

Richter, Wolfram F.; Breuer, Markus

Conference Paper

Pricing the Transfer of Intellectual Property: A Plea for Regulated and Internationally Coordinated Profit Splitting

Beiträge zur Jahrestagung des Vereins für Socialpolitik 2016: Demographischer Wandel - Session: Innovation and the Global Economy, No. A03-V3

Provided in Cooperation with:

Verein für Socialpolitik / German Economic Association

Suggested Citation: Richter, Wolfram F.; Breuer, Markus (2016) : Pricing the Transfer of Intellectual Property: A Plea for Regulated and Internationally Coordinated Profit Splitting, Beiträge zur Jahrestagung des Vereins für Socialpolitik 2016: Demographischer Wandel - Session: Innovation and the Global Economy, No. A03-V3, ZBW - Deutsche Zentralbibliothek für Wirtschaftswissenschaften, Leibniz-Informationszentrum Wirtschaft, Kiel und Hamburg

This Version is available at:

<https://hdl.handle.net/10419/145621>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

**Pricing the Transfer of Intellectual Property:
A Plea for Regulated and Internationally Coordinated Profit Splitting¹**

by

Wolfram F. Richter

TU Dortmund University, CESifo Munich, IWH Halle, and IZA Bonn

and

Markus Breuer

SRH Hochschule Heidelberg

October 2015

This version: August 2016

Abstract:

Taxing intellectual property is a challenging task. With its BEPS initiative the OECD (2013) aims at taxing intangibles in accordance with value creation although difficulties in determining the jurisdiction in which value creation occurs are acknowledged. The European Commission promotes the introduction of a Common Consolidated Corporate Tax Base (CCCTB) to neutralize profit shifting. The drawback of this proposal is that incentives are set to relocate R&D activities to low-tax countries. This is the background against which the present paper pleads for a regulated and internationally coordinated split of the profits earned with licensed know-how.

JEL Classification: H25, O34, M48, F23

Keywords: Transfer Pricing Rule, Intellectual Property, Two Books vs. One Book, Formula Apportionment, Shapley Value

Addresses:

Wolfram F. Richter, TU Dortmund University, Department of Economics, 44221 Dortmund, Germany; Wolfram.Richter@tu-dortmund.de, phone: +49 231 755 3146; Markus Breuer, SRH Hochschule Heidelberg, Department of Business Administration and Economics, Ludwig-Guttman-Str. 6, 69123 Heidelberg, Germany; Markus.Breuer@Hochschule-Heidelberg.de, phone: +49 6221 881476.

¹ Valuable comments and suggestions made by Stefan Homburg, Mohammed Mardan, Sören Bo Nielsen, Ulrich Schreiber, and Christoph Spengel (on this paper's version and forerunners) are gratefully acknowledged.

1. Introduction

Intellectual property (“IP”) and intangibles are of increasing importance for multinational enterprises (“MNEs”). The value of patents, trademarks, copyrights, and other intangible assets as a percentage of the largest US companies’ market value is estimated to have increased from 16.8% in 1975 to almost 80% in 2005 (Parr, 2013, citing Ocean Tomo). As a result, the adequate pricing of IP in transactions between the affiliates of multinationals has become a pressing issue for corporate management and even more for tax authorities. It is a characteristic of IP that the application of the standard methods for the determination of arm’s length transfer prices – the comparable uncontrolled-price method, the cost-plus method, and the resale-minus method – is not free of arbitrariness.

Companies, particularly those of the digital economy, take advantage of the situation. They are incentivized to shift profits to low-tax jurisdictions and to save on tax payments (Commission Expert Group on Taxation of the Digital Economy, 2014). As a result, the link between taxation and real economic activity is suspected to get more and more lost. Although profit shifting is by its nature difficult to measure, there is evidence that IP plays a key role. According to estimates of Heckemeyer and Overesch (2013), 72% of profit shifting is attributed to the pricing of IP in intra-firm transactions and to the strategic location of ownership rights.

