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Abstract

We develop a positive model of multinational firm behavior and analyze a firm's incentive to transfer an intellectual property (IP) right of uncertain value offshore ex ante, i.e. before its success or failure is realized. With an asymmetric treatment of losses in the home country, the multinational firm will transfer its IP to a foreign low-tax country to avoid potentially negative profits at home. In addition, similar incentives exist to transfer the IP to a jurisdiction where tax rates are comparable or even higher than at home if the foreign jurisdiction offers a more symmetric treatment of losses.

JEL-Codes: H250, H260, D210, F230.

Keywords: intellectual property, corporate taxation, loss-offset, tax avoidance.

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1 Introduction

Lately, as U.S. Big Tech have ascended the throne of the most valuable companies globally, they have repeatedly come under fire for remitting too little taxes. One recent report, *The Silicon Six and their $100 billion global tax gap*, investigates the tax conduct of Facebook, Apple, Amazon, Netflix, Google and Microsoft, and claims that, over the last decade, the corporate tax paid by these companies is much lower than is commonly understood (Fair Tax Mark, 2019). This finding may, however, be less surprising when accounting for the highly intangible nature of big tech, who have mostly intangibles as inputs and output that is often just as intangible. Intellectual property (IP) rights, such as patents, trade secrets, or trademarks, facilitate the strategic adjustment of the transfer price when selling or licensing an IP between affiliates of a multinational company (MNC).[1] In addition, the highly idiosyncratic nature of IP rights makes it difficult to find comparable, non-tax-saving-motivated, transactions that satisfy the notion of arm's length pricing (Schoen and Konrad, 2012).[2]

In this paper we develop a positive model of MNC behavior and analyze a MNC's incentive to transfer IP of uncertain value offshore ex ante, that is, before its success or failure is realized. The model builds on the empirically well-documented phenomenon that multinational firms disproportionally locate intangibles, especially patent ownership, in low-tax countries,[3] and that this transfer takes place at a very early stage, often before the patent is actually granted,[4] or the commercial success of the IP has

[1] See, for instance, Keen and Konrad (2013), or Dharmapala (2014).

[2] MNCs' strategic re-location of intellectual property to low-tax affiliates and the thereby initiated income shifting through mis-pricing of the IP-related intra-firm trade (royalties) was one of the critical aspects that led to the action plan against Base Erosion and Profit Shifting (BEPS) by the OECD (OECD 2013; OECD 2017) and to the European Union's Anti-Tax Avoidance Directive (Council Directive 2016/1164/EU).

[3] Dischinger and Riedel (2011) find a negative correlation between an affiliate's corporate tax rate relative to the rest of the group and the affiliate's share of intangible assets. A negative effect of the corporate tax rate on the number of patent applications filed by a multinational affiliate is documented in Karkinsky and Riedel (2012), Griffith et al. (2014), and Alstadsaeter et al. (2018).

[4] Recent empirical evidence by Ciaramella et al. (2017), drawing on half a million patents granted at the European Patent Office (EPO) between 1998 and 2012, reveals that more than one-third of patents changed ownership at least once and that about 80% of the transfers took place before the grant date of the patent. Similarly, Graham et al. (2018) find a significant growth of pre-grant changes in patent ownership over the recent years for the U.S. using United States Patent and Trademark Office (USPTO) data. For the sub-set of patents in medical technologies, where tracing of patents is possible, Ciaramella et al. (2017) find that two-thirds of all ownership changes were intra-group and that the transferred patents are more valuable than non-transferred patents in terms of patent citation, frequency of patent renewal, and breadth of protection.

been realized.[5] We highlight the implications of corporate taxation, loss offset regimes, and R&D tax incentives on the commercialization decision of an uncertain IP within a MNC.[6]

Our analysis provides four important findings. First, we show that, even when the transfer of the intellectual property takes place at a legitimate arm's-length price, the MNC has an incentive to transfer its IP ex ante to a low-tax jurisdiction whenever the treatment of losses is asymmetric in the high-tax (home) country. Intuitively, when the full value of tax losses associated with negative profits is not granted by the home country, firms have an incentive to avoid potentially negative profits at home by transferring the IP to the foreign, low-tax affiliate before learning the profitability of the IP. In the low-tax jurisdiction, the asymmetric treatment of losses is less important because of the lower tax rate.

Second, our analysis shows that a MNC can have similar incentives to transfer its intellectual property to a jurisdiction where tax rates are comparable or even higher than at home if the foreign jurisdiction offers a more symmetric treatment of losses. This finding has important implications for tax policy: a more generous loss offset provision can make a country an attractive location in the same way as a low tax rate.

Third, as long as the high-tax country provides only an incomplete loss offset, for example by means of a loss carry forward provision without interest, R&D tax incentives increase the MNC's expected profit when transferring the intellectual property to the foreign low-tax jurisdiction. The MNC is better off by claiming the full R&D tax incentive immediately when transferring the IP ex ante, instead of facing limitations

[5]In 2013, when Uber's pre-money valuation was US$ 3.5bn, Uber US entered a license agreement with Uber International in the Netherlands, giving the latter the right to fiscally exploit the Uber US IP outside the US. The agreement included a one-time fee of US$ 1m and a royalty fee of 1.45% of the future revenue generated by the Uber IP (O'Keefe and Marty, 2015). In 2014, Uber's pre-money valuation increased to US$ 17bn and amounted to roughly US$ 100bn in 2020 (Weber, 2015). This anecdotal evidence shows that license agreements, similar to a offshore transfer of IP, enable the fiscal exploitation of an IP in a country different than the country of IP development. In addition, companies seem to initiate the transfer of the legal right to exploit the IP at an early stage before the full earnings potential of the IP is realized. A similar behavior was disclosed in the case of Amazon. In 2005, Amazon granted its Luxembourg affiliate the right to use its IP in Europe at the highly controversial buy-in price of US $ 254m. Only thereafter, 11 new product categories were launched through the Amazon Europe websites (U.S. Tax Court, 2017).

[6]In our analysis we assume that the riskiness (probability of success) of the IP is exogenous. Haufler et al. (2014) analyze the impact of tax policies on an entrepreneur's choice of riskiness of an innovation project and the mode of commercialization of the innovation. In an extension to the model, we consider heterogeneous MNCs, which differ with regard to the exogenous level of riskiness (probability of success) of their IP.

on claiming the R&D tax incentive (due to an incomplete loss offset or a loss carry forward without interest) if the IP fails. Thus, and presumably unintentionally, R&D tax incentives generate an incentive for MNCs to transfer IP with an uncertain value offshore ex ante. If the R&D tax incentive takes the form of a so-called super deduction (tax credit), this unintended effect becomes stronger (weaker) the larger is the tax rate in the high-tax country.

Fourth, in the case that MNCs differ with regard to the success probability of their IP and if MNCs have private information about their success probability, MNCs with an above-average success probability face an additional benefit when shifting the IP offshore. This benefit emerges if only the distributional features but not the MNC-specific success probabilities are common knowledge. Then, the government has to condition the regulated arm's-length transfer price on the MNCs' average success probability and this arm's-length transfer price is too low for a MNC with an above average success probability. Moreover, the critical success probability above which the MNC benefits from transferring the IP offshore ex ante, is below the mean success probability if the loss offset regime in the foreign country is sufficiently more symmetric than in the home country.

Our findings contribute new insights to the literature on multinational firm behavior and tax avoidance. While the existing theoretical literature primarily focuses on the ex-post behavior of MNCs, such as the transfer pricing decision for a successful IP input,[7] we analyze the MNC's ex-ante choice of transfer pricing and re-location of an IP of uncertain value within the MNC. More broadly, a plethora of empirical studies highlight the role of IP (re-)location for tax-motivated income shifting.[8] However, the theoretical justification for this type of MNC behaviour under different tax systems is scant. To our knowledge, ours is the first paper providing a thorough analysis of the tax motivated ex ante offshore transfer of IP. Finally, loss offset provisions and loss-making MNC affiliates have been relatively neglected in the academic literature despite their

[7]Haufler and Schjelderup (2000) and Gresik (2001), for instance, analyze the MNC's choice of the optimal royalty payment in a setup of a given IP location and with an unconstrained transfer pricing choice among profitable affiliates. Kalamov and Runkel (2016) and Mardan and Stimmelmayr (2018) explore the transfer pricing choice for IP in a setting with profitable and loss-making affiliates, while Koethenbuerger et al. (2019) consider the case of a constrained transfer pricing choice. For empirical evidence on tax-motivated transfer pricing see, among others, Clausing (2003), Cristea and Nguyen (2016), and Davies et al. (2018).

[8]See Gruber (2003) and Desai et al. (2006) for empirical evidence on tax-motivated income shifting via IP and footnote 3 for the empirical literature on tax-motivated (re-)location of IP within MNCs.

prominent empirical relevance.[9] Our paper broadens the understanding of loss offset regimes and their role in attracting foreign developed IP.

The paper is structured as follows. In Section 2, we introduce the basic model and, in Section 3, we study the MNC's incentive to shift its IP to a foreign zero- or low-tax location. Extensions to the basic model, including royalty payments and R&D tax incentives, are considered in Section 4. In Section 5, we analyze how the incentives to shift the IP offshore are affected if firms differ with regard to the success probability of the IP and if they have private information about the likely success of the IP. In Section 6, we discuss the effect of recent anti-tax-avoidance legislation on limiting the offshore transfer of IP. Section 7 concludes.

2 Basic Framework

We demonstrate our main results using a highly stylized, one-period model. We consider a competitive MNC with two affiliates, one located in the high-tax (home) country, the other one in a foreign location. Each country levies a source-based profit tax and, without loss of generality, we assume that the foreign location is the zero- or low-tax country, i.e. $\tau > \hat{\tau} \geq 0$. All variables with a hat refer to the foreign location.

The MNC has expended a fixed cost f to develop a technology with an uncertain return. With probability $\alpha < 1$, the technology succeeds and gives the MNC access to the production function $F(k)$, which exhibits decreasing returns to scale, i.e. $F'(k) > 0 > F''(k)$. The MNC borrows tangible capital, k, on the (world) capital market at an exogenous interest rate r. The output produced can be sold at price p. There is one single period in which production takes place and income is taxed. Decreasing returns to scale implies that there are variable profits, revenues less tangible capital costs. These variable profits are the income generated by the MNC's intangible asset or intellectual property (IP). With probability $1 - \alpha$, the technology fails and no production takes place.

