the spillover is high the internalization of the indirect effect on the foreign division’s contribution margin becomes important. Then, the internal royalty rate becomes negative when no restrictions on tax avoidance are imposed. This can be interpreted as investment subsidy. Hence, the spillover directly affects the internal royalty rate. However, in both cases of the foreign ownership an increasing spillover leads to decreasing internal royalty rates. Furthermore, the spillover affects the headquarters’ expected profit twice. First, an increasing spillover leads to a higher foreign contribution margin. Second, the domestic division’s investment affects both, the domestic and the foreign divisions’ contribution margin. Hence, with an increasing spillover the investment incentives of the domestic division becomes more important from headquarters’ point of view. With restrictions on tax avoidance centralization allows the implementation of first-best investments, which become especially important for a high spillover. For a low spillover, centralization of the intangible’s ownership does not occur in equilibrium. Thus, only a high spillover
forces the MNC to locate the intangible in the high-tax jurisdiction. The headquarters faces a higher degree of freedom in the transfer pricing design. The internal royalty rate for cross-border transactions does not depend on the spillover. In line with prior research, we can show that this internal royalty rate depends on the externally accepted royalty rate (Hyde and Choe, 2005; Haak et al., 2017). 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 6. An increasing spillover does not increase the internal royalty rate. The rates either decrease or are unaffected.**

Furthermore, we are interested in the effect of reducing the profit shifting possibilities. Governments can define tax compliant external royalty rates. Thus, the arm’s length range determines the firm’s possibilities to engage in 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 of profit shifting possibilities harms the investment incentives. If the intangible is located in the low-tax jurisdiction the investment incentives for the domestic division decreases if less profit shifting is possible. The investment incentives of the foreign division remains the same because they own the intangible and their investment affects only its own profits. In case of a centralized ownership reducing profit shifting possibilities harms the investment incentives of both divisions.

Our result also contributes to former findings of De Waegenaere et al. (2012) who show that a weaker enforcement of the arm’s length principle may improve social welfare. The deterioration of the overall investment incentives due to reduced profit shifting possibilities is not sensitive to the ownership location of the intangible. Thus, tight transfer pricing regulations may have negative impacts on real investment decisions.

**Proposition 7. Curtailing profit shifting possibilities by narrowing the arm’s length range leads to decreasing investment incentives for the MNC.**

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 investments so that in sum, the domestic investment increases. This is true for both foreign or central ownership. When the intangible is located in the low-tax foreign division, an increase in the tax rate differential does not affect the foreign division’s investment decision. This does not apply to the setting of centralized ownership. Under centralized ownership the foreign division pays a positive external royalty rate to the headquarters. They in turn have to pay taxes on this royalty income. A raise 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 smaller internal royalty rate. That is, whereas 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 8.** An increase in the tax rate differential

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

### 6 Location Choice of Intangibles under OSB

So far we have assumed TSB. And in this section we investigate the OSB setting. Thus, we restrict the MNC’s transfer pricing flexibility by requiring the internal and the external royalty rate to coincide. We can show that in a tax-world with TSB and restriction on tax avoidance a ‘home bias’ occurs for a large spillover, i.e., centralized ownership in the high-tax jurisdiction is optimal for a high spillover. For a low spillover the foreign division owns the intangible and profit shifting is deployed most effectively. If the foreign division owns the intangible the headquarters’ expected profit is shown in equation (1). The only difference in a OSB setting is that the headquarters’ transfer pricing decision is restricted to the interval \([\gamma_r, \overline{\gamma}_r]\) because we require the internal and the external royalty rate to be the same. Thus, in general stipulating an internal royalty rate to induce first-best investments is no longer possible. Hence, investment decisions will typically be distorted. Moreover, the foreign division uses no longer necessarily the highest acceptable royalty rate in order to minimize its tax liability. Under a OSB setting
the royalty rate serves two purposes. On the one hand, the royalty rate is used to achieve goal
congruence regarding investment decisions of divisional managers. On the other hand taxes
should be minimized. Thus, a trade off is inherent in the MNC’s decision. The conflicting
objectives have to be balanced in order to maximize the headquarters overall after-tax profit.
The resulting transfer pricing decision if the intangible is located in the foreign division is given
by:

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

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

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

Our analysis has shown that the the intangible is optimally located in the foreign division or
centralized in the headquarters in a tax world with restrictions on tax avoidance when the MNC
keeps TSB. For a low spillover, i.e., $\beta < \beta_2^d$ the result of locating the intangible offshore is
preserved under a OSB accounting system. However, profit shifting is less effectively than under
the TSB accounting system because the royalty rate is not necessarily the highest acceptable
from the arm’s length range. Thus, foreign ownership is implemented by the MNC for a low
spillover whether OSB is kept or the MNC uses TSB and faces restrictions. That is, even for
the most severe restriction on the internal transfer price, i.e., forcing MNCs to use OSB, the
tax-saving motive dominates the location choice for a small spillover. The reason is that the
investment distortions for a small spillover are not severe.

It is straightforward that depending on the spillover’s magnitude either tax minimization or in-
vestment decisions become the driving force of the location choice. In particular, if the spillover
is high an investment distortion is detrimental. However, under a OSB setting centralized ownership cannot be optimal because neither profit shifting nor investment decisions are optimal if the royalty rate for internal decisions must be from the arm’s length range.

For medium spillover joint ownership becomes optimal in the OSB setting. Since neither profit shifting nor investment incentives can become optimal under OSB the MNC trades off both objectives. If the intangible is located offshore profit shifting is deployed most effectively. However, the investment distortion is also most severe. If the spillover increases such a distortion becomes more detrimental. Thus, profit shifting takes a back seat. However, in case of joint ownership at least one division invests optimal from headquarters point of view and profit shifting does not occur at all. In contrast to the OSB setting, joint ownership is never optimal for an MNC keeping TSB under restrictions. The intuition is that with joint ownership neither the tax saving possibilities can be completely exploited nor the first-best investments can be induced. Thus, either foreign ownership with optimal tax saving behavior or centralized ownership with first-best investments outperform joint ownership when TSB with restrictions are considered.