The challenges related to the taxation of MNEs have prompted the OECD (2013) to identify fifteen fields of action against base erosion and profit shifting (“BEPS”). With the BEPS initiative the OECD aims at taxing the returns to R&D in accordance with value creation although difficulties in determining the jurisdiction in which value creation occurs are frankly acknowledged. The problem is particularly acute when pricing IP. There is no obvious answer to the key question whether value is created by the development of know-how or by its use. One therefore has to wait and see to what extent the BEPS initiative will be successful. Skepticism is warranted.

The tax gain from shifting profit to low-tax jurisdictions would vanish if the profits earned by the affiliates of a company were consolidated before being taxed. This is the idea of the Common Consolidated Corporate Tax Base (CCCTB) whose introduction in the European Union was originally proposed by the European Commission in 2011. In June 2015 the Commission has confirmed the proposal though with a slight twist. While MNEs should be free to opt in to the CCCTB according to the original proposal, MNEs should be obliged to

use CCCTB in tax reporting according to the relaunched proposal. The Commission fears that otherwise MNEs would be unlikely to opt in to the CCCTB. The clear advantage of the CCCTB is that it takes the MNEs the incentive to minimize taxes by means of profit shifting. There is however an equally clear disadvantage. As the share of the common base which is apportioned to a participating country for the purpose of taxation depends on local activity a strong incentive is given to shift R&D activities to low-tax jurisdictions. High-tax countries with strong R&D activities have therefore reason not to join a CCCTB regime.

In order to limit the scope for MNEs to opportunistically reallocate taxable income across jurisdictions, Desai and Dharmapala (2011) have recommended a one-book system. MNEs should be required to report transfer prices which are consistent with those used internally. The appeal of a one-book system is that it sustains global production efficiency when prices are uncontrolled. It is, however, not very realistic to assume that MNEs abstain from controlling transfer prices when the tax bill is affected. As already noted by Nielsen (2014), a one-book system does not remove the ability to manipulate tax payments, only moderates it.

This is the background against which the present paper pleads for a pricing policy which relies on splitting the profit earned with licensed know-how. The idea is that the profit earned by some MNE's affiliate with IP is divided between the licensee and the licensor in fixed proportion for the purpose of taxation. As we require the splitting to be internationally coordinated, we speak of *Regulated Profit Splitting* (RPS). By assumption, the splitting is fully exogenous. This is different from Boos (2003, p. 204) who discusses sharing rules based on hypothetical negotiations between independent parties. An equal split is no necessary part of RPS, but it is a kind of a benchmark which is suggested by equity considerations. Profit is only earned in the country hosting the licensee if this country cooperates with the country hosting the licensor. In this cooperation, the former country provides earnings opportunities while the latter country provides know-how which is a non-rival production input. As the marginal cost of both provisions is zero, an equal split of the tax base appears to be just and fair.

To the best of our knowledge, RPS has not received any thorough analysis in the theoretical literature so far. However, as this paper shows RPS deserves a serious consideration as an alternative to the governing tax law. The properties of RPS turn out to be particularly appealing if evaluated from the perspective of a high-tax country hosting strong R&D activities.

RPS has to be differentiated against the Profit Split Method (PSM), the CCCTB, and also against the Comparable Profits Method (CPM). RPS differs from the PSM and the CCCTB in that splitting refers to the licensee's profit and not to the licensor's profit. It equally differs from the PSM and the CPM in that it is no transactional transfer pricing method. No attempt is made to split the profit from some controlled transactions between associated firms. The object of splitting is the licensee's overall profit determined before royalty payments.

The theoretical analysis of RPS is motivated by practice. There is the well-known Goldscheider Rule requiring the licensee to pay 25% of its expected profits for the product that incorporates the intellectual property at issue to the licensor (Goldscheider, Jarosz, and Mulhern, 2005). The Rule is not undisputed. It has even been rejected by the US Federal Circuit in 2011 ('Uniloc vs. Microsoft'). On the other hand, Knoppe (1972) has made a similar proposal independently. He recommends that 25% – 33% of the licensee's expected profit is paid to the licensor.