In case of a successful technology, the MNC chooses its scale by solving the following problem:

$$\max_{k} \quad \pi = (1 - \tau) \left(p\, F\left(k\right) - rk \right). \tag{1}$$

[9] Recent contributions that investigate MNCs' income shifting behavior when affiliates incur losses include De Simone et al. (2017) and Hopland et al. (2017)

For simplicity, we assume that regular capital expenses are fully tax deductible, turning the profit tax into a cash-flow tax.[10] Suppressing prices, let π denote pre-tax variable profits. Thus, the expected variable profit of the MNC is:

$$E[\pi] = \alpha(1-\tau)(\pi - f) + (1-\alpha)(1-d\tau)(-f), \tag{2}$$

where $0 \leq d \leq 1$ determines the loss treatment regime. When $d = 1$, we have complete deductibility and the treatment of profits and losses is symmetric. The MNC receives a full tax rebate of τf in case of a loss. When $d = 0$, the investor receives nothing from the government in case of a loss. In general, when $d < 1$, the treatment of profits and losses is asymmetric.[11]

3 Shifting the Intellectual Property Ex Ante

We now suppose that the MNC has the option to sell, at a transfer price q, its intellectual property to the affiliate in the low-tax or zero-rate haven country. In doing so, we assume that the disposal of the IP has to take place before the success or failure of the IP is realized, that is, ex ante. The rationale underlying this assumption builds on the observed real-world behaviour of MNCs (see footnote 5).[12] Waiting for the realization of the IP's success would generate observable information on the IP's earnings potential or market value, which can be used by tax authorities to make the ex post transfer of the IP prohibitively expensive, such as in the case of the European exit tax, which has been implemented in response to increased profit shifting.[13]

If the MNC shifts its intellectual property ex ante, we assume that production will

[10] Our formulation of profits in (1) implies an immediate expensing of the cost of capital. The model would function similarly in a context with depreciation allowances instead of immediate expensing. With multiple periods, firms would also have incentives to use tax havens to defer realizing tax liability, although the incentive to use tax havens to obtain symmetric tax treatment of losses persists whenever firms realize tax losses.

[11] Existing tax systems predominantly grant a loss carry forward or backward scheme instead of an immediate tax rebate. A loss carry forward provision without interest violates the symmetric treatment of profits and losses.

[12] In Appendix A we analyze how the incentives to shift the IP offshore are affected if the MNC already knows whether the IP is successful or failed.

[13] EU member states must levy an exit tax equal to the market value of the transferred IP to prevent domestic companies from avoiding taxes by shifting an IP to low-tax non-EU jurisdictions (Council Directive 2016/1164/EU).

take place only in the low-tax affiliate, while the home-country affiliate (i.e. the non-IP-owning affiliate) is idle.[14] This assumption helps provide us with a clear and logically consistent framework for our analysis. Moreover, as a consequence of the assumption, all profits subsequently earned by the technology (IP) will no longer be subject to home country taxation. For this to be the case either a territorial tax system has to apply, or a worldwide system with rules enabling the low-tax (tax haven) affiliate to be exempt from the worldwide tax base, for example though check-the-box rules in the U.S.

3.1 Arbitrary Transfer Price

First, we will consider the incentives to shift the IP when the low-tax or haven affiliate pays an arbitrary transfer price, q, to the parent firm. We will subsequently consider what happens under an arm's-length price for q.

If the IP is sold to the affiliate in the foreign low-tax country, the after-tax profits at home are equal to $(1-\tau)(q-f)$, as long as $q-f \geq 0$ (which we will assume). Note that the after-tax profits at home will be the same whether the project succeeds or fails.

In the case that the IP is shifted abroad and the technology is successful, the profits in the foreign country become $(1-\hat{\tau})(\pi-q)$, with $\hat{\tau}$ denoting the foreign country's tax rate. Further, we will assume that $\pi > q$, implying a positive tax base in the foreign country. In the case of failure, the profits in the foreign country are $\left(1-\hat{d}\,\hat{\tau}\right)(-q)$ with the parameter $\hat{d}$ determining the deductibility regime in the foreign country. Putting together the pieces, the expected profits in the foreign country are: $\alpha(1-\hat{\tau})(\pi-q) + (1-\alpha)\left(1-\hat{d}\,\hat{\tau}\right)(-q)$. Hence, the total expected profits of the MNC when the IP is shifted offshore are:

$$E[\hat{\pi}] = (1-\tau)(q-f) + \alpha(1-\hat{\tau})(\pi-q) + (1-\alpha)\left(1-\hat{d}\,\hat{\tau}\right)(-q). \tag{3}$$

By analyzing (3), we can study the MNC's incentives to shift the intellectual property abroad. If the total expected after-tax profits from transferring the technology abroad, $E[\hat{\pi}]$, are larger than the total expected after-tax profits from keeping the technology at home, $E[\pi]$, as given in (2), the firm will shift the IP abroad. The reward to shifting the IP offshore ex ante is thus given by the difference in expected profits, $\Delta E[\pi] =$

[14] In Section 4.1 we suspend this assumption, and show that all of our findings remain valid.

$E[\hat{\pi}] - E[\pi]$:

$$\begin{aligned}\Delta E[\pi] &= (1-\tau)(q-f) + \alpha(1-\hat{\tau})(\pi-q) + (1-\alpha)\left(1-\hat{d}\,\hat{\tau}\right)(-q) \\ &\quad -\alpha(1-\tau)(\pi-f) + (1-\alpha)(1-d\,\tau)\,f,\end{aligned}$$

which simplifies to:

$$\Delta E[\pi] = \alpha(\tau-\hat{\tau})(\pi-q) + (1-\alpha)\left(-\tau(q-f) - d\,\tau f + \hat{d}\,\hat{\tau} q\right). \tag{4}$$

Transferring the IP to the foreign country yields a benefit in the form of tax saving of $(\tau-\hat{\tau})(\pi-q)$ in the case of success. This tax saving is larger, the larger the difference between tax rates in the home and foreign jurisdictions, $(\tau-\hat{\tau})$, and the larger the difference between the profits generated by the IP and the transfer price for selling the IP to the foreign affiliate, $(\pi-q)$. In the case of failure, the costs associated with shifting the IP abroad consist of the tax due at home for selling the IP at price q, i.e. $\tau(q-f)$, and the forfeit of the domestic loss offset provision, $d\,\tau f$. These costs are reduced by amount $\hat{d}\,\hat{\tau} q$ if the foreign country operates a loss offset regime.

We analyze the firm's choice of the transfer price q and its incentive to shift the IP abroad for three different scenarios. First, we consider the case in which neither home nor foreign grants a loss offset, i.e. $d = \hat{d} = 0$, and that home is the high-tax country, $\tau > \hat{\tau}$. In this case, (4) simplifies to:

$$\Delta E[\pi]_{|_{d=\hat{d}=0}} = \alpha(\tau-\hat{\tau})(\pi-q) + (1-\alpha)(-\tau(q-f)). \tag{5}$$

Differentiating (5) with respect to q yields:

$$\frac{\partial\left(\Delta E[\pi]_{|_{d=\hat{d}=0}}\right)}{\partial q} = -\alpha(\tau-\hat{\tau}) + (1-\alpha)(-\tau) \quad < 0. \tag{6}$$

A marginal increase in the transfer price reduces the tax saving associated with the transfer of a successful IP (the first term on the right-hand side of (5)) and increases the tax liability in foreign if the transferred IP is not successful (the second term on the right-hand side of (5)). Thus, the firm will set the transfer price q to its minimum possible value, which we have assumed is $q = f$. The MNC makes zero taxable profits in the home country when it shifts the intellectual property, while its expected taxable profits in the foreign low-tax (or zero-tax) location amount to $\alpha\pi - q$. Indeed, given

equation (5), the difference in expected profits is strictly positive for $q = f$, inducing the MNC to shift the IP at the lowest possible price. The model's prediction of zero taxable profits of the MNC affiliate in the home country, if the MNC is free to set the transfer price for its IP transfer, coincides with the empirical evidence in Grubert et al. (1993), Dharmapala and Hebous (2018), Bilicka (2019), or Johannesen et al. (2020), supporting the general perception that transfer pricing is a major reason why reported profits of MNC affiliates bunch around zero. While this empirical finding is frequently discussed in the context of (implicitly) ex-post transfer pricing, our results provide a new mechanism to rationalize these findings from an ex-ante perspective.

Second, we consider the case that both countries offer a loss offset scheme, i.e. $1 \geq d \geq 0$ and $1 \geq \hat{d} \geq 0$, and home remains the high-tax country, $\tau > \hat{\tau}$. We can show that the firm would still set the transfer price q to its minimum possible value. Differentiating the difference in expected profits given in (4) with respect to q yields:

$$\frac{\partial \left(\Delta E\left[\pi\right]\right)}{\partial q} = -\alpha \left(\tau - \hat{\tau}\right) + \left(1 - \alpha\right) \left(-\tau + \hat{d}\,\hat{\tau}\right) < 0. \tag{7}$$

The third term in equation (7) is new compared to the expression in (6). Similar to before, a marginal increase in the transfer price reduces the potential tax saving from shifting a successful IP offshore and increases the tax liability at home if the IP fails (the first and second term in (7)). Now, these two negative effects resulting from a marginal increase in q are mitigated by the marginal benefit of a higher loss offset in foreign (as captured by the term $\hat{d}\,\hat{\tau}$ in (7)). Rearranging equation (7) gives:

$$\frac{\partial \left(\Delta E\left[\pi\right]\right)}{\partial q} = -\tau + \hat{\tau} \left(\alpha + \left(1 - \alpha\right) \hat{d}\right). \tag{8}$$

Given the success probability $\alpha < 1$, the term in brackets equals α if $\hat{d} = 0$ and approximates 1 as $\hat{d}$ increases to its maximum value of 1. For $\tau > \hat{\tau}$, the expression in (8) is always negative. Hence, independent of the assumed values of $\hat{d}$, the firm always chooses the minimum possible transfer price, i.e. $q = f$. As in the previous scenario, the MNC declares no taxable profits in the home country when it shifts the intellectual property offshore, and taxable profits in the low-tax haven are given by $\alpha\pi - q$. In the case of failure, the MNC may offset the transfer price, i.e. the fixed costs of the IP, under the foreign loss offset regime instead of under the domestic one.