Similar to the TSB setting the intangible is optimally held in the high-tax jurisdiction for a high spillover. However, rather than a centralized ownership under TSB the intangible should be located in the domestic division under OSB in order to mitigate the investment distortion for a high spillover. In particular, the spillover is so important that profit shifting to the high-tax country as a consequence is accepted. In sum, the finding that the intangible is located in the high-tax jurisdiction for a high spillover does not depend on the TSB assumption. We also obtain this finding in the OSB setting. Our findings are summerized in proposition 9 and illustrated in figure 5.

**Proposition 9.** For $h < \frac{3 - \sqrt{5}}{2}$, $t < \frac{2 - h(3 + \sqrt{5})}{2}$, $h < \frac{1}{2}(1 - t)$ and $\gamma_r < \frac{1 - t}{1 - t + h}$, under a OSB accounting system and

- **a low spillover, i.e.,** $\beta \leq \beta_j^{d2}$, the intangible is located in the low-tax foreign division
- **a medium spillover,** i.e., $\beta_j^{d2} < \beta < \beta_j^{d1}$, joint ownership is optimal
- **a high spillover,** i.e., $\beta \geq \beta_j^{d1}$, the intangible is located in the high-tax domestic division.
Figure 5: Expected Firm Profits with Foreign (d2) and Joint (J) and Domestic (d1) Ownership under OSB (plotted for $\gamma_r = 0.1, \gamma_F = 0.5, t = 0.2, h = 0.15$, and $k = 3$)

7 Conclusion

Intangibles are critical for a firm’s success. In contrast to tangible assets, intangibles have several specific features. On the one hand, intangibles are often unique but not exclusive in their consumption. On the other hand, the use of an intangible is typically associated with no or negligible marginal costs. Moreover, spillovers or network effects regularly occur. Due to these specific characteristics, the use of an intangible is hard to value. Still, when an intangible is used by several divisions internal royalty payments are needed to induce adequate maintenance investments. Next to this internal role of royalty payments, an external transfer price is needed to report the taxable income. Thus, an MNC operating in different tax jurisdictions might also use royalty payments to shift profits and hence, save tax payments. Governments and tax authorities are aware of this strong profit shifting incentive associated with intangibles. However, most companies refrain from a dispute with tax authorities and aim at tax compliance.

We study the optimal internal royalty rates while endogenizing the location choice of the intangible in an analytical model. In general, the optimal internal royalty rates for the use of intangibles are not zero although no marginal costs of using the intangible occur. Non-zero royalty rates are needed to induce adequate maintenance investments because of a positive spillover from the domestic to the foreign division’s contribution margin.

Our model highlights that without restrictions on tax avoidance, the intangible is located in the low-tax jurisdiction. This allows the MNC to optimally shift profits in order to minimize its tax
liability. This result is in line with theoretical work regarding tax minimization and empirical findings that many intangibles are located offshore. However, when compliance is an issue the MNC takes restrictions on tax avoidance into account. It is restricted in setting the internal royalty rates. If restrictions are present and spillovers are low, locating the intangible in the low-tax jurisdiction is still optimal. But for a high spillover, the MNC needs to trade-off effective profit shifting within its legal boundaries and first-best maintenance investments. Effective profit shifting is obtained when the intangible is held by the foreign division operating in the low-tax jurisdiction. However, first-best maintenance investments are achieved with centralized ownership of the intangible, i.e., the headquarters which is located in the high-tax jurisdiction has the legal right to exploit, rent or sell the intangible. A higher spillover results in higher benefits from adequate maintenance investments. As a consequence, for a large spillover, the benefits from first-best maintenance investments exceed the costs from ineffective profit shifting. Thus, the intangible is located in the high-tax jurisdiction. This provides a potential explanation for the ‘home bias’ found in the empirical literature.

Recently, governments and tax authorities seek to curtail firms’ profit shifting possibilities. Especially the BEPS project is intended to reduce profit shifting. Our analysis illustrates that restricting profit shifting possibilities harms domestic firms’ investment incentives. When the intangible is located in the domestic high-tax jurisdiction, the firms’ investment incentives in the foreign low-tax jurisdiction are also diminished. In sum, curtailing profit shifting possibilities results in lower overall investments by MNCs. Therefore, the findings are relevant for legislators, tax authorities, MNCs, and supranational organizations like the OECD and the EU.
8 Appendix

8.1 Proof of Proposition 1

We first consider all possible location choices in a no-tax world in order to provide a useful benchmark for the subsequent analysis of tax induced location choices.

8.1.1 The Domestic Division owns the Intangible

Expected profits are given by:

\[ E[\Pi_1] = \theta_1 - \frac{k}{2}\theta_1^2 + \gamma(\theta_2 + \beta \theta_1) \]

and

\[ E[\Pi_2] = (1 - \gamma)(\theta_2 + \beta \theta_1) - \frac{k}{2}\theta_2^2 \]

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

\[ FOC \theta_1 : 1 - k\theta_1 + \gamma\beta = 0 \]
\[ SOC \theta_1 : -k < 0 \]
\[ FOC \theta_2 : 1 - k\theta_2 - \gamma = 0 \]
\[ SOC \theta_2 : -k < 0 \]

Thus, the FOCs determine a local maximum:

\[ \theta_{d1}^1 = \frac{1 + \gamma\beta}{k} \]

and

\[ \theta_{d1}^2 = \frac{1 - \gamma}{k} \]

The headquarters’ profit is equal to:

\[ E[\Pi_{HQ}] = \theta_1 + \theta_2 + \beta \theta_1 - \frac{k}{2}(\theta_1^2 + \theta_2^2) \]  (5)

Differentiating headquarters’ expected profit with respect to \( \theta_1 \) and \( \theta_2 \) shows the investment levels which maximize the overall profit:

\[ FOC \theta_1 : 1 - k\theta_1 + \beta = 0 \]
\[ SOC \theta_1 : -k < 0 \]
\[ FOC \theta_2 : 1 - k\theta_2 - \gamma = 0 \]
\[ SOC \theta_2 : -k < 0 \]