The paper is structured as follows: Section 2 shortly surveys related literature. Section 3 sets up the model of a MNE. Policy objectives are specified. The paper studies the effects that competing transfer-pricing regimes have on the allocational efficiency of R&D activity and on the distribution of tax revenue across jurisdictions. Section 4 studies the effects of the governing tax law with two sets of books. Section 5 derives the effects of a one-book system. Section 6 looks at CCCTB. Section 7 analyzes RPS. Section 8 compares the reform options. Section 9 summarizes and concludes.

2. Related literature

There is a growing body of literature trying to estimate the extent of base erosion and profit shifting in corporate taxation. The estimates are subject to large uncertainty and have to be interpreted with great caution. Surveying the literature, Riedel (2014) estimates that MNEs transfer 5% to 30% of their earned income from high-tax to low-tax jurisdictions. For other recent surveys see Dharmapala (2014) and the European Commission (2015). By its very nature, profit shifting is difficult to measure because there is not just one channel. Profit is not only shifted via strategic mispricing of intra-firm trade but also via corporate restructuring, the unbundling and migration of ownership rights and the use of intra-firm debt. Synthesizing the evidence from 25 studies Heckemeyer and Overesch (2013) conclude that transfer pricing and licensing are the dominant profit-shifting channel accounting for 72% of the overall pre-

tax profits response to a change in the shifting incentives. The recent literature therefore focuses increasingly on tax planning with IP (Grubert, 2003; Mutti et al., 2009; Dischinger et al., 2011; Karkinsky et al., 2012; Griffith et al., 2014; Evers et al., 2014; Beer et al., 2015; Evers et al., 2015; Bräutigam et al., 2015; Alstadsaeter et al., 2015; Dudar et al., 2015).

The effect of taxation on profit-shifting activity is to be documented by this kind of research. The normative question of policy design is not in the focus. It is mooted by Fuest and co-authors (2013). These researchers raise the question of how they would like international corporate taxation to work and they discuss the pros and cons of four policy options: (i) enforcing residence taxation for which they however see little chances internationally, (ii) extending source taxation which they deem to be more promising, (iii) reforming corporate taxation fundamentally by introducing the CCCTB or by switching to a destination-based cash-flow tax which they consider to be interesting options only for the longer perspective, and (iv) enforcing stricter reporting and transparency requirements of which they do not expect much improvement. In the short run, Fuest et al. (2013) recommend to extend source taxation and to impose withholding taxes on interest and royalty payments.

Desai et al. (2011) propose to fight base erosion and profit shifting by reforming the determination of transfer prices. More precisely, they propose to base the determination on what they call the performance related principle. The principle amounts to switching from a two-book to a one-book system. The potential merits of decoupling, i.e., the use of different transfer prices for internal and external statements, is investigated in a number of papers. An example is Johnson (2006), who sets up a sequential model in which two related legal entities (profit centers) trade IP. One firm invests in R&D leading to a certain output of IP which can be sold to the other firm in a second step. Johnson shows that decoupling can boost the overall group profit. Johnson's sequential setting is picked up by Hiemann and Reichelstein (2012). These authors confirm the merits of decoupling. It allows MNEs to make better investments and also to earn higher after-tax profits. The effects of decoupling are also analyzed by Nielsen (2014). He presents a model with a MNE delegating its quantity-setting power to a subsidiary which is engaged in Cournot–Nash competition with an uncontrolled second supplier. In this framework he works out the trade-offs that a ban on decoupling and other constraints on the choice of transfer prices have for corporate behavior. An unambiguous assessment is not obtained.

Starting with McLure (1980) a sizable literature has developed around the idea to consolidate tax bases and to apply formula apportionment. The European Commission (2011) has taken

up this idea and proposed an optional CCCTB for Europe. In the relaunched version of 2015 the Commission advances the view that MNEs should be taxed on the basis of a compulsory CCCTB. For a discussion of CCCTB see Devereux (2004) and Fuest (2008).

Formula apportionment can be understood as the attempt to fairly divide a MNE's profit between its affiliates. There are proposals in the literature which share this objective but draw different conclusions. Gonnet et al. (2007) and Vögele et al. (2008) apply game-theoretic concepts and they propose the use of Shapley's value. Other researchers such as Avi-Yonah et al. (2008) and Luckhaupt et al. (2012) recommend an apportionment method that combines a fixed standard profit margin with apportionment of residual profits.