Third, we analyze the case when the tax systems in the two jurisdictions are identical,

i.e. $\tau = \hat{\tau} = \tilde{\tau}$ and $d = \hat{d} = \tilde{d}$. This scenario corresponds to what happens under a worldwide tax system with a credit for foreign corporate taxes paid when profits are repatriated to the home country.[15] Given the symmetry of the tax systems, one might expect that taxation has no affect on the IP location decision. In this setting, equation (4) simplifies to:

$$\Delta E[\pi] = (1-\alpha)\left(-(1-\tilde{d})\,\tilde{\tau}\,(q-f)\right). \tag{9}$$

From expression (9) we infer that a successful IP will not influence the difference in expected profits as given in (4). Intuitively, profits that are brought back to the home country face an additional tax levy of $\tau - \hat{\tau}$ if $\tau > \hat{\tau}$. Hence, the return from the IP will be subject to the same effective tax burden regardless of where the IP is located. Only the tax treatment of an unsuccessful IP impacts the location decision in this case. Specifically, with identical tax rates in the two countries, the tax benefit from transferring the IP offshore (the first term on the right-hand side of (5)) disappears and any increase of the transfer price in excess of the fixed costs f would result in a larger tax liability at home when selling the IP to the foreign affiliate compared to when keeping the IP at home. Thus, only if the MNC is able to set the minimum possible transfer price of $q = f$, or if a complete loss offset regime $d = \hat{d} = \tilde{d} = 1$ exists, then the MNC is indifferent to transferring the IP offshore. Otherwise, the MNC will keep the IP at home.

We summarize our findings in:

Proposition 1 *Assume the MNC is free to set the transfer price when shifting its intellectual property abroad. Then, the MNC*

(a) will always shift the IP at the minimum possible transfer price if the foreign country levies a lower tax rate than home, $\tau > \hat{\tau}$, and regardless of the loss offset regime established in either country,

(b) or optimally keeps the intellectual property in the home country if a symmetric

[15] With the 2017 Tax Cuts and Jobs Act (TCJA), the U.S. shifted from worldwide taxation towards territorial taxation. The TCJA eliminated the taxation of repatriated dividends but expanded the taxation of earned income accrued within CFCs through a global minimum tax for MNCs with a sufficiently low global foreign tax burden. While the tax on global intangible low-taxed income (GILTI) still exempts the first 10 percent return on the physical assets located in a foreign country, the Made in America Tax Plan stipulates a tightening of the global minimum tax on foreign earned low-tax income from intangible assets. In Section 6 we discuss the impact of different tax legislation on the MNC's incentive to shift an IP of uncertain value offshore ex ante.

tax system exists in the two countries (with indifference prevailing in case of a complete loss-offset regime in place ($d = \hat{d} = \tilde{d} = 1$) or when $q = f$).

3.2 Arm's-Length Transfer Price

In the previous section, we assumed that the MNC is unconstrained in the choice of the transfer price. In practice, various regulations constrain the choice of the transfer price. One prominent principle that underlies the transfer pricing regulation is the notion of arm's-length pricing (OECD, 2017). A key question in this context is whether the implementation of an arm's-length transfer price would eliminate the tax-induced incentives for the MNC to transfer its IP with an uncertain value offshore ex ante.

To address this issue, we now consider the MNC's incentives to shift its intellectual property under a reasonable notion of arm's-length pricing. In principle, the arm's-length price should capture the value of the technology to an independent party in the foreign country. This value should simply be the expected returns from the asset: $\alpha\pi + (1-\alpha) * 0 = \alpha\pi$.[16] One might argue that, from a tax authority perspective, it is difficult to determine the expected profit of an IP and that the authority is only able to implement a lower transfer price for tax purposes. In this sense, our choice of the regulated transfer price might be too conservative, and eliminates tax incentives more strongly than in the practical implementation of the arm's-length principle.

Setting $q = \alpha\pi$ and inserting into (3), the total expected profits when the firm shifts its IP to the foreign country become:

$$E\left[\hat{\pi}\right]_{|_{q=\alpha\pi}} = (1-\tau)(\alpha\pi - f) + (1-\alpha)\left(-(1-\hat{d})\,\hat{\tau}\,\alpha\pi\right). \tag{10}$$

The first term on the right-hand side of (10) denotes the net-of-tax profits earned by the home affiliate when selling the IP to the foreign affiliate. The second term denotes the potential costs associated with a limited loss offset in the foreign country, if $\hat{d} < 1$ and the IP fails. In the case the foreign country is a tax haven, i.e. $\hat{\tau} = 0$, or provides a complete loss offset, $\hat{d} = 1$, the MNC has taxable profits only in the home country.

In general, for an arm's-length transfer price equal to the expected return of the IP, the MNC makes at best zero taxable profits in the foreign low-tax or tax haven location

[16]Note that the fixed cost f to develop the technology (the IP) has been already incurred when the MNC decides whether to shift the IP offshore. Thus, these costs are sunk and do not affect the commercialization decision of the IP, that is, the pricing of the IP upon its disposal.

in expectation.[17] Does this mean that the MNC does not benefit from shifting the intangible asset abroad?

To examine this, we once more look at the difference in expected profits between the case when the MNC shifts the IP to the foreign affiliate and when it does not shift the IP. Substituting the arm's-length transfer price of $q = \alpha\pi$ into equation (4) yields:

$$\Delta E\left[\pi\right]_{|q=\alpha\pi} \quad = \quad (1-\alpha)\left((1-d)\,\tau f - (1-\hat{d})\,\hat{\tau}\,\alpha\pi\right). \tag{11}$$

With a regulated arm's-length price of $q = \alpha\pi$, the incentives to shift the IP offshore are independent of the tax liability in the home and foreign country when the loss offset is complete in the two countries ($\hat{d} = \hat{d} = 1$). If the IP is kept at home, the tax owed in the home country amounts to $\tau\,(\alpha\pi - f)$ and is identical to tax liability emerging in the home country if the IP is shifted offshore at the regulated transfer price of $q = \alpha\pi$ (see equation (3)). In the foreign jurisdiction, the expected tax base is zero because the IP is sold at a transfer price that coincides with the expected profits of the IP.

In the case where the foreign jurisdiction is a zero-rate tax haven, $\hat{\tau} = 0$, equation (11) simplifies to:

$$\Delta E\left[\pi\right]_{|q=\alpha\pi} \quad = \quad (1-\alpha)\,(1-d)\,\tau f. \tag{12}$$

Despite the fact that the transfer price q is set according to the arm's-length principle and the MNC makes zero expected profits in the tax haven, the MNC still benefits from transferring the IP offshore ex ante as long as the treatment of losses is not fully symmetric at home, i.e. $d < 1$. The expected profit of the MNC when it shifts the IP offshore is in fact equal to the profits it would make at home under a symmetric treatment of losses.

This analysis shows that the asymmetric treatment of losses at home can itself create an incentive to transfer the intellectual property abroad. Moving the intangible asset to the tax haven allows the MNC to effectively enjoy a symmetric treatment of losses even when such a treatment is not provided by the home country. By receiving the expected profits of an uncertain project at home with certainty, firms can ensure that

[17] The MNC's expected net-of-tax profit of the foreign affiliate is $\alpha(1-\hat{\tau})(\pi - q) + (1-\alpha)(1-\hat{d}\hat{\tau})$. For $q = \alpha\pi$ and $\hat{d} = 1$, the tax base becomes zero while for $q = \alpha\pi$ and $\hat{d} < 1$, the limited loss offset possibility in the foreign country implies an expected loss of size $(1-\alpha)\left(-(1-\hat{d})\,\hat{\tau}\,\alpha\pi\right)$ as given by the second term on the right-hand side of (10).

they are never subject to the unfavorable tax treatment of losses. This result arises due to the fact that a tax rate of zero implies symmetric tax treatment of losses, not due to the difference in tax rates *per se*.

Next, we are interested in how the incentives to shift the IP offshore change if the foreign country is not a tax haven but a low-tax country, i.e. $\tau > \hat{\tau} > 0$, if the loss offset is incomplete in the two countries, $0 \leq d$, $\hat{d} < 1$. In this case, the interpretation of the first term in the brackets on the right-hand side of equation (11) remains as before. The incentives to shift the IP abroad increase if the treatment of losses becomes more asymmetric at home, i.e. the lower is d. The second term in the brackets on the right-hand side of equation (11) captures the fact that either higher tax rates or worse loss deductibility allowances in the foreign country reduce the value of shifting the asset abroad.

Specifically, the incentives to shift the IP abroad are maximized when either $\hat{\tau} = 0$ or $\hat{d} = 1$. This means that a relatively symmetric treatment of losses makes a foreign location attractive in a way similar to the way that a low tax rate does. When $\hat{d} = 1$, shifting the IP offshore ex ante would allow the MNC to avoid losses at home – where the tax treatment of losses is unfavorable – without receiving any unfavorable treatment of its losses abroad.

Perhaps surprisingly, shifting the asset at the arm's-length price to a place with a *higher* tax rate, i.e. $\hat{\tau} > \tau$, can also be attractive when expected profits are not much higher than the fixed cost and the higher-rate jurisdiction treats losses favorably enough, $\hat{d} > d$, so that $(1-d)\,\tau f > (1-\hat{d})\,\hat{\tau}\,\alpha\pi$. Thus, the analysis highlights that, in addition to the competition in tax rates, the competition in loss offset regimes also matters for attracting mobile assets with high income potential, such as intangibles.[18] From an empirical perspective, this tax-induced shifting behavior is unconventional and would not be captured by a proxy of tax incentives that looks at statutory tax rate differentials, as commonly done in the empirical literature.