Thus, the FOCs determine a local maximum. The optimal investment levels from headquarters point of view are:

\[ \theta_{HQ}^1 = \frac{1 + \beta}{k} \]  (6)
\[
\theta_2^{d1} = \frac{1}{k}
\]

First-best investments cannot be achieved. Hence, the headquarters choose the transfer price in order to maximize the overall profit given the division’s investments:

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

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

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

\[
\gamma^{d1} = \frac{\beta^2}{1 + \beta^2}
\]

8.1.2 The Foreign Division owns the Intangible

Expected profit of the domestic division, incorporating royalty payments:

\[
E[\Pi_1] = (1 - \gamma) \theta_1 - \frac{k}{2} \theta_1^2
\]

and the foreign division expects profit of:

\[
E[\Pi_2] = \theta_2 + (\gamma + \beta) - \frac{k}{2} \theta_2^2
\]

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

\[
FOC \theta_1 : 1 - k \theta_1 - \gamma = 0
\]

\[
SOC \theta_1 : -k < 0
\]

\[
FOC \theta_2 : 1 - k \theta_2 = 0
\]

\[
SOC \theta_2 : -k < 0
\]

Thus, the FOCs determine a local maximum:

\[
\theta_1^{d2} = \frac{1 - \gamma}{k}
\]

and

\[
\theta_2^{d1} = \frac{1}{k}
\]

The headquarters objectives remain in all no-tax scenarios unchanged and are depicted in (5), (6) and (7) respectively. Thus, first-best investments can easily be achieved setting \(\gamma = -\beta\) if there are no restrictions on tax planning. The foreign division is willing to accept a negative royalty payment administered by the headquarters because its expected profit with the subsidy

\[
E[\Pi_2] = \frac{1}{k} + \beta \frac{1 + \beta}{k} - \frac{k}{2} \frac{1 + \beta}{k^2} - \beta \frac{1 + \beta}{k} = \frac{1}{2k}
\]
equals the expected profit of the foreign division if it denies access to the intangible for the domestic division:

\[ E[\Pi_2] = \frac{1}{k} - \frac{k}{2} \frac{1}{k^2} = \frac{1}{2k} \]

However, if we take into account restrictions on tax avoidance because compliance is a relevant issue. First-best investments are no longer achievable because negative royalty rates are considered to be non-compliant. Hence, the headquarters incorporates the investment decisions of its affiliates and uses the royalty rate to maximize its overall profit.

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

\[ SOC_\gamma : - \frac{1}{k} < 0. \]

Thus, headquarters expected profit is concave in \( \gamma \). If a negative royalty rate is no longer admissible the headquarters chooses \( \gamma^{d2} = 0 \). Hence, the imposition of external restrictions on the royalty rate prevents the implementation of first-best investments. Thus, the investment incentives in (8) can easily replicate the incentives under consideration using \( \gamma = 0 \). This implies that \( E[\Pi_{Hq}^{d1}] > E[\Pi_{Hq}^{d2}] \) holds true. Then, ownership of the foreign division is strictly dominated.

### 8.1.3 Joint Ownership of the Intangible

In case of a joint ownership no division faces royalty payments. Hence, the expected profits take the following form:

\[ E[\Pi_1] = \theta_1 - \frac{k}{2} \theta_1^2 \]

and

\[ E[\Pi_2] = \theta_2 + \beta \theta_1 - \frac{k}{2} \theta_2^2 \]

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

\[ FOC_{\theta_1} : 1 - k \theta_1 = 0 \]

\[ SOC_{\theta_1} : -k < 0 \]

\[ FOC_{\theta_2} : 1 - k \theta_2 = 0 \]

\[ SOC_{\theta_2} : -k < 0 \]

Thus, the FOCs determine a local maximum:

\[ \theta_{d1}^{d2} = \frac{1}{k} \]

and

\[ \theta_{d1}^{d1} = \frac{1}{k} \]

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:

\[ E[\Pi_2] = \frac{1}{k} + \frac{\beta}{k} - \frac{k}{2k^2} = \frac{1}{2k} (1 + 2\beta) \tag{10} \]

is higher than with subsidy because (10) > (9). The investment incentives in (8) can easily replicate the incentives under consideration using \(\gamma = 0\). This implies that \(E[\Pi_{HQ}^{d}] > E[\Pi_{HQ}^{c}]\) holds true. Then, centralized ownership of the intangible is strictly dominated.

8.1.4 The Headquarters owns the Intangible

Both divisions pay royalty fees for the intangibles use. Expected profits are:

\[ E[\Pi_1] = (1 - \gamma) \theta_1 - \frac{k}{2} \theta_1^2 \]

and

\[ E[\Pi_2] = (1 - \gamma) (\theta_2 + \beta \theta_1) - \frac{k}{2} \theta_2^2 \]

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

\[ \text{FOC} \theta_1 : 1 - k \theta_1 - \gamma = 0 \]

\[ \text{SOC} \theta_1 : -k < 0 \]

\[ \text{FOC} \theta_2 : 1 - k \theta_2 - \gamma = 0 \]

\[ \text{SOC} \theta_2 : -k < 0 \]

Thus, the FOCs determine a local maximum:

\[ \theta_{HQ}^{d1} = \frac{1 - \gamma}{k} \]

and

\[ \theta_{HQ}^{d2} = \frac{1 - \gamma}{k} \]

Obviously, first-best investments can be achieved using \(\gamma_{HQ}^{d1} = -\beta\) and \(\gamma_{HQ}^{d2} = 0\). However, if external restrictions on the royalty rate has to be incorporated first-best investments cannot be induced. Headquarters’ expected profit is concave in \(\gamma\). Hence, taking into account external restrictions on the royalty rate leads to a zero payment of both divisions. In this case, the investment incentives in (8) can easily replicate the incentives under consideration using \(\gamma = 0\). This implies that \(E[\Pi_{HQ}^{d}] > E[\Pi_{HQ}^{c}]\) holds true. Then, centralized ownership of the intangible is strictly dominated.