This paper departs from the literature by arguing in favor of pricing the transfer of IP by splitting the licensee's profit before royalty payments in fixed and internationally agreed proportion. We call this Regulated Profit Splitting. In its major part, this paper compares RPS with the governing tax law, with a one-book system, and with CCCTB.

3. Know-how, intellectual property, and the model of a multinational enterprise

Know-how K is assumed to be the sole variable input of production. Such know-how is the result of R&D. The country in which know-how is developed is called the *home country* and the country only sharing the know-how is called the *host country*. In what follows, we use know-how and R&D as interchangeable notions. We however differentiate between know-how and intellectual property for two reasons. The first one is that we like to allow for the case that the know-how is only patentable to a certain extent. R&D activities produce local *spillover effects*, $E(K)$, on which property rights cannot be acquired. Third parties cannot be excluded from their use. $E(K)$ is, however, assumed to increase the home country's tax base. The second reason for differentiating between know-how and intellectual property is that we also like to study the case of unbundled ownership rights. Contracted research often has the effect that the country in which patents are held deviates from the country in which R&D is undertaken. Let $C(K)$ capture the cost caused by the development of know-how assumed to be increasing and weakly convex, $C' > 0$, $C'' \geq 0$.

Consider a MNE with two divisions producing output $F = F(K)$ and $f = f(K)$ for third-party customers at a price normalized to one. Marginal productivities, F' , f' , and E' , are positive and decreasing. Know-how is a non-rival production input which explains why F and

f are both stated as functions of K . F is the production function of the division located in the home country. As know-how is developed in the home country, we call this division the *developing division*. The division located in the host country and modelled by f is called the *sharing division* as the host country is sharing the developed know-how. In the scenario with bundled property rights, the developing division is the licensor of IP while the sharing division is the licensee. In the alternative scenario with unbundled property rights, the sharing division can slip into the role of the licensor. The royalty which the licensee has to pay is denoted by $R(K)$.

One could argue that intellectual property is an asset which can rarely be increased incrementally. The present model is flexible enough to cope with a zero-one innovation. One only has to set $F(K) \equiv p(K)\Phi$, $f(K) \equiv p(K)\phi$ and to interpret $p(K)$ as the probability that R&D results in a product innovation. Requiring $p' > 0$ then amounts to assuming that the probability of success increases in the amount of resources devoted to R&D.

3.1 Policy objectives

The tax regimes studied are evaluated in terms of (i) allocational efficiency, (ii) management neutrality, (iii) revenue effects, and (iv) distributive equity. With regard to efficiency, we differentiate between internal and external definitions. More precisely, the quantity K_i^* is called (*globally*) *internally (production) efficient* if the sum of marginal productivities equals marginal cost, $F' + f' = C'$. This is Samuelson's rule. Internal efficiency refers to the inside of the MNE. External efficiency includes non-patentable spillover effects generated by the production of know-how. The quantity K_e^* is called (*globally*) *externally efficient* if $F' + f' + E' = C'$. Another possible reason for differentiating between internal and external efficiency could be market power caused by the monopolization of IP. We, however, prefer to justify the differentiation with reference to non-patentable spillover effects because these are more strongly connected with the home country. It is just plausible to assume that any external benefits $E(K)$ are local in the sense that they exclusively accrue to the country in which R&D is undertaken. By contrast, the inefficiency of monopolization tends to spread over all countries in which the MNE is active.

The management of the MNE can be centralized or decentralized. Decentralization means that each division maximizes its own profit after tax. By contrast, a centralized MNE maximizes

joint profit. We assume that centralization entails some managerial cost. We speak of *management neutrality* if tax policy sets no incentive to centralize.

The taxation of MNEs aims at collecting revenue. In a closed economy or in a world of cooperating tax authorities, the true policy objective should be the minimization of social costs. In a non-cooperative setting, the revenue collected from taxing MNEs is a legitimate separate objective of national policy. There will be a point in this paper where the focus is on *revenue effects* and where social costs of taxation are ignored.