We summarize our findings in:

Proposition 2 *Assume the MNC has to set a transfer price that accounts for expected profits when shifting an intellectual property abroad. Then, the firm's incentives to shift*

[18]The revenue consequences of a competition in loss offset regimes will depend on the quality (riskiness) of the intangibles. However, the empirically documented large relevance of corporate losses in the U.S. context (Altshuler et al. 2011), and the quantitatively high importance of unused tax losses (Cooper and Knittel 2006; and Auerbach 2007), might render a competition in loss offset regimes costly.

the intellectual property abroad

(a) increase as the treatment of losses at home becomes more asymmetric, i.e. as d declines.

(b) are maximized if the foreign country is a zero-rate tax haven, $\hat{\tau} = 0$, or has a complete loss offset regime in place $\hat{d} = 1$.

(c) prevail even if the foreign country is a relatively high-tax location, $\hat{\tau} > \tau$, but offers a sufficiently more favorable treatment of losses than home, such that $(1 - d)\,\tau f > (1 - \hat{d})\,\hat{\tau}\,\alpha\pi$.

Finally, we analyze the case when the tax systems in the two jurisdictions are identical, i.e. $\tau = \hat{\tau} = \tilde{\tau}$ and $d = \hat{d} = \tilde{d}$. In this setting, the MNC is subject to the same tax system regardless of where its intellectual property is located. Substituting in $\tilde{\tau}$ and $\tilde{d}$ in (11) yields:

$$\Delta E\left[\pi\right]_{|_{q=\alpha\pi}} \;=\; -(1-\alpha)\,(1-\tilde{d})\,\tilde{\tau}\,(\alpha\pi - f) \leq 0. \tag{13}$$

Expression (13) tells us that the implementation of a reasonable arm's-length price discourages the MNC from transferring its IP with an uncertain value to a foreign location that has an identical tax system as the home country unless a complete loss offset exists ($\tilde{d} = 1$), in which case the MNC is indifferent. Phrased differently, in the environment of a pure worldwide tax system with a tax credit for the foreign taxes paid but where the treatment of losses is asymmetric ($\tilde{d} < 1$), the MNC generally is hurt by shifting its intangible asset offshore. Similar to the scenario of an arbitrary transfer price, the intuition for the finding is as follows: Prior to shifting the asset and in case of failure, the size of the maximum possible loss under the $(\tilde{\tau}, \tilde{d})$ tax system amounts to f. If the IP is transferred at a price $\alpha\pi > f$ to the foreign location, the maximum possible loss under the same tax system increases to $\alpha\pi > f$ in the case of failure. Thus, moving the asset abroad creates the potential for a larger loss than the one that would occur if the asset is kept at home.

We summarize our findings in:

Proposition 3 *Assume a MNC operates under a pure worldwide tax system with asymmetric treatment of losses and is forced to set a reasonable transfer price, reflecting expected profits, when moving the intellectual property abroad. Then, the MNC*

has a strict incentive not to transfer its intellectual property offshore ex ante. With a symmetric treatment of losses, the MNC is indifferent.

4 Extensions to the Basic Framework

4.1 Royalty Payments

In this section, we account for production in both locations, leading to pre-tax variable profits of π and $\hat{\pi}$ in the home and foreign affiliate, respectively, as well as royalty payments, $R \geq 0$, for the use of the IP input by the non-IP-owning affiliate. We assume that the value of the royalty is capped by the amount of the pre-tax variable profits earned by the royalty paying affiliate.[19] Similar to before, we assume that the IP is developed in the home country of the MNC. In the case the technology is successful and the IP is kept at home, the foreign affiliate makes the royalty payment R to the domestic affiliate for the use of the IP input. After-tax expected profits of the domestic and foreign affiliate are given by $\alpha(1-\tau)(\pi+R-f)$ and $\alpha(1-\hat{\tau})(\hat{\pi}-R)$, respectively; thus, we assume that the royalty payment R is tax deductible in the foreign country.

In the case the technology fails, the loss of the domestic affiliate amounts to $(1-\alpha)(1-d\,\tau)(-f)$. As before, d denotes the loss offset granted in the home country. Expected after-tax profits of the MNC as a whole, $E[\Pi_a]$, are thus given by:

$$E\left[\Pi_a\right] = \alpha\left((1-\tau)(\pi+R-f)+(1-\hat{\tau})(\hat{\pi}-R)\right)+(1-\alpha)(1-d\,\tau)(-f). \qquad (14)$$

The MNC might, however, decide to transfer the uncertain IP ex ante offshore to its foreign affiliate, charging transfer price q when selling the technology. Note that, after transferring the uncertain IP to the foreign affiliate, the domestic affiliate has to pay royalty $\hat{R}$ to the foreign affiliate. In this setting, the MNC generates a certain tax liability of $\tau(q-f)$ in the home country in addition to the state-dependent, pre-tax variable profit $(\pi-\hat{R})$ if the IP is successful. We assume the royalty payment is tax deductible at home. In the case of success, the net-of-tax profit of the foreign affiliate is $(1-\hat{\tau})(\hat{\pi}+\hat{R}-q)$, while the foreign affiliate incurs a loss of $(1-\hat{d}\,\hat{\tau})q$ if the technology

[19] This simplification ensures that the tax base of the royalty-paying affiliate remains larger or equal to zero.

fails. Again, $\hat{d}$ denotes the loss offset in the foreign country. Adding the parts together, the MNC's expected after-tax profits, in case the uncertain IP is transferred offshore, become:

$$\begin{aligned} E[\hat{\Pi}_a] &= (1-\tau)(q-f) + \alpha\left((1-\tau)(\pi-\hat{R}) + (1-\hat{\tau})(\hat{\pi}+\hat{R}-q)\right) \\ &\quad + (1-\alpha)\,(1-\hat{d}\,\hat{\tau})\,(-q). \end{aligned} \tag{15}$$

The MNC will transfer the uncertain technology offshore if the expected profit of doing so is larger than the expected profit when keeping the technology at home, i.e. if $E[\hat{\Pi}_a] - E\left[\Pi_a\right] = \Delta E\left[\Pi_a\right] \geq 0$, with:

$$\Delta E\left[\Pi_a\right] = \alpha\left(\tau - \hat{\tau}\right)\left(R + \hat{R} - q\right) + (1-\alpha)\left(-\tau\left(q-f\right) - d\,\tau f + \hat{d}\,\hat{\tau} q\right). \tag{16}$$

Note that equation (16) is identical to equation (4), except for the fact that the return from the technology (if successful) is now given by $R + \hat{R}$ instead of π.

Arbitrary Transfer Price and Royalty Payment.
Assuming the MNC is free to set the transfer price q and the royalty payments $\hat{R}$ and R, differentiating equation (16) with respect to q, R, and $\hat{R}$ yields:

$$\frac{\partial\left(\Delta E\left[\Pi_a\right]\right)}{\partial q} = -\alpha(\tau - \hat{\tau}) + (1-\alpha)\left(-\tau + \hat{d}\,\hat{\tau}\right) < 0, \text{ for } \tau > \hat{\tau},\ 0 \leq \hat{d} \leq 1 \tag{17}$$

$$\frac{\partial\left(\Delta E\left[\Pi_a\right]\right)}{\partial \hat{R}} = -\frac{\partial\left(\Delta E\left[\Pi_a\right]\right)}{\partial R} = \alpha(\tau - \hat{\tau}) > 0, \qquad \text{for} \quad \tau > \hat{\tau}. \tag{18}$$

The expression in (17) is identical to equation (7) and (8), respectively. An increase in the transfer price q reduces the potential tax benefit from shifting a successful IP offshore ex ante and, in addition, it increases the tax liability in the home country in the case that the IP fails. While a higher transfer price has the benefit of a larger loss offset in foreign (if $\hat{d} > 0$), this positive effect cannot dominate the other two negative effects. Thus, a marginal increase in the transfer price q will always reduce the MNC's tax benefit from transferring the IP offshore. The MNC will set the transfer price to its minimum possible value.

Equation (18) tells us that a marginal increase in the royalty payment $\hat{R}$ yields a marginal benefit in the form of a tax saving equal to the difference in tax rates $\tau - \hat{\tau}$ if the technology is successful. The reverse holds when increasing R. Thus, the MNC

would choose the maximum possible value for the royalty payment $\hat{R}$ and the minimum possible value for the payment R.

Regulated Transfer Price and Royalty Payment.
Production in the two affiliates will only take place if the technology is successful. Hence, the expected return from the IP is given by $\alpha(\pi + \hat{\pi})$, and thus this price can be regarded as the relevant arm's-length price.

With regard to the royalty payment, we assume that the regulated price should reflect the non-IP-owning affiliate's actual gain in pre-tax profit from utilizing the IP input. This price reflects the (maximum) price an independent party would pay for licensing the IP input. Accounting for the fact that the royalty is only payable in case production takes place, i.e. the technology is successful, the regulated royalty payments are $R = \hat{\pi}$ and $\hat{R} = \pi$. Substituting the regulated arm's-length prices into equation (16) yields:[20]

$$\Delta E\left[\Pi_a\right]_{\substack{| \\ q = \alpha(\pi + \hat{\pi}), \\ R = \hat{\pi},\, \hat{R} = \pi}} = (1-\alpha)\left(-(1-\hat{d})\,\hat{\tau}\,\alpha\,(\pi + \hat{\pi}) + (1-d)\,\tau f\right). \tag{19}$$

Equation (19) is identical to (11), except that the return to the IP is now given by $\pi + \hat{\pi}$ instead of π, reflecting that production takes place in both locations.

Combining the two cases of an arbitrary and regulated pricing behavior, we find that our results derived in Proposition 1 and Proposition 2 carry over to the more comprehensive model of MNC behavior with production in both affiliates and royalty payments from licensing the IP input to the non-IP-owning affiliate.

4.2 R&D Tax Incentives

Over the last decades, the number of countries offering financial support to promote business research and development (R&D) investment has increased rapidly.[21] The predominant instruments for granting R&D tax incentives are tax allowances, exemptions, deductions or tax credits. In the following extension, we analyze how R&D tax incentives influence the MNC's decision to transfer its uncertain IP offshore ex ante.