8.2 Proof Proposition 2

We now provide an overview over possible location choices in a tax-world.
8.2.1 The Domestic Division owns the Intangible

Expected profit of division 1 is given by:

\[ E \left[ \Pi_{d1}^\text{i} \right] = (1 - t - h) \left[ \theta_1 - \frac{k}{2} \theta_1^2 \right] + \gamma_i (\beta_1 + \theta_2) - (t + h) \gamma_i (\beta_1 + \theta_2) \]

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

\[ E \left[ \Pi_{d2}^\text{i} \right] = (1 - t) \left[ \beta \theta_1 + \theta_2 - \frac{k}{2} \theta_2^2 \right] - \gamma_i (\beta \theta_1 + \theta_2) + t \gamma_i (\beta_1 + \theta_2) \]

Due to the tax rate differential the transfer price is no longer canceled out. Hence, 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.

\[ FOC_{\theta_1} : (1 - t - h) (1 - k \theta_1) + \gamma_i \beta - \beta_1 \gamma_i (t + h) = 0 \]

\[ SOC_{\theta_1} : (1 - t - h) (-k) < 0 \]

\[ FOC_{\theta_2} : (1 - t) (1 - k \theta_2) - \gamma_i + t \gamma_i = 0 \]

\[ SOC_{\theta_2} : (1 - t) (-k) < 0. \]

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

\[ \theta_{d1}^\text{i} = \frac{1}{k} + \frac{1}{k (1 - t - h)} \left[ \beta \left( \gamma_i - \gamma_i (t + h) \right) \right] \]

(11)

and

\[ \theta_{d2}^\text{i} = \frac{1}{k} + \frac{1}{k (1 - t)} \left[ t \gamma_i - \gamma_i \right] \]

(12)

Headquarters expects the following profit:

\[ E \left[ \Pi_{HQ}^\text{i} \right] = (1 - t - h) \left[ \theta_1 - \frac{k}{2} \theta_1^2 \right] + (1 - t) \left[ \beta_1 + \theta_2 - \frac{k}{2} \theta_2^2 \right] - h \gamma_i (\beta_1 + \theta_2) \]

(13)

The MNC is interested in the lowest possible transfer price because the intangible is located in the high-tax country. Thus, it chooses \( \gamma_i \) for external purposes. Differentiating headquarters’ expected profit with respect to \( \theta_1 \) and \( \theta_2 \) shows the investment levels which maximize the overall profit:

\[ FOC_{\theta_1} : (1 - t - h) (1 - k \theta_1) + (1 - t) \beta h \gamma_i = 0 \]

\[ SOC_{\theta_1} : (1 - t - h) (-k) < 0 \]

\[ FOC_{\theta_2} : (1 - t) (1 - k \theta_2) - h \gamma_i = 0 \]

\[ SOC_{\theta_2} : -k < 0. \]

Thus, the FOCs determine a local maximum. However, 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.

\[ FOC_{\gamma_i} : \frac{1}{1 - t - h} \left[ \beta^2 \gamma_i (t + h) - \beta^2 \gamma_i + \beta^2 (1 - t) - \beta^2 h \gamma_i \right] + \frac{1}{1 - t} \left[ \gamma_i (t + h) - \gamma_i \right] = 0 \]
SOCγ: \( \frac{1}{1-t-h} (-\beta^2) - \frac{1}{1-t} < 0. \)

Hence, the optimal internal royalty rate is:

\[
\gamma_{d1} = \frac{1}{1-t-h+\beta^2(1-t)} \left[ \beta^2 (1-t) \left( t\gamma_r + 1-t \right) + \gamma_r (t+h) (1-t-h) \right]
\] (14)

### 8.2.2 The Foreign Division owns the Intangible

Expected profit of the domestic division:

\[
E \left[ \Pi_{d1}^2 \right] = (1-t-h) \left[ \theta_1 - \frac{k}{2} \theta_1^2 \right] - \gamma_1 \theta_1 + \gamma_r \theta_1 (t+h)
\]

and of the foreign:

\[
E \left[ \Pi_{d2}^2 \right] = (1-t) \left[ \theta_2 + \beta \theta_1 - \frac{k}{2} \theta_2^2 \right] + \gamma_1 \theta_1 - t\gamma_r \theta_1.
\]

The divisions choose their investment levels in order to maximize their own after-tax profits. Thus, the FOCs determine a local maximum and the investments are:

\[
\theta_{d1}^2 = \frac{1}{k} + \frac{1}{k(1-t-h)} \left[ \gamma_r (t+h) - \gamma \right]
\] (15)

and

\[
\theta_{d2}^2 = \frac{1}{k}.
\] (16)

Headquarters expected profit is:

\[
E \left[ \Pi_{HQ}^2 \right] = (1-t-h) \left[ \theta_1 - \frac{k}{2} \theta_1^2 \right] + (1-t) \left[ \beta \theta_1 + \theta_2 - \frac{k}{2} \theta_2^2 \right] + h\gamma_r \theta_1
\]

Obviously, the MNC is interested in the highest possible external transfer price, i.e. \( \gamma_r \) in order to maximize its tax savings. Headquarters is interested in investment decisions maximizing overall after-tax profits:

\[
FOC\theta_1: (1-t-h) (1-k\theta_1) + \beta (1-t) + h\gamma_r (t+h) = 0
\]

\[
SOC\theta_1: (1-t-h)(-k) < 0
\]

\[
FOC\theta_2: (1-t) (1-k\theta_2) = 0
\]

\[
SOC\theta_2: (1-t)(-k) < 0.
\]

Thus, the FOCs determine a local maximum.
Thus, stipulating the following internal royalty rate induces first-best investments:

\[ \gamma_i^{d2} = \gamma_r t - (1 - t) \beta \]  

(17)

8.2.3 Joint Ownership of the Intangible

Expected profit of the domestic division:

\[ E \left[ \Pi'_1 \right] = (1 - t - h) \left[ \theta_1 - \frac{k}{2} \theta_1^2 \right] \]

and

\[ E \left[ \Pi'_2 \right] = (1 - t) \left[ \theta_2 + \beta \theta_1 - \frac{k}{2} \theta_2^2 \right]. \]