In this paper, the notion of *distributive equity* refers to “inter-nation equity”. For the specific problems raised by the digital economy see the report of the Commission Expert Group on Taxation of the Digital Economy (2014). The issue of equity is raised when countries have to cooperate for generating taxable income. In this paper’s model, the home country provides know-how and the host country provides market opportunities. As the use of know-how is non-rival, both provisions are without cost and in this sense comparable. Such a constellation raises the question of an equitable division of the tax base generated by the MNE’s investment in the host country. The host country’s share b should be larger than zero because the country provides the opportunity to extend the MNE’s operations. On the other hand, the base b should be less than $f(K)$ because the know-how comes from outside. For converse reasons, the base B taxed by the home country should be larger than $F + E - C$ and smaller than $F + E - C + f$.² An equal split with $b = f/2$ suggests itself as a natural benchmark of distributive equity. Applying the Shapley value of cooperative game theory strengthens this suggestion. However, reasoning à la Shapley also provides an argument against a perfect equal split as is shown next.

3.2 The Shapley value

A cooperative game consists of a set of players and a characteristic function specifying for each subset of players the value these players are able to create by concerted action. In the present context, the countries take the role of the players. On a stand-alone basis, the value created by the home country is $v(home) \equiv F(\bar{K}) + E(\bar{K}) - C(\bar{K}) = \max[F(K) + E(K) - C(K)]$ and the value of the host country is $v(host) \equiv 0$. If the countries cooperate, their joint value is $v(home, host) \equiv F(K_e^*) + E(K_e^*) - C(K_e^*) + f(K_e^*) = \max[F + E - C + f]$. The

² The notion of distributive equity will have to be modified when a withholding tax is analyzed. In this case, the base is shared and distributive equity refers to revenue collected by taxing the shared base.

structure of the game is reminiscent of the one discussed by Shapley (1967) under the heading “the landlord and the peasants”. Just as a peasant can create value from farming only if he cooperates with the landlord, the host country can create value from using patented know-how only when cooperating with the know-how developing home country. Shapley’s proposal is to divide the value of the grand coalition among the players according to the average marginal value each player contributes when joining the grand coalition in a random fashion. Applied to the host country this means the following. With a probability of one half, the host country joins the grand coalition before the home country does. The marginal contribution is zero in this case. With an equal probability of one half, the host country joins the grand coalition after the home country and its marginal contribution is $v(home, host) - v(home)$. Following Shapley, the host country’s share in the joint tax base should therefore be

$$\begin{aligned} b &\equiv \frac{1}{2} \left[(f(K_e^*) + E(K_e^*) - C(K_e^*)) - (F(\bar{K}) + E(\bar{K}) - C(\bar{K})) \right] \\ &= \frac{1}{2} \left[f(K_e^*) + \frac{1}{2} (K_e^* - \bar{K})^2 (F'' + E'' - C'') \right] \leq \frac{1}{2} f(K_e^*). \end{aligned} \quad (1)$$

If the second-order term in eq. (1) can be ignored, the Shapley value provides support for the equal-split solution. The tax base generated in the host country is shared equally with the home country while the tax base generated in the home country is not shared with the host country. This is so as the home country generates value even when not cooperating.

In general, the second-order term in eq. (1) cannot be ignored, however. It can be ignored if K_e^* is close to \bar{K} or if $F'' + E'' - C''$ is close to zero. The former case is obtained if the host country has relatively small weight in the MNE’s global operations. The other case is obtained if the marginal net benefit of know-how is close to constant. The second-order term can be interpreted as an external effect exerted on the home country’s tax base when the MNE increases its R&D activity in order to match extended sales operations abroad. The Shapley value suggests the need to compensate for the suffered externality. In practice, it will, however, be difficult to quantify the externality. This is why the following proposition emphasizes the upper bound of the host country’s tax base.

Proposition 1: Distributive equity requires dividing the tax base f generated by the MNE’s operations in the host country. The Shapley value suggests that the share of f allocated to the host country is positive but not larger than one half.