[20] For the simple case that variable profits generated in the two affiliates are identical, i.e. $\pi = \hat{\pi}$, the regulated arm's-length prices imply $p = 2\alpha\pi$ and $R = \pi$. Note that in this case the expression $R + \hat{R}$ in equation (16) simplifies to $2R$.

[21] As of 2020, almost 90% of the OECD countries, 80% of the European Union member states, as well as Argentina, Brazil, China, Russia, and South Africa provide some kind of tax relief for R&D expenditures in their tax codes (Appelt et al., 2019).

The common feature of tax allowances, exemptions, and deductions is that each instrument reduces the tax base before the firm's corporate tax liability is computed. For the case of R&D expenditures, a full deduction of the R&D costs is the default (Appelt et al. 2019); however, several countries allow for a deduction rate of more than 100% of the eligible R&D expenditures, a so-called enhanced or super deduction.[22] Contrary to allowances and deductions, a R&D tax credit is subtracted from the firm's tax liability. While the different instruments can be converted into each other, it is important to note that the R&D tax credit is independent of the corporate tax rate while the value of the R&D allowance or the R&D super deduction increases with the corporate tax rate.[23,24]

In the model extension, we account for the R&D tax credit by introducing the variable λ. We assume that the R&D tax credit is taxable and that the variable d, which determines the country's loss offset regime, also determines whether the R&D tax credit is refundable. For $d = 0$, the R&D tax credit is non-refundable, while $d > 0$ implies a partial refundability or the availability of a loss carry forward provision for the tax credit. Having $d = 1$ would indicate a 100% immediate refund.

With a R&D tax credit, the MNC's expected profits are given by:

$$E[\pi] = \alpha\left((1-\tau)(\pi - f) + (1-\tau)\lambda\right) + (1-\alpha)\left((1-d\,\tau)(-f) + d(1-\tau)\lambda\right). \quad (20)$$

If the IP is successful, the R&D tax credit reduces the MNC's tax liability by its net-of tax amount $(1-\tau)\lambda$. In the case the IP fails, the net-of-tax value of the R&D tax credit may be (partially) refundable or non-refundable, depending on the value of d.

Alternatively, we could consider the case of a R&D super deduction. We assume that the variable ρ denotes the deductibility rate that exceeds the full, i.e. the 100%, deduction of the R&D expenditures. With a R&D super deduction, the MNC's tax base in the

[22]Prominent examples of countries with an R&D super deduction include Brazil, Indonesia, Lithuania, Singapore, and the United Kingdom with deduction rates of between 200% and 300% of eligible R&D expenditures, while China, Russia, and South Africa, for instance, provide a super deduction rate of 1.5, which implies that 150% of eligible R&D expenditures are tax deductible.

[23]However, if the R&D tax credit is deemed as taxable income, as is the case for large companies in Australia, Canada, Chile, the United Kingdom, and the United States, the net-of-tax value of the R&D tax credit declines as the corporate tax rate increases.

[24]For loss-making firms with no taxable income, the R&D tax allowance/deduction or the R&D tax credit is refundable in some countries, while other countries provide loss carry forward provisions (see Table A.1. in Appelt et al. (2019) for an overview of the main features of R&D tax incentives in OECD, EU, and partner economies). The R&D tax incentives may also be non-refundable, such as in the case of the R&D tax credit in the U.S. (EY, 2020).

case of success is given by $\pi - (1+\rho)f$, and in the case of failure, losses amount to: $(1 - d\,\tau(1+\rho))\,(-f)$.[25] Similar to the case of the R&D tax credit, we assume that the variable d determines whether the R&D super deduction can be claimed if the IP fails and the firm makes losses.[26] Thus, with a R&D super deduction, the MNC's expected profits are given by:

$$E\,[\pi] = \alpha\,(\pi - f - \tau\,(\pi - (1+\rho)f)) + (1-\alpha)\,(1 - d\,\tau(1+\rho))\,(-f). \qquad (20')$$

If the IP is successful, the deductibility of the R&D expenditures amounts to $(1+\rho)f$, reflecting the deduction of the full costs plus the super deduction. In the case the IP fails, this R&D tax incentive is available to the MNC only if some form of loss offset is permitted, i.e. $d > 0$. For a R&D tax credit of size $\lambda = \frac{\tau\,\rho\,f}{(1-\tau)}$, equations (20) and $(20')$ coincide, i.e. the R&D tax incentives from both instruments are identical. We will continue our analysis using the R&D super deduction.

In the situation where the IP is transferred to the foreign low-tax affiliate at price q, the expected profits of the MNC become:

$$E\,[\hat{\pi}] = q - f - \tau\,[q - (1+\rho)f] + \alpha\,(1-\hat{\tau})\,(\pi - q) + (1-\alpha)\,(1 - \hat{d}\,\hat{\tau})\,(-q). \qquad (21)$$

The formulation of the MNC's expected profits in equation (21) is identical to the one in equation (3) except for the expression $\tau\rho f$ in the first term on the right-hand side. It denotes the additional reduction of the MNC's tax liability arising from the R&D super deduction.[27] This tax benefit accrues with certainty if the IP is sold to the affiliate in the low-tax (or tax haven) country. The reward to transferring the IP offshore in the presence of a R&D super deduction is given by:

$$\Delta E\,[\pi] = \alpha\,(\tau - \hat{\tau})\,(\pi - q) + (1-\alpha)\left(-\tau\,(q - (1+\rho)f) - d\,\tau\,(1+\rho)f + \hat{d}\,\hat{\tau}q\right). \qquad (22)$$

The first term in (22) is identical to the one in (4), and denotes the benefit from paying taxes on the return of the successful IP in the low-tax instead of the high-tax country. In the case that the IP fails, the transfer of the IP creates a tax liability of τq in the home

[25] Any limitations of the R&D tax incentives due to thresholds or ceilings for eligible R&D expenditures can be incorporated in the model by an appropriate downward adjustment of ρ.

[26] This approach reflects the heterogeneity with regard to the existing loss carry forward provision in the different countries offering R&D super deductions.

[27] In the case of the R&D tax credit, the additional reduction in the MNC's tax liability due to the R&D tax incentive amounts to $(1-\tau)\lambda$.

country, but the transfer also enables the MNC to claim the R&D super deduction with certainty, while limitations on claiming the R&D super deduction may apply if the IP is kept in the home country depending on the size of d (the second term in the brackets on the right-hand side of (4)). Note that an unlimited, interest-free loss carry forward of the unused R&D tax incentive already constitutes a sufficient limitation.[28] Due to the foregone interest on the loss carry forward, the MNC is better off by transferring the IP to the low-tax country and claiming the full R&D tax incentive immediately instead of using the interest-free loss carry forward in the future. Differentiating the difference in expected profits given in (22) with respect to the rate of super deduction, ρ, yields:

$$\frac{\partial\left(\Delta E\left[\pi\right]\right)}{\partial\rho} = \left(1-\alpha\right)\left(1-d\right)\tau f \quad > 0 \quad \text{for} \quad d < 1. \tag{23}$$

As long as the home country applies any limitations on claiming the R&D tax incentive in full for a loss-making MNC (i.e. if $d < 1$), both the R&D super deduction and the R&D tax credit increase the MNC's expected profit when transferring an uncertain IP offshore ex ante. In the case of the R&D super deduction, this presumably unintended effect of the R&D tax incentive on re-locating the IP offshore becomes even stronger the larger the home country's tax rate.[29]

Interestingly, the R&D-tax-incentive-induced benefit from shifting the IP offshore ex ante remains present even under a reasonable notion of arm's-length pricing. Assuming an arm's-length price that reflects the true value of the IP, i.e. $q = \alpha\pi$, and substituting into equation (22) yields:

$$\Delta E\left[\pi\right]_{\left|_{q=\alpha\pi}\right.} = \left(1-\alpha\right)\Big(-(1-\hat{d})\,\hat{\tau}\,\alpha\pi + (1-d)\,\tau\,(1+\rho)f\Big). \tag{24}$$

Differentiating equation (24) with respect to the rate of super deduction ρ yields the same expression as given in (23). Thus, the positive impact of the R&D tax incentive on the MNC's expected profit when re-locating the uncertain IP to the foreign low-tax

[28] According to Appelt et al. (2019), an interest-free loss carry forward of the unused R&D tax incentive represents the predominant policy in most OECD and EU countries.

[29] In the case of a taxable (non-taxable) R&D tax credit, the MNC's expected gain from transferring the uncertain IP offshore ex ante is given by:

$$\Delta E\left[\pi\right] = \alpha\left(\tau-\hat{\tau}\right)\left(\pi-q\right) + \left(1-\alpha\right)\Big(-\tau q + \left(1-d\right)\left[\tau f + (1-\tau)\lambda\right] + \hat{d}\,\hat{\tau} q\Big).$$

Similar to the case of the R&D super deduction, a higher R&D tax credit enlarges the differential in expected profits, $\frac{\partial\Delta E[\pi]}{\partial\lambda} = (1-\alpha)(1-d)(1-\tau) > 0$, and thus increases the expected benefit from shifting the IP offshore ex ante. However, for the R&D tax credit, this expected gain decreases the larger the home country's tax rate, provided $d < 1$.

country cannot be curbed by (just) implementing a reasonable transfer price.

We summarize our findings in:

Proposition 4 *Assume the high-tax (home) country grants an R&D tax incentive and that this benefit cannot be claimed in full by a loss-making MNC with a failed IP. Then, the R&D tax incentive increases the MNC's expected profit when transferring its intellectual property offshore ex ante. This effect cannot be mitigated by implementing a reasonable arm's-length transfer price for the IP, and the effect increases (decreases) with the home country's tax rate in the case of a R&D super deduction (taxable R&D tax credit).*

5 Heterogeneous Firms with Private Information

In the following section, we expand the model to address another important feature of the real world: that MNCs differ with regard to their IP success probabilities and that they have private information about the likely success of their IP. We proceed as follows. With probability α_j, the IP of MNC j is successful and generates a profit of $(\pi - f)$. In the case of failure, MNC j incurs a loss of $-f$. The parameter α_j is independently drawn from the interval $(0, 1)$ with distribution $G(\alpha_j)$, density $g(\alpha_j)$, and mean $\bar{\alpha}$. The firm-specific success probability α_j is known by the MNC only, while the distributional information about α_j is common knowledge. The regulated arm's-length price set by the government is $\bar{\alpha}\pi$, while the firm-specific transfer price reflecting expected profits of MNC j is $\alpha_j\pi$.