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

\[ FOC \theta_1 : (1 - t - h) (1 - k \theta_1) = 0 \]

\[ SOC \theta_1 : (1 - t - h) (-k) < 0 \]

\[ FOC \theta_2 : (1 - t) (1 - k \theta_2) = 0 \]

\[ SOC \theta_2 : (1 - t) (-k) < 0. \]

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

\[ \theta'_1 = \frac{1}{k} \]  

(18)

and

\[ \theta'_2 = \frac{1}{k}. \]  

(19)

Headquarters expected profit is:

\[ E \left[ \Pi'^' \right] = (1 - t - h) \left[ \theta_1 - \frac{k}{2} \theta_1^2 \right] + (1 - t) \left[ \theta_2 + \beta \theta_1 - \frac{k}{2} \theta_2^2 \right]. \]

By setting \( \gamma_i = \gamma_r (t + h) \) in 8.2.2 the investment incentives in 8.2.3 can be replicated. But \( \gamma_i^{d2} \neq \gamma_r (t + h). \) Hence, \( E \left[ \Pi'^'_{HQ} \right] > E \left[ \Pi'^'_{HQ} \right]. \)

8.2.4 Centralized Ownership of the Intangible

Expected profit of the domestic division:

\[ E \left[ \Pi'^{C}_1 \right] = (1 - t - h) \left[ \theta_1 - \frac{k}{2} \theta_1^2 \right] - \gamma \theta_1 + \gamma \theta_1 (t + h) \]

and of the foreign division:

\[ E \left[ \Pi'^{C}_2 \right] = (1 - t) \left[ \beta \theta_1 + \theta_2 - \frac{k}{2} \theta_2^2 \right] - \gamma (\beta \theta_1 + \theta_2) + t \gamma_r (\beta \theta_1 + \theta_2) \]
The divisions choose their investment levels in order to maximize their own after-tax profits.

\[ FOC_{\theta_1} : (1-t-h)(1-k\theta_1) - \gamma_r + \gamma_r(t+h) = 0 \]

\[ SOC_{\theta_1} : (1-t-h)(-k) < 0 \]

\[ FOC_{\theta_2} : (1-t)(1-k\theta_2) - \gamma_r + t\gamma_r = 0 \]

\[ SOC_{\theta_2} : (1-t)(-k) < 0. \]

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

\[ \theta_C^1 = \frac{1}{k} \left( 1 \frac{1}{1-t-h} \right) \]

and

\[ \theta_C^2 = \frac{1}{k} \left( t \gamma_r - \gamma_r \right). \]

Headquarters expected profit is:

\[ E[\Pi_{HQ}^C] = (1-t-h) \left( \theta_1 - \frac{1}{2} \theta_1^2 \right) + (1-t) \left( \theta_2 + \beta \theta_1 - \frac{1}{2} \theta_2^2 \right) - h\gamma_r (\theta_2 + \beta \theta_1) \]

Obviously, the MNC is interested in the lowest possible external transfer price, i.e. \( \gamma_r \) in order to minimize its tax liabilities. Headquarters is interested in investment decisions maximizing overall after-tax profits:

\[ FOC_{\theta_1} : (1-t-h)(1-k\theta_1) + \beta (1-t) - h\beta \gamma_r = 0 \]

\[ SOC_{\theta_1} : (1-t-h)(-k) < 0 \]

\[ FOC_{\theta_2} : (1-t)(1-k\theta_2) - h\gamma_r = 0 \]

\[ SOC_{\theta_2} : (1-t)(-k) < 0. \]

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

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

\[ \gamma_i^{1C} = \gamma_r (t+h) - \left( 1 - t - h\gamma_r \right) \beta \]

and

\[ \gamma_i^{2C} = \gamma_r (t+h) \]

In a world without restrictions on tax avoidance the foreign division always owns the intangible, i.e., \( E[\Pi_{HQ}^{d2}] > E[\Pi_{HQ}^{d1}] > E[\Pi_{HQ}] \) and \( E[\Pi_{HQ}^{d2}] > E[\Pi_{HQ}^c] \).

With restrictions on tax avoidance, we have \( E[\Pi_{HQ}^{d2}] > E[\Pi_{HQ}^j] \) and \( E[\Pi_{HQ}^c] > E[\Pi_{HQ}^{d1}] \). Thus, either foreign or centralized ownership is optimal. For \( \beta < \beta^{d2} \), foreign ownership is optimal as \( E[\Pi_{HQ}^{d2}] > E[\Pi_{HQ}] \). For \( \beta = \beta^{d2} \), foreign ownership is also optimal as \( E[\Pi_{HQ}^{d2}] > E[\Pi_{HQ}^c] \). For \( \beta \geq \beta^{d2} \), foreign ownership dominates centralized ownership if and only if

\[ E[\Pi_{HQ}^{d2}] \geq E[\Pi_{HQ}] \]
\[ \iff \quad \delta := E \left[ \Pi_{HQ}^{d_2} \right] - E \left[ \Pi_{HQ}^c \right] \geq 0 \]
\[ \iff \quad \frac{1}{2k(1-t)(1-t-h)} [A\beta^2 + B\beta + C] \geq 0, \]

where
\[ A := (t - 1) \left( t + \gamma h - 1 \right)^2 < 0, \]
\[ B := 2(t - 1) \left[ \gamma h(t + h - 1) + \gamma(t - 1)(t + h) \right] > 0, \text{ and} \]
\[ C := 2\gamma h(t - 1)(t + h - 1) + \gamma h(t + h - 1)(\gamma h + 2t - 2) + \gamma^2(t - 1)(t^2 - h^2). \quad (24) \]

Due to \( A < 0 \), \( \delta \) is inversely U-shaped in \( \beta \). Setting \( \delta \) equal to zero yields two thresholds
\[ \beta_1 = \frac{1}{2A} \left[ -B + \sqrt{B^2 - 4AC} \right] \text{ and} \]
\[ \beta^c = \frac{1}{2A} \left[ -B - \sqrt{B^2 - 4AC} \right]. \]