The idea to use Shapley's value for determining the transfer price of intellectual property goes back to Gonnet et al. (2007) and Vögele et al. (2008). These authors do not, however, derive general implications although some noteworthy general implications exist. A first one is that Proposition 1 is easily seen to extend to the scenario with more than just one host country. A second one applies to the scenario in which each of n countries provides a non-rival input which is needed to produce the output f in just one host country. In such a scenario, the Shapley approach suggests that the host country's tax base b_n should be positive but not larger than $f/(n + 1)$. This is so, as value is generated in the host country only if this country is the last to join the grand coalition, and this probability equals $1/(n + 1)$. With regard to the discussion of formula apportionment in Section 6 it is noteworthy to mention that the stated boundaries of b_n are totally independent of the costs incurred by developing the various non-rival inputs. We shall speak of an equitable distribution of the tax base in the *weak* sense if $0 < b_n < f$ and we differentiate this weak notion from the stronger one suggested by the Shapley value.

In what follows we compare the governing tax law with competing policy regimes and we evaluate the regimes in terms of efficiency, management neutrality, revenue effects, and distributive equity.

4. The governing tax law with two sets of books Consider a MNE which is decentralized. Hence, each division maximizes its own profit after tax. This means that the sharing division demands K by maximizing

$$\pi(K) \equiv f(K) - R_i(K) - g(K) \quad \text{with} \quad g(K) \equiv t[f(K) - R_e(K)] + wR_e(K), \quad (2)$$

while the developing division supplies K by maximizing

$$\begin{aligned} \Pi(K) &\equiv F(K) - C(K) + R_i(K) + G(K) \quad \text{with} \\ G(K) &\equiv T[F(K) + R_e(K) - C(K)] - wR_e(K). \end{aligned} \quad (3)$$

These equations have to be interpreted as follows. Profit is taxed at rate t in the host country and at rate T in the home country. T may exceed t but need not do so. We study both scenarios. Costs of know-how are assumed to be tax deductible. The definitions (2) and (3)

assume that the developing division is the licensor of IP. Hence royalties are paid by the sharing division. We allow for decoupling which means that the payment used *internally* for financial statements may differ from the payment used *externally* for tax reporting (“*two books*”). $R_i(K)$ is the royalty which the sharing division has to pay internally and $R_e(K)$ is the transfer price used for tax reporting. According to the Model Tax Convention of the OECD royalties shall be taxable in the country where the payments are received. This provision does not necessarily exclude the case that a creditable withholding tax w is levied by the country from which payments are made. An exception is the European Union. It has adopted a directive designed to eliminate withholding taxes on interest and royalty payments. In what follows, we allow for a withholding tax with *limited crediting*. This means that the withholding tax is credited up to the amount of tax due in the crediting country, $w \leq T$.

Definitions (2) and (3) capture main features of international corporate taxation. Corporate income is taxed at source and exempted from taxation in the parent’s country of residence. If the latter country should apply a system of crediting, special provisions typically allow the MNE to postpone the taxation of repatriated profits so that the difference to effective exemption can be ignored.

The clear advantage of maintaining two separate sets of books is that it allows the MNE to minimize tax payments without compromising on management neutrality. This can be shown as follows. Maximizing (2) and (3) implies

$$f' - g' = R'_i = -[F' - C' - G']. \quad (4)$$

If internal royalties are not paid lump-sum, a price $P_i \equiv R'_i$ exists equating demand and supply in the internal market for know-how. In practice, one can think of a headquarter fixing the price. Most patent licensing agreements observed empirically rely on marginal pricing by including per-unit or ad valorem royalties (San Martín and Saracho, 2010).³ Obviously, eq. (4) implies $f' - g' + F' - C' - G' = 0$ which is the first-order condition when the centralized MNE maximizes joint profit,

$$\pi + \Pi = f - g + F - C - G \quad \text{with} \quad g + G = tf + T[F - C] + (T - t)R_e \quad (5)$$

³ These authors treat the two pricing strategies as alternatives. In the present model the difference can be viewed as one between ex ante and ex post. Just assume $f(K) \equiv p(K)\varphi$ where $p(K)$ denotes the probability that R&D results in a product innovation. When taxation is absent, maximizing the profit of the sharing division yields $p'\varphi = P_i$. What appears as a per-unit royalty ex ante, P_iK , then equals a linear payment in sales ex post, $p'K \cdot \varphi$.

in K . Hence, centralized and decentralized profit maximization is behaviorally equivalent. Let us state this result in the form of a proposition. The finding is clearly not novel. But stating it and further findings in the form of propositions helps to structure the subsequent discussion.