5.1 Shifting the IP Ex Ante

When the MNC is free to set the transfer price, our analysis in Section 3.1 carries over to the model with different success probabilities. Intuitively, the quantitative impact of the success probability α_j on expected profits is the same independent of where the IP is located. Thus, the success probability α_j has no qualitative impact on the decision about where to locate the IP. The MNC continues to transfer the IP offshore ex ante at the minimum possible transfer price. This holds independently of the MNC's success probability. Similarly, in the case of two identical countries, the MNC prefers to realize

the IP-related income stream in the home country when the loss offset is incomplete while being indifferent with a complete loss offset regime in place. Hence, Proposition 1 extends to the case of heterogeneous success probabilities.

However, for the case that the MNC is constrained in its choice of the transfer price and has to implement a regulated arm's-length transfer price, the incentive to transfer the IP offshore ex-ante will depend on the MNC's success probability, α_j. To demonstrate this, we once again compare the after-tax expected profit in case the IP is shifted offshore with the after-tax expected profit when the IP is kept at home. Accounting for the firm-specific success probability α_j and the regulated arm's-length transfer price, which is conditioned on the firms' mean success probability, i.e. $q = \bar{\alpha}\pi$, and substituting into equation (4) yields:

$$\begin{aligned} \Delta E(\pi)_{|q=\bar{\alpha}\pi} &= \alpha_j(\tau-\hat{\tau})(\pi-\bar{\alpha}\pi) + (1-\alpha_j)\left(-\tau\,(\bar{\alpha}\pi - f) - d\,\tau f + \hat{d}\,\hat{\tau}\,\bar{\alpha}\pi\right) \\ &= (\alpha_j-\bar{\alpha})(\tau-\hat{\tau})\pi + (1-\alpha_j)\left(-(1-\hat{d})\,\hat{\tau}\,\bar{\alpha}\pi + (1-d)\,\tau f\right). \end{aligned} \tag{25}$$

With heterogeneous MNCs, an additional effect emerges. The first term on the right-hand side of (25) is positive for MNCs with a firm-specific success probability larger than the average, and thus provides for these firms an additional incentive for transferring their uncertain IPs offshore ex ante. To be specific, MNCs with a success probability larger than the mean, $\alpha_j > \bar{\alpha}$, earn an additional rent of size $(\alpha_j - \bar{\alpha})(\tau - \hat{\tau})\pi$ when shifting their IPs offshore. This rent arises because, from the individual firm's perspective, the regulated arm's-length transfer price $\bar{\alpha}\pi$ is set too low relative to the firm-specific success probability α_j.[30] This effect from shifting the uncertain IP offshore becomes zero for MNCs with a success probability equal to the mean, $\alpha_j = \bar{\alpha}$, and becomes negative for MNCs with a success probability smaller than the mean, $\alpha_j < \bar{\alpha}$. For the latter type of firms, the regulated arm's-length price is too high relative to the firm-specific success probability. Thus, in case of a successful IP, the arm's-length price even induces a cost when shifting the IP to the low-tax country, the first term in (25). It is only for the knife-edge case of $\alpha_j = \bar{\alpha}$ that the arm's-length price neutralizes tax incentives to shift a successful IP. The structure and interpretation of the second

[30] In a similar vein, but for an environment of heterogeneous firms that sort into outsourcing, Bauer and Langenmayr (2013) show that an arm's-length price based on market value cannot eliminate profit shifting because integrated multinational firms obtain their inputs at lower prices compared to firms obtaining their inputs from external sources. As a consequence, a market-value-based arm's-length price for inputs systematically exceeds the marginal cost of multinational firms and gives rise to profit shifting by integrated multinational firms.

term on the right-hand side of (25), which captures the shifting incentive in case of an unsuccessful IP, is similar to the one in (11).

Assuming the foreign jurisdiction is a zero-rate tax haven, $\hat{\tau} = 0$, the MNC's incentives to shift its IP offshore are given by:

$$\Delta E(\pi)_{|q=\bar{\alpha}\pi} = (\alpha_j - \bar{\alpha})\,\tau\pi + (1 - \alpha_j)\,(1 - d)\,\tau\,f. \tag{26}$$

We find that a MNC with a success probability below the mean has an incentive to shift its intellectual property to the foreign zero-rate tax haven, too. The critical success probability α^* for which equation (26) becomes zero is given by:

$$\alpha^* = \frac{\tau\,\bar{\alpha}\pi - (1 - d)\,\tau f}{\tau\pi - (1 - d)\,\tau f}. \tag{27}$$

As it states, a more symmetric treatment of profits and losses in the home country increases the critical success probability α^* above which the MNC transfers its IP offshore ex ante. The critical success probability is lower than the mean if the home country treats profits and losses asymmetrically ($d < 1$), and it approaches the mean $\bar{\alpha}$ if the home country treats profits and losses symmetrically, i.e. $d = 1$. Thus, even MNCs with a below-average success probability have a tax-induced incentive to shift the IP with an arm's-length price in place in the presence of an asymmetric loss-offset regime in the home country.

In the case the foreign jurisdiction levies a positive tax rate, $\hat{\tau} > 0$, the critical success probability α^{**} above which MNC j transfers its IP to the foreign low-tax jurisdiction is given by:

$$\alpha^{**} = \frac{(\tau - \hat{\tau})\,\bar{\alpha}\pi + \left((1 - \hat{d})\,\hat{\tau}\,\bar{\alpha}\pi - (1 - d)\,\tau f\right)}{(\tau - \hat{\tau})\,\pi + \left((1 - \hat{d})\,\hat{\tau}\,\bar{\alpha}\pi - (1 - d)\,\tau f\right)}. \tag{28}$$

Now the critical success probability may also be higher than the mean. This is the case when the loss-offset regime in the foreign country is sufficiently more asymmetric than in the home country ($\hat{d} \ll d < 1$). As a consequence, a MNC with a success probability above the mean but below α^{**} will not transfer its IP offshore ex ante. The regulated arm's-length price becomes more effective in curbing shifting incentives.

Finally, in the case of two identical countries, i.e. $\tau = \hat{\tau} = \tilde{\tau}$ and $d = \hat{d} = \tilde{d}$, or alternatively, in an environment of a pure worldwide tax system with a tax credit for

foreign taxes owed, equation (25) changes to:

$$\Delta E(\pi)_{|q=\bar{\alpha}\pi} \quad = \quad -(1-\alpha_j)\,(1-\tilde{d})\,\tilde{\tau}\,(\bar{\alpha}\pi - f) \leq 0. \tag{29}$$

This expression is in structure identical to the corresponding expression in the case without heterogeneity in the success probability, given in equation (13). A pure world-wide system disincentivizes the MNC to transfer its uncertain IP to the foreign low-tax affiliate ex ante because then the MNC would suffer from a greater loss in case of failure ($\bar{\alpha}\pi$ vs. f) and this is costly as long as $\tilde{d} < 1$.

We summarize our findings in:

Proposition 5 *Assume MNCs differ with regard to success probability α and only the distributional features of α are common knowledge and can be used to determine the arm's-length transfer price. The IP is shifted ex ante.*

(a) Then, MNCs with an above average success probability face an additional benefit when shifting the IP offshore because the regulated arm's-length transfer price is set too low relative to the firm-specific success probability.

(b) The critical success probability α^{**} above which the MNC benefits from transferring the IP offshore ex ante, is below the mean success probability $\bar{\alpha}$ if the loss offset regime in the foreign country is sufficiently more symmetric than in the home country, i.e. $d \ll \hat{d} < 1$.

5.2 Multiple Projects and Ex-Post Deniability

The basic idea in the foregoing analysis is that a firm can reduce its tax liability by selectively shifting its IP offshore when it knows the IP is relatively more likely to be successful. The significance of this type of profit shifting becomes especially apparent when considering the generally more realistic case where MNCs have a large number of IPs, because in this case MNCs would then have a certain type of ex-post deniability.

Specifically, consider a case where a MNC with success probability α_j has N projects. This means that $\alpha_j N$ projects will be successful and $(1-\alpha_j)N$ will be unsuccessful. Particularly when the success rate is very low, the MNC is ex-post in a position to

argue that the great majority of its projects actually failed and in fact it had set a transfer price that was to their disadvantage on most IPs. For example, if $\alpha = 0.01$, then the MNC could argue that 99% of its projects failed and they just got lucky with a small number of extremely successful projects. It may be quite challenging for tax authorities to definitively refute this argument in the context of legal proceedings. Some existing empirical evidence is consistent with this narrative. Patents for which the transfer of ownership took place in bundles with multiple patents seem to contain patents of higher quality, in terms of more citations and lower generality.[31]

This type of ex-post deniability also points to why this type of strategy is especially relevant in the context of IPs, but would not be as applicable to most types of intra-firm transfers. In contrast to IP, most intra-firm trade content is not subject to much uncertainty about realized values and/or a high probability of failure. Hence, the type of profit shifting incentive we identify is still broadly in keeping with the more standard idea of MNCs using their informational advantage to effectively manipulate transfer prices. However, the probabilistic nature of intangible assets gives MNCs a distinctive ability to justify their transfer prices.

6 Anti Tax Avoidance Measures and IP Transfer

In this section, we analyze the effectiveness of some recent anti tax avoidance measures, including the 2017 U.S. tax on global intangible low-taxed income (GILTI) as well as a global minimum tax, for curbing MNCs' incentives to transfer IPs and IP-related profits offshore to low-tax jurisdictions.

6.1 GILTI

Among other measures, the 2017 Tax Cuts and Jobs Act (TCJA) introduced a tax on global intangible low-taxed income (GILTI) earned by U.S.-controlled foreign corporations. The provision aims at discouraging U.S. MNCs from re-locating their easy-to-transfer IP assets such as copyrights, patents, and trademarks, as well as the IP-related profits, offshore to low-tax countries.