\( \beta_1 \) is smaller than \( \beta^c \). Using \( E \left[ \Pi_{HQ}^{d_2} \right] > E \left[ \Pi_{HQ}^c \right] \) for \( \beta = \beta^{d_2} \) and that \( \delta \) is inversely U-shaped in \( \beta \) yields that for \( \beta < \beta^c (\beta > \beta^c) \), \( E \left[ \Pi_{HQ}^{d_2} \right] > E \left[ \Pi_{HQ}^c \right] \) (\( E \left[ \Pi_{HQ}^{d_2} \right] < E \left[ \Pi_{HQ}^c \right] \)). As the example in figure 3 demonstrates, \( \beta^c \) can be smaller than 1. Thus, centralized ownership can become optimal. \( \square \)

### 8.3 Proof of Proposition 3, 4, and 5

As stated in the proof of proposition 2, the threshold \( \beta^c \) is determined by \( A\beta^2 + B\beta + C = 0 \) (see equations (24)). Define \( F := A\beta^2 + B\beta + C \).

\[ \frac{\partial F}{\partial \beta^c} = 2A + \beta^c < 0. \]

\[ \frac{\partial F}{\partial \gamma_r} = 2h \left[ \beta (1-t)(1-t-h) + \beta^2 (1-t)(1-\gamma h-t) + (1-t-h)(1-\gamma h-t) \right] \geq 0. \]

Using the implicit function theorem yields
\[ \frac{\partial \beta^c}{\partial \gamma_r} = \frac{-\partial F}{\partial \gamma_r} / \frac{\partial F}{\partial \beta^c} > 0. \]

\[ \frac{\partial F}{\partial \gamma_r} = 2(1-t) \left[ h(1-t-h) + \beta (1-t)(h+t) + \gamma_r(h^2 - t^2) \right], \]

which is positive for \( \beta \geq \beta^{d_2} \). Using the implicit function theorem yields
\[ \frac{\partial \beta^c}{\partial \gamma_r} = \frac{-\partial F}{\partial \gamma_r} / \frac{\partial F}{\partial \beta^c} > 0. \]
\[
\frac{\partial F}{\partial h} = 2\gamma r^2 h (1-t) + 2\gamma (1-t)(1-t-2h + \beta(1-t)) + \\
\gamma \left[ \gamma h (3h - 2(1-t)) + 2(1+\beta)(1-t)(1-t-2h) + 2\beta^2(1-t)(1-\gamma h - t) \right],
\]
which is positive for \( h < (1-t)/2 \). Using the implicit function theorem yields
\[
\frac{\partial \beta}{\partial h} = -\frac{\partial F}{\partial h} \frac{\partial F}{\partial \beta} > 0.
\]

8.4 Proof of Proposition 6
For \( \beta \leq \beta^C \), the intangible is located in the foreign division. The internal transfer price is given by: \( \gamma^{d2}_i = r\gamma - (1-t)\beta \), where \( \gamma \) is non-zero if there is no restriction on tax-avoidance or if restrictions are present for \( \beta < \beta^{d2} \) and \( \gamma = 0 \) for \( \beta^{d2} \leq \beta \leq \beta^C \). A non-zero internal royalty rate decreases with an increasing spillover:
\[
\frac{\partial \gamma^{d2}_i}{\partial \beta} = -(1-t) < 0.
\]
Otherwise, if \( \gamma^{d2} = 0 \) the internal royalty rate is unaffected.
For \( \beta > \beta^C \), the intangible is held centrally in the headquarters. The internal royalty rate for purely domestic transactions is given by: \( \gamma^{1C}_i = \gamma (t+h) - \left( 1-t-h\gamma \right) \beta \) and the internal royalty rate for cross-border transactions is \( \gamma^{2C}_i = \gamma (t+h) \). Thus, the internal royalty rate for purely domestic transactions decreases with an increasing spillover:
\[
\frac{\partial \gamma^{1C}_i}{\partial \beta} = -(1-t) + h\gamma < 0.
\]
The internal royalty rate for cross-border transactions is unaffected, i.e.
\[
\frac{\partial \gamma^{2C}_i}{\partial \beta} = 0.
\]

8.5 Proof of Proposition 7
For \( \beta \leq \beta^C \), the intangible is located in the foreign division. For \( \beta \leq \beta^{d2} \), first-best investments are achievable and are given by \( \theta_1^{d2, HQ} = \frac{1}{k} + \frac{1}{(1-t-h)} [(1-t)\beta + h\gamma] \). If \( \beta^{d2} = \beta \leq \beta^C \) an investment distortion occurs; the distorted investment decisions of the domestic division is given by (15). The derivatives show
\[
\frac{\partial \theta_1^{d2, HQ}}{\partial \gamma} = \frac{h}{k(1-t-h)} > 0
\]
and
\[
\frac{\partial \theta_1^{d2}}{\partial \gamma} = \frac{t+h}{k(1-t-h)} > 0.
\]
Thus, curtailing profit shifting, i.e., decreasing \( \gamma_r \), leads to decreasing investments in the domestic division. The investment decision of the foreign country is shown in (16). Obviously, the investment incentives are unaffected and remain the same. Thus, the MNC’s overall investment decreases.

For \( \beta > \beta^C \), the intangible is located in the domestic headquarters. The investment decisions are described in (20) and (21). The derivatives with respect to the external royalty rate are:

\[
\frac{\partial \theta_{HQ}^1}{\partial \gamma_r} = \frac{-h \beta}{k (1 - t - h)} < 0
\]

and

\[
\frac{\partial \theta_{HQ}^2}{\partial \gamma_r} = \frac{-h}{k (1 - t)} < 0.
\]

Thus, curtailing profit shifting possibilities, i.e. increasing \( \gamma_r \) leads to less investments in both divisions.