Proposition 2: A two-book system allows a MNE to minimize tax payments without compromising on management neutrality.

4.1 Minimizing tax payments with bundled ownership rights

The definitions (2) and (3) capture the case in which the developing division is the licensor of IP. In other words, ownership rights are bundled. As management neutrality holds, we can assume that the MNE maximizes joint profit after tax in $R_e \in [\underline{R}_e, \bar{R}_e]$ where $\underline{R}_e, \bar{R}_e$ denote the bounds of feasible transfer prices. The choice of $R_i(K)$ is not relevant for tax planning. The term does not appear in equation (5) as neither does the withholding tax. The latter only redistributes tax revenue between tax jurisdictions. A fully creditable withholding tax does not affect the MNE's dispositions. The objective to minimize tax payments induces the MNE's headquarter to set $R_e = \underline{R}_e$ if $T > t$ and to set $R_e = \bar{R}_e$ if $T < t$. Such an optimizing behavior raises the question of how to model the boundaries of feasible transfer prices.

An upper bound can be derived from the requirement that transfer prices do not imply losses. We call this the *no-loss constraint* of transfer pricing. In the present framework with no uncertainty, a loss can only result when a tax refund is part of strategic planning. For this reason, tax authorities can be expected to reject transfer prices implying losses and to enforce the no-loss constraint. In the model, a loss results from setting $R_e > f$. Neither will the host country be prepared to refund $t(R_e - f) > 0$, nor will the home country refund $(t - T)(R_e - f) > 0$ which it would have to do if $t > T$ and if a cross-border loss offset were institutionalized.⁴ Hence there is good reason to set $\bar{R}_e \equiv f$. Assuming $T < t$ and maximizing joint profit (5) subject to $R_e \leq f$ yields $R_e = f$ and $F' + f' = C'$. This outcome implies internal efficiency. It is, however, unfavorable for the host country because positive revenue is only collected when applying a withholding tax on royalty payments, $g = t(f - R_e) +$

⁴ Cross-border loss compensation for MNEs has become a major policy issue in Europe. For a discussion of the implications for tax compensation see Haufler and Mardan (2014).

$wR_e = wf$. Distributive equity in the weak sense requires $0 < w < t$ while the Shapley approach suggests $0 < w \leq t/2$.

If $T > t$, joint profit decreases in royalty payments. It then pays for the MNE to set R_e as low as possible. This is without drawback as external transfer prices have no managerial function. The only negative effect is on the tax revenue of the high-tax country. This will give its tax authorities reason to negotiate over the choice of specific prices. In practice, their position is, however, weak because information about the productivity of know-how is typically not available. The informational asymmetry gives the MNE's headquarter a lot of leeway in setting R_e . Just for the sake of simplicity, let us assume that the choice of R_e is only constrained to be nonnegative. Negative transfer prices would certainly be challenged by tax authorities. The MNE's optimal choice then requires setting $R_e = \underline{R}_e \equiv 0$. This is as if IP is taxed at source. Maximizing eq. (5) with $R_e \equiv 0$ yields

$$(1 - T)[f' + F' - C'] = -(T - t)f' \quad (6)$$

The last term on the right-hand side of eq. (6) works like a subsidy to the development of know-how. Such a subsidy is internally inefficient but it may raise external efficiency. The development of know-how exceeds the internally efficient level when some returns are taxed at a lower rate than the rate at which costs are deducted. However, external efficiency cannot be guaranteed. As there is no connection between $(T - t)f'$ and E' the subsidy can well be too weak or too strong. The subsidy fails to target external efficiency. Let us summarize the main findings. Note that $g = tf$ when $R_e = 0$.

Proposition 3: If ownership rights are bundled and if the boundaries of feasible transfer prices are as specified, a two-book system sets incentives to shift profit with the following implications:

- (i) If home is a low-tax country, the production of know-how is internally efficient. Distributive equity in taxation requires levying a withholding tax on royalty payments.
- (ii) If home is a high-tax country, the tax gap works like an untargeted subsidy to R&D. IP is taxed at source which is not compatible with distributive equity.