[31] Ciaramella et al. (2017) find a positive correlation between patents that are transferred in a bundle and the number of citations, but a negative correlation with the generality index.

The portion of a MNC's income that constitutes GILTI follows from complex calculations. Roughly speaking, GILTI amounts to the total active income earned by a U.S. MNC's foreign affiliate(s) exceeding 10 percent of the depreciable tangible property owned by the affiliate(s). This GILTI amount is subject to an effective tax rate of at least 10.5% (up to 13.125% depending on local jurisdiction tax rates).[32] Additionally, corporations can claim a tax credit for 80 percent of foreign taxes paid on GILTI.[33]

To analyze the implication of the tax on GILTI for a MNC's incentives to shift its IP offshore ex-ante, we consider the following stylized modeling of the tax on GILTI. Suppose the tax rate on GILTI is τ^G, the foreign low-tax country's tax rate is $\hat{\tau}$, and the tax base, i.e. the global intangible low-taxed income (GILTI), amounts to B^G. The intangible income, B^G, is the only income of the foreign affiliate and it only accrues if the IP is shifted to the foreign affiliate. Moreover, the home country grants a tax credit for 80 percent of foreign taxes paid on the intangible income. Then, the tax liability of the foreign affiliate amounts to $\left(\tau^G B^G - 0.8\,\hat{\tau}\,B^G\right) + \hat{\tau} B^G$. The first term in brackets denotes the tax liability from the tax on GILTI minus the foreign tax credit. The second term determines the tax liability in the foreign country.

Ignoring U.S. local jurisdiction tax rates and accounting for Section 250 deductions, the tax rate on GILTI equals one-half of the statutory U.S. tax rate, i.e. $\tau^G = 1/2\,\tau$, where τ denotes the home (high-tax) country's tax rate. Substituting τ^G yields: $(0.5\,\tau - 0.8\,\hat{\tau})\,B^G + \hat{\tau} B^G$. For $\hat{\tau} < 5/8\,\tau$, the tax credit for foreign taxes paid is not high enough to offset the tax liability from the tax on GILTI. Thus, the tax on GILTI increases the tax due on foreign-earned intangible income. However, for $\hat{\tau} \geq 5/8\,\tau$, the tax on GILTI has no effect. The tax credit for foreign taxes paid is sufficiently high to offset the GILTI tax liability.

Based on the analysis conducted in Section 3 and Section 4 with an arbitrary value of the foreign country's tax rate $\hat{\tau}$, we infer that, if the foreign country's tax rate is sufficiently low, the tax on GILTI will lead to the same effects as would result from an increase of the foreign country's tax rate. However, if the foreign country's tax rate is sufficiently high, but still below the home country's tax rate, $\tau > \hat{\tau} \geq 5/8\,\tau$, our analysis in Section 3 and Section 4 applies, as the tax on GILTI has no effect. Thus, we conclude that the tax on GILTI does not affect our analysis qualitatively, but it will

[32]Corporations are eligible for up to a 50% deduction against GILTI, which reduces the U.S. statutory tax rate of 21% to an effective rate of 10.5%.

[33]If a company has more foreign tax credits than tax liability, these extra credits cannot be used (in the future).

reduce the benefits from transferring the IP offshore ex-ante if the foreign country's tax rate is sufficiently low, i.e. $\hat{\tau} < 5/8\,\tau$.[34]

Finally, in the case that the MNC's foreign affiliate is located in a zero rate tax haven, the tax on GILTI resembles a minimum tax on foreign income, which we analyze in detail in the next sub-section.

6.2 Global Minimum Tax

A global minimum tax has long been proposed as a means of reducing profit shifting and more generally tempering or reversing a worldwide race to the bottom. These proposals have gained momentum recently with the G20's endorsement of a global minimum tax based on the OECD's Pillar Two. The type of profit shifting associated with the transfer of intellectual property that we consider in our analysis has been a major impetus for the development of these proposals, and so it is natural to consider the implications of such policies in our model.

Suppose that there is a global minimum tax, τ_m. In keeping with our interest in a relatively high-tax home country and a relatively low-tax foreign affiliate, the case of interest is when $\hat{\tau} < \tau_m \leq \tau$. This means that the global minimum tax binds in the foreign tax haven but not in the home country. The policy would have no effect if it did not bind in either country, whereas if it bound in both countries, we would effectively return to the pure worldwide system case considered earlier.

With this setup, from the firm's perspective incentives would be essentially equivalent to a situation where it faces a tax of τ_m instead of $\hat{\tau}$ in the foreign country. Because we conducted our analysis in Section 3 and Section 4 with an arbitrary value of $\hat{\tau}$, this analysis would not change, though of course the potential benefits from shifting intellectual property would be limited by the effectively higher value for $\hat{\tau}$. A properly implemented global minimum tax should therefore reduce the ex-ante intrafirm transfer of intellectual property in general. There is, however, an exception to this point. We note in Section 3 that the incentives to transfer intellectual property ex ante could be generated when the generosity of the loss offset regime in the foreign country is relatively high, regardless of the value of $\hat{\tau}$. This particular incentive would survive if

[34] Any direct (or indirect) increase of the tax rate on GILTI, as proposed in the Made in America Tax Plan (U.S. Department of the Treasury, 2021), would imply an increase of the critical threshold of $5/8\,\tau$ below which the tax on GILTI constitutes an extra tax burden on foreign earned income.

there is a global minimum tax without a corresponding coordination of the loss offset regime. This is an example of the more general concern that establishing a minimum statutory corporate tax rate could be rendered ineffective by countries setting non-rate aspects of the tax system that reduce the effective expected tax burden.

A global minimum tax would introduce a worldwide element to an otherwise territorial tax system. A concern with worldwide systems in general is that they can create incentives for corporate inversions. These concerns would be dampened by global coordination if all signatory countries adhere to the minimum tax, but could still be present when considering inversion to countries that are not signatories. More broadly, corporate inversions are relatively drastic and visible policies that the U.S. government, for example, had been able to render increasingly costly for corporations. In the context of our intellectual property model, however, there may be a less drastic and visible variant of a corporate inversion that we may perhaps describe as "ex-ante inversion" – with the term "inversion" used somewhat impressionistically.

In the variant of the model in Section 4.1, a signal of the expected profitability of a project α_j is observed before the actual realization of profits. At this stage, the firm – or more generally an "entrepreneur" who develops a promising early-stage idea – may not make any actual profits and might have relatively few employees or visible capital. Such an entrepreneur could presumably choose to set up a new firm in a foreign country that is not a signatory to the global minimum tax, where the idea might be further developed. This type of ex-ante "inversion" – not necessarily an inversion in a formal sense – may not be subject or even realistically subjectable to the same types of restrictions designed to curtail typical corporate inversions.

It should be noted that the foreign country in question need not directly be the low-tax jurisdiction that is the final destination of the intellectual property, but could be a relatively high-tax country that has not signed up to the global minimum tax. Indeed, there would seem to be some incentive for a country to attract R&D activity by serving as the destination for such an inversion. Such a country might remain outside of the global minimum tax and provide lax regulation and/or enforcement of profit shifting activity.

7 Conclusion

It is well known that a multinational company can reduce its worldwide tax liability by selling an intangible asset to an affiliate in a low-tax country at an artificially low price. In this paper we show that this strategy might be profitable even at an arm's-length price, as long as the tax loss offset in the home country is imperfect. In doing so, MNCs owning an IP with an above average success probability may even earn an additional gain from shifting the IP offshore ex ante. This extra gain arises if the government cannot observe the MNC-specific success probability and has to condition the arm's-length price on the average success probability of all IPs. From the perspective of a MNC with an IP that has an above average success probability, the regulated arm's-length price is too low. Furthermore, we show that it may even be beneficial to transfer the IP offshore to a country with an identical or higher tax rate, as long as the tax treatment of losses offshore is sufficiently more generous than in the home country.

Appendix

A Shifting the IP Ex Post

In the ex-ante analysis we so far assumed that the MNC does not know the realisation of the uncertain IP when deciding whether to transfer the IP offshore. As a robustness analysis, we will now evaluate how incentives change if the MNC has the possibility to shift its IP ex post, that is, after the MNC knows whether the IP is successful or failed. For the government the information structure remains as before. The government knows the distributional features of α only. In what follows, we analyze the cases of a successful and a failed technology.

Successful Technology

First, we assume that the IP is successful and enables production. We denote this scenario by superscript S. If the IP is kept at home, after-tax profit of the MNC is $\pi^{a,S} = (1-\tau)(\pi - f)$. If the IP is shifted offshore to the foreign affiliate, the after-tax profit of the MNC is $\hat{\pi}^{a,S} = (1-\tau)(q-f) + (1-\hat{\tau})(\pi - q)$. The MNC's incentive to

shift a successful IP to the foreign low-tax affiliate is given by:

$$\Delta\pi^{a,S} = \hat{\pi}^{a,S} - \pi^{a,S} = (\tau - \hat{\tau})(\pi - q) > 0 \qquad \text{for} \quad q < \pi. \tag{30}$$

Transferring a successful IP to the low-tax country yields a tax saving of $\tau - \hat{\tau}$ on the part of profits that exceed the transfer price p. Thus, the benefit of shifting a successful IP offshore ex post are maximized if the MNC sets the transfer price q to its minimum value, which we assumed to be f.

In the case of the regulated arm's-length transfer price $q = \bar{\alpha}\pi$, which is based on the observable distribution of α, equation (30) changes to:

$$\Delta\pi^{a,S} \;=\; (\tau - \hat{\tau})(1 - \bar{\alpha})\,\pi > 0. \tag{31}$$

The regulated arm's-length transfer price reduces the MNC's benefit from shifting the IP to the low-tax country, however, it cannot eliminate the MNC's incentive to shift a success full IP offshore ex post. The fact that the regulated arm's-length transfer price is conditioned on the distributional features of α that are observable ex ante, the arm's-length price is always too low from the ex-post perspective.