8.6 Proof of Proposition 8

With foreign ownership the derivatives of the domestic division’s investment with respect to the tax rate differential are for \( \beta \leq \beta^C \):

\[
\frac{\partial \theta_{d, HQ}^1}{\partial h} = \frac{1}{k} \frac{(1 - t)(\gamma_r + \beta)}{(1 - t - h)^2} > 0
\]

and for \( \beta > \beta^C \):

\[
\frac{\partial \theta_{d, HQ}^1}{\partial h} = \frac{1}{k} \frac{\gamma_r}{(1 - t - h)^2} > 0.
\]

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

\[
\frac{\partial \theta_{d, HQ}^2}{\partial h} = 0.
\]

With central ownership the derivatives of both divisions’ investments with respect to the tax rate differential are

\[
\frac{\partial \theta_{HQ}^1}{\partial h} = \frac{\beta (1 - t)(1 - \gamma_r)}{k (1 - t - h)^2} > 0
\]

and

\[
\frac{\partial \theta_{HQ}^2}{\partial h} = \frac{-\gamma_r}{k (1 - t)} < 0.
\]

8.7 Proof Proposition 9

We now provide an overview over possible location choices in a tax-world when one set of books is kept.
8.7.1 The Domestic Division owns the Intangible

Expected profit of division 1 is given by:

\[ E[\Pi^{d1}_1] = (1 - t - h) \left[ \theta_1 + \gamma (\beta \theta_1 + \theta_2) - \frac{k}{2} \theta_1^2 \right] \]

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

\[ E[\Pi^{d1}_2] = (1 - t) \left[ (1 - \gamma) (\beta \theta_1 + \theta_2) - \frac{k}{2} \theta_2^2 \right] \]

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

\[ FOC\theta_1 : (1 - t - h) (1 + \gamma \beta - k \theta_1) = 0 \]

\[ SOC\theta_1 : (1 - t - h) (-k) < 0 \]

\[ FOC\theta_2 : (1 - t) (1 - \gamma - k \theta_2) = 0 \]

\[ SOC\theta_2 : (1 - t) (-k) < 0. \]

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

\[ \theta_1^{d1,OSB} = \frac{1}{k} (1 + \gamma \beta) \] \hspace{1cm} (25)

and

\[ \theta_2^{d1,OSB} = \frac{1}{k} (1 - \gamma) \] \hspace{1cm} (26)

Headquarters expects the following profit:

\[ E[\Pi^{d1}_{HQ}] = (1 - t - h) \left[ \theta_1^{d1,OSB} - \frac{k}{2} \left( \theta_1^{d1,OSB} \right)^2 \right] \]

\[ + (1 - t) \left[ \beta \theta_1^{d1,OSB} + \theta_2^{d1,OSB} - \frac{k}{2} \left( \theta_2^{d1,OSB} \right)^2 \right] - h \gamma \left( \beta \theta_1^{d1,OSB} + \theta_2^{d1,OSB} \right) \] \hspace{1cm} (27)

Differentiating headquarters’ expected profit with respect to \( \gamma \) yields:

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

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

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

\[ \gamma^{d1,OSB} = \frac{(1 - t) \beta^2 - h(1 + \beta)}{\beta^2 (1 - t + h) + (1 - t - 2h)} \] \hspace{1cm} (28)

However, the royalty rate needs to belong to the arm’s length range. For \( \gamma_r \leq \frac{1 - t}{1 - t + h} \) and \( h < \frac{1 - t}{2} \),

\[ \gamma^{d1,OSB} \geq \gamma_r \]

if and only if

\[ \beta \geq \beta^{d1,OSB}_1 := \frac{1}{2(1 - t - \gamma_r (1 - t + h))} \left[ h + \sqrt{h^2 + 4(1 - t - \gamma_r (1 - t + h))(h + (1 - t - 2h)\gamma_r)} \right]. \]
For $\gamma_r \leq \frac{1-t}{1+t+h}$ and $h < \frac{1-t}{2}$, $\gamma_d^{1, OSB} \leq \gamma_r$ if and only if
\[
\beta \leq \beta_2^{d1, OSB} := \frac{1}{2(1-t-\gamma_r(1-t+h))} \left[ h + \sqrt{h^2 + 4(1-t-\gamma_r(1-t+h))(h+(1-t-2h)\gamma_r)} \right].
\]
In sum, for $\gamma_r \leq \frac{1-t}{1+t+h}$ and $h < \frac{1-t}{2}$ the optimal royalty rate is
\[
\gamma_d^{1, OSB} = \begin{cases} 
\gamma_r & \text{for } \beta \in \left[ 0, \beta_1^{d1, OSB} \right] \\
\gamma_1^{1, OSB} & \text{for } \beta \in \left( \beta_1^{d1, OSB}, \beta_2^{d1, OSB} \right) \\
\gamma_r & \text{for } \beta \in \left[ \beta_2^{d1, OSB}, 1 \right]
\end{cases}
\]

8.7.2 The Foreign Division owns the Intangible

Expected profit of the royalty paying domestic division 1 is given by:
\[
E[\Pi_{d1}^{2}] = (1-t-h) \left[ (1-\gamma)\theta_1 - \frac{k}{2}\theta_1^2 \right]
\]
and the expected profit of the foreign division is given by:
\[
E[\Pi_{d2}^{2}] = (1-t) \left[ \beta\theta_1 + \theta_2 + \gamma\theta_1 - \frac{k}{2}\theta_2^2 \right]
\]
The divisions choose their investment levels in order to maximize their own after-tax profits.
\[
FOC\theta_1 : (1-t-h)(1-\gamma-k\theta_1) = 0 \\
SOC\theta_1 : (1-t-h)(-k) < 0 \\
FOC\theta_2 : (1-t)(1-k\theta_2) = 0 \\
SOC\theta_2 : (1-t)(-k) < 0.
\]
Thus, the FOCs determine a local maximum and the investments are:
\[
\theta_1^{d2, OSB} = \frac{1}{k}(1-\gamma) \quad (29)
\]
and
\[
\theta_2^{d2, OSB} = \frac{1}{k} \quad (30)
\]
Headquarters expects the following profit:
\[
E[\Pi_{HQ}^{d2}] = (1-t-h) \left[ \theta_1^{d2, OSB} - \frac{k}{2} \left( \theta_1^{d2, OSB} \right)^2 \right] \\
+ (1-t) \left[ \beta\theta_1^{d2, OSB} + \theta_2^{d2, OSB} - \frac{k}{2} \left( \theta_2^{d2, OSB} \right)^2 \right] + h\gamma\theta_1^{d2, OSB} \quad (31)
\]
Differentiating headquarters’ expected profit with respect to $\gamma$ yields:
\[
FOC\gamma : \frac{1}{k} \left[ -\gamma(1-t+h) + h - (1-t)\beta \right] = 0
\]
Thus, the FOC determines a local maximum. Hence, the optimal royalty rate is:

$$\gamma^{d_2,OSB} = \frac{h - \beta (1 - t)}{1 - t + h}. \quad (32)$$

However, the royalty rate needs to belong to the arm’s length range. $\gamma^{d_2,OSB} \geq \gamma_r$ if and only if

$$\beta \leq \beta^{d_2,OSB}_2 := \frac{h - \gamma_r (1 - t + h)}{1 - t}.$$ 

$\gamma^{d_2,OSB} \leq \gamma_r$ if and only if

$$\beta \geq \beta^{d_2,OSB}_1 := \frac{h - \gamma_r (1 - t + h)}{1 - t}.$$ 

In sum, the optimal royalty rate is

$$\gamma^{d_2,OSB} = \begin{cases} 
\gamma_r & \text{for } \beta \in [0, \beta^{d_2,OSB}_1] \\
\gamma^{d_2,OSB}_1 & \text{for } \beta \in (\beta^{d_2,OSB}_1, \beta^{d_2,OSB}_2) \\
\gamma_r & \text{for } \beta \in [\beta^{d_2,OSB}_2, 1]
\end{cases} \quad (33)$$

### 8.7.3 Joint Ownership of the Intangible

Expected profit of the domestic division:

$$E \left[ \Pi_1^L \right] = (1 - t - h) \left[ \theta_1 - \frac{k}{2} \theta_1^2 \right]$$

and

$$E \left[ \Pi_2^L \right] = (1 - t) \left[ \theta_2 + \beta \theta_1 - \frac{k}{2} \theta_2^2 \right].$$

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

$$FOC \theta_1 : (1 - t - h) (1 - k \theta_1) = 0$$

$$SOC \theta_1 : (1 - t - h) (-k) < 0$$

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

$$SOC \theta_2 : (1 - t) (-k) < 0.$$ 

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

$$\theta^{I,OSB}_1 = \frac{1}{k} \quad (33)$$

and

$$\theta^{I,OSB}_2 = \frac{1}{k} \quad (34)$$
Headquarters expected profit is:

$$E[\Pi'] = (1 - t - h) \left[ \theta_1 - \frac{k}{2} \theta_1^2 \right] + (1 - t) \left[ \theta_2 + \beta \theta_1 - \frac{k}{2} \theta_2^2 \right].$$

### 8.7.4 Centralized Ownership of the Intangible

Expected profit of the domestic division:

$$E[\Pi_1^C] = (1 - t - h) \left[ (1 - \gamma_1) \theta_1 - \frac{k}{2} \theta_1^2 \right]$$

and of the foreign division:

$$E[\Pi_2^C] = (1 - t) \left[ (1 - \gamma_2)(\beta \theta_1 + \theta_2) - \frac{k}{2} \theta_2^2 \right].$$

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

**FOC**$_1$: $(1 - t - h)(1 - \gamma_1 - k \theta_1) = 0$

**SOC**$_1$: $(1 - t - h)(-k) < 0$

**FOC**$_2$: $(1 - t)(1 - \gamma_2 - k \theta_2) = 0$

**SOC**$_2$: $(1 - t)(-k) < 0$.

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

$$\theta_1^{C,OSB} = \frac{1}{k}(1 - \gamma_1)$$

and

$$\theta_2^{C,OSB} = \frac{1}{k}(1 - \gamma_2).$$

Headquarters expected profit is:

$$E[\Pi_{HQ}^C] = (1 - t - h) \left[ \theta_1^{C,OSB} - \frac{k}{2} \left( \theta_1^{C,OSB} \right)^2 \right] + (1 - t) \left[ (1 - \gamma_2)(\theta_2^{C,OSB} + \beta \theta_1^{C,OSB}) - \frac{k}{2} \left( \theta_2^{C,OSB} \right)^2 \right] + (1 - t - h)\gamma_2 \left( \theta_2^{C,OSB} + \beta \theta_1^{C,OSB} \right).$$

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

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

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

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

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The determinant of the Hessian matrix is

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

which is positive for \( h < (3 - \sqrt{5})/2 \) and \( t < (2 - h(3 + \sqrt{5}))/2 \). 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 the \( \gamma_1 = \gamma_r \) and \( \gamma_2 = \gamma_r \), all Kuhn-Tucker maximum conditions are satisfied.

\[ E [\Pi^f] \geq E [\Pi^C], \quad E [\Pi^f] \geq E [\Pi^{d1}] \]

if and only if \( \beta < \beta_j^{d1} \), where

\[
\beta_j^{d1} := \frac{h + \sqrt{h^2 + (\gamma_r(1+h-t) + 2(t-1)(\gamma_r(2h+t-1) - 2h))}}{2(1-t) - \gamma_r(1+h-t)}.
\]

\[ E [\Pi^f] \geq E [\Pi^{d2}] \]

if and only if \( \beta > \beta_j^{d2} \), where

\[
\beta_j^{d2} := \frac{2h + \gamma_r(t-h-1)}{2(1-t)} \quad \text{and} \quad \beta_1^{d2,OSB} < \beta_2^{d2,OSB} < \beta_j^{d2} < \beta_j^{d1,OSB} < \beta_2^{d1,OSB}.
\]

Therefore, the intangible is located in the foreign division for \( \beta \in [0, \beta_j^{d2}] \). Joint ownership dominates for \( \beta \in (\beta_j^{d2}, \beta_j^{d1}) \). The intangible is located in the domestic division for \( \beta \in [\beta_j^{d1}, 1] \).
References


Springsteel, I., 1999. Separate but unequal. when tax-based transfer prices fall short, a second managerial system helps some companies measure internal profits better. CFO 15 (8), 89–92.