Failed Technology

In the situation the technology fails, indicated by superscript F, an after-tax loss of size $\pi^{a,F} = -(1 - d\,\tau)f$ emerges in the home country. If the failed IP is transferred to the foreign affiliate, the after-tax profit of the MNC is: $\hat{\pi}^{a,F} = (1-\tau)(q-f) - (1-\hat{d}\,\hat{\tau})q$. The MNC's incentive to shift a failed IP abroad is given by:

$$\Delta\pi^{a,F} \;=\; \hat{\pi}^{a,F} - \pi^{a,F} \;=\; -\tau\,(q - f) - d\,\tau f + \hat{d}\,\hat{\tau} q \;\lesseqgtr\; 0. \tag{32}$$

Shifting a failed IP at a price q to the foreign location comes at the costs of an incurred domestic tax liability of $\tau\,(q - f)$ and the forfeit of the domestic loss offset provision $d\,\tau f$ for the fixed cost, but it enables the MNC to make use of the foreign loss offset provision amounting to $\hat{d}\,\hat{\tau} q$.

In the case that neither the home nor the foreign country allow for any loss offset, $d = \hat{d} = 0$, there are no benefits for the MNC from transferring a failed IP to the low-tax country ex post, i.e. $\Delta\pi^{a,F} < 0$. This disincentive to shift a failed IP ex post survives even if both countries treat profits and losses fully symmetric, i.e. grant a

complete loss offset, $d = \hat{d} = 1$.[35]

However, for certain combinations of tax rates and values for the loss offset provision, the MNC faces a tax incentive to transfer even a failed IP offshore ex post. Re-arranging equation (32) yields:

$$\frac{\hat{\tau}}{\tau} \geq \frac{q - (1-d)f}{\hat{d}\, q}. \tag{32'}$$

In the case the MNC is free to set the transfer price to the minimum possible value of $q = f$, the MNC will shift a failed IP offshore ex post if the benefit from the loss offset in the foreign country dominates the one in the home country, i.e. if $\hat{\tau}\,\hat{d} \geq \tau\, d$.

For the case that the MNC is forced to implement a transfer price above the minimum possible value, i.e. for $q > f$, which also includes the case of the regulated arm's-length price of $q = \bar{\alpha}\pi$, the incentives to shift a failed IP offshore ex post are maximized if the home country provides no opportunity for loss offset, $d = 0$, while the foreign country treats profits and losses fully symmetric, $\hat{d} = 1$.

Finally, in the case of a pure worldwide system, i.e. $\tau = \hat{\tau} = \tilde{\tau}$ and $d = \hat{d} = \tilde{d}$, expression (32) becomes:

$$\Delta\pi^{a,F} \;=\; \hat{\pi}^{a,F} - \pi^{a,F} \;=\; -(1-\tilde{d})\,\tilde{\tau}\,(q-f) \leq 0. \tag{33}$$

This mirrors our findings for the worldwide system in (13) and (29). Once again, as long as $\tilde{d} < 1$, transferring the IP under a worldwide system leads to larger losses in case of failure. Note that in case of success, (31) implies that $\Delta\pi^{a,S} = \hat{\pi}^{a,S} - \pi^{a,S} = 0$, meaning that transferring the IP would be neither incentivized nor disincentivized.

Our analysis of the ex-post offshore transfer of the IP reflects our findings already derived under the ex-ante analysis. A successful IP will always be shifted to the low-tax jurisdiction because the arm's-length transfer price is set too low from the ex-post perspective. In addition, the conditions which make the offshore transfer of a failed IP beneficial ex post coincide with the conditions stated in Proposition 2. A relative more symmetric treatment of loss in foreign compared to home increase the incentives to shift an IP ex ante, or a failed IP ex post.

[35] For $d = \hat{d} = 1$, equation (32) becomes $\Delta\pi^{a,F} = -(\tau - \hat{\tau})\, q \;<\; 0$ for $\tau > \hat{\tau}$.

References

- Appelt, S., F. Galindo-Rueda, and A.C. Gonzalez Cabral (2019). Measuring R&D Tax Support: Findings from the New OECD R&D Tax Incentives Database. *OECD Science, Technology and Industry Working Paper* 2019/06. Paris, France.

- Alstadsaeter, A., S. Barrios, G. Nicodeme, A.M. Skonieczna, and V. Antonio (2018). Patent Boxes Design, Patents Location, and Local R&D. *Economic Policy* 33, 131-177.

- Altshuler R., A.J. Auerbach, M. Cooper and M. Knittel (2011). Understanding U.S. Corporate Tax Losses. Department of Economics, Rutgers, the State University of New Jersey, Working Paper No. 2011, 24.

- Auerbach, A.J. (2007). Why have Corporate Tax Revenues Declined? Another Look. *CESifo Economic Studies* 53, 153-171.

- Bauer, C.J. and D. Langenmayr (2013). Sorting into Outsourcing: Are Profits Taxed at a Gorilla's Arm's Length? *Journal of International Economics* 90, 326-336.

- Bilicka, K.A. (2019). Comparing UK Tax Returns of Foreign Multinationals to Matched Domestic Firms. *American Economic Review* 108, 2921-53.

- Clausing, K.A. (2003). Tax-motivated Transfer Pricing and US Intrafirm Trade Prices. *Journal of Public Economics* 87, 2207-2223.

- Ciaramella, L., Martìnez, C., and Ménière, Y. (2017). Tracking Patent Transfers in Different European Countries: Methods and a First Application to Medical Technologies. *Scientometrics* 112, 817-850.

- Council Directive 2016/1164/EU of 12 July 2016 Laying Down Rules Against Tax Avoidance Practices that Directly Affect the Functioning of the Internal Market. OJ L193/1-14.

- Cooper M. and M. Knittel (2006). Partial Loss Refundability: How are Corporate Tax Losses Used? *National Tax Journal* 59, 651-664.

- Cristea, A.D. and D.X. Nguyen (2016). Transfer Pricing by Multinational Firms: New Evidence from Foreign Firm Ownerships. *American Economic Journal: Economic Policy* 8, 170-202.

  De Simone, L., K. Klassen, and J.K. Seidman (2017). Unprofitable Affiliates and Income Shifting Behavior. *The Accounting Review* 92, 113-136.

- Davies, R.B., Martin, J., Parenti, M., and F. Toubal (2018). Knocking on Tax Haven's Door: Multinational Firms and Transfer Pricing. *Review of Economics and Statistics* 100, 120-134.

- Desai, M.A., Foley, F.C., and J.R. Hines (2006). The Demand for Tax Haven Operations. *Journal of Public Economics* 90, 513-531.

- Dharmapala, D. (2014). What Do We Know About Base Erosion and Profit Shifting? A Review of the Empirical Literature. *Fiscal Studies* 35, 421-448.

- Dischinger, M. and N. Riedel (2011). Corporate Taxes and the Location of Intangible Assets within Multinational Firms. *Journal of Public Economics* 95, 691-707.

- EY (2020). *Worldwide R&D Incentives Reference Guide 2020.*

- Fair Tax Mark (2019). *The Silicon Six and Their $100 Billion Global Tax Gap*. Manchester, United Kingdom.

- Graham, S.J.H., Marco, A.C., and A.F. Myers (2018). Patent Transactions in the Marketplace: Lessons from the USPTO Patent Assignment Dataset. *Journal of Economics & Management Strategy* 27, 343-371.

- Griffith, R., Miller, H., and M. O'Connell (2014). Ownership of Intellectual Property and Corporate Taxation. *Journal of Public Economics* 112, 12-23.

- Grubert, H. (2003). Intangible Income, Intercompany Transactions, Income Shifting, and the Choice of Location. *National Tax Journal* 56, 221-242.

- Gresik, T. (2001). The Taxing Task of Taxing Transnationals. *Journal of Economic Literature* 39, 800-838.

- Haufler, A. and G. Schjelderup (2000). Corporate Tax Systems and Cross Country Profit Shifting. *Oxford Economic Papers* 52, 306-325.

- Haufler, A., Norbäck, P.-J., and L. Persson (2014). Entrepreneurial Innovations and Taxation. *Journal of Public Economics* 113, 13-31.

  Hopland, A., P. Lisowsky, M. Mardan and D. Schindler (2018). Income Shifting under Losses. *The Accounting Review* 93, 163-183.

- Kalamov, Z., Runkel, M. (2016). On the Implications of Introducing Cross-border Loss-offset in the European Union. *Journal of Public Economics* 144, 78-89.

- Karkinsky, T. and N. Riedel (2012). Corporate Taxation and the Choice of Patent Location within Multinational Firms. *Journal of International Economics* 88, 176-185.

- Keen, M. and K. Konrad (2013). The Theory of International Tax Competition and Coordination, in: *Handbook of Public Economics*, Volume 5, A. Auerbach, R. Chetty, M. Feldstein and E. Saez (eds.), North-Holland, Chapter 5.

- Koethenbuerger, M., Mardan, M., and M. Stimmelmayr (2019). Profit Shifting and Investment Effects: The Implications of Zero-taxable Profits. *Journal of Public Economics* 173, 96-112.

- Mardan, M. and M. Stimmelmayr (2018). Tax Revenue Losses through Cross-Border Loss Offset: An Insurmountable Hurdle for Formula Apportionment? *European Economic Review* 102, 188-210.

- OECD (2013). Action Plan on Base Erosion and Profit Shifting, Paris, France.

- OECD (2017). Transfer Pricing Guidelines for Multinational Enterprises and Tax Administrations, Paris, France.

- O'Keefe, B. and J. Marty (2015). How Uber Plays the Tax Shell Game. *Fortune Magazine*. https://fortune.com/2015/10/22/uber-tax-shell/

- Schoen, W. and Konrad, K.A. (Eds.), (2012). Fundamentals of International Transfer Pricing in Law and Economics. MPI Studies in Tax Law and Public Finance. Springer, Heidelberg.

- U.S. Department of the Treasury (2021). The Made in America Tax Plan. Washington, D.C.

- U.S. Tax Court (2017). US vs. Amazon. Case No. 148 T.C. No 8. Washington, D.C. https://tpcases.com/us-vs-amazon-march-2017-us-tax-court/

- Weber, H. (2015). Timeline: How Uber's Valuation Went from $60M in 2011 to a Rumored $50B This Month. *Venture Beat*. https://venturebeat.com/2015/05/10/timeline-how-ubers-valuation-went-from-60m-in-2011-to-a-rumored-50b-this-month/