4.2 Minimizing tax payments with unbundled ownership rights

The analysis of Section 4.2 assumes that the development of know-how and the holding of the derived ownership rights are bundled and allocated to the home country. This may not be a realistic scenario. Large multinationals can organize their activities in such a way that R&D may be located in a high-tax country while the ownership rights and the received royalty payments are shifted to a low-tax country (Evers et. al, 2015). The special appeal of such a strategy of unbundling is that it promises the MNE a “double dip” tax deduction. Not only are the costs of R&D tax deductible in the home country, the royalties which the home country has to pay to the host country for the right of exploiting the know-how are equally deductible from the home’s country tax base.

To be more specific, let us assume $T > t$ so that the home country takes the role of the high-tax country. The incentive to unbundle only exists if the developing division is resident in a high-tax country. If the international migration of ownership rights is not taxed effectively, the home country ends up collecting no positive revenue from taxing the MNE’s profit. The result is achieved by setting $R_e \equiv F - C$. The home country collects revenue from taxing the external effects which the production of know-how promises and beyond that only if a withholding tax is levied on royalty payments. As the withholding tax w is assumed to be creditable but limited by the crediting country’s tax rate, $g = t(f + R_e) - wR_e = tf + (t - w)(F - C) \geq tf$. Such a result is not compatible with distributive equity. On the other hand, internal efficiency is sustained as is revealed by maximizing joint profit,

$$\pi + \Pi = f + F - C - [t(f + R_e) + T(F - C - R_e)] = (1 - t)[f + F - C]. \quad (7)$$

The incentive to unbundle can be measured by the resulting decrease Δ in the MNE’s aggregate tax payment. Subtracting $t[f + F - C]$ from $tf + T[F - C]$ yields $\Delta = (T - t)(F - C)$. The incentive to unbundle increases in the tax gap and in the profit to be earned in the home country.

Proposition 4: If unbundling is feasible, a two-book system sets an incentive to locate R&D in the high-tax country and to hold ownership rights in the low-tax country. The incentive increases in $\Delta = (T - t)(F - C)$. A withholding tax with limited crediting is unable to secure distributive equity. Still, tax-base erosion sustains internal efficiency in the development of know-how.

A country only sharing know-how has a strong incentive to undercut the corporate tax level of the developing countries. A marginal decrease in the rate is able to trigger a first-order increase in taxable profits. This is so as the locational choice for the holding of IP is a binary decision. As a result, tax competition is at the extensive margin and not at the intensive one. Countries are led to compete by offering favorable tax provisions. A prominent provision is the so-called patent box which a growing number of developed economies have recently implemented (Evers et al., 2015; Alstadsaeter et al., 2015, Dudar et al., 2015). There is increasing evidence supporting the suspicion that those patent boxes are primarily designed to steal the revenue collected from taxing intangibles. Countries hosting R&D activities are incentivized to react by taxing the international migration of IP. It is however not clear to what extent the tax benefit from strategic migration can be skimmed off in practice. For a discussion see Russo (2007, 180-182) or Endres et al. (2015, §16.04).

A major problem of exit taxation is that the return to know-how lags behind costs incurred. Therefore, profit can hardly serve as the base of a realistic exit tax. In a realistic model, the exit tax is one on cost C , possibly one on cost plus some mark-up captured by the factor $m \geq 1$. Let us assume that the host country allows the cost of acquisition to be deducted. The developing country then collects TmC and the host country loses tmC . In order to make sense, T must exceed t . Assuming $R_e = F - C$ and maximizing joint profit implies

$$(1 - t)[F' + f' - C'] = (T - t)mC' > 0 \quad (8)$$

As the right-hand side is positive, optimal know-how falls below the internally efficient level. The exit tax is effectively a tax on R&D. If the host country does not allow mC to be deducted from taxable income, the effect of the exit tax on R&D is even more detrimental.

Proposition 5: An exit tax on the migration of IP protects high-tax countries against base erosion at the price of reduced internal efficiency.

5. One-book system

Desai and Dharmapala (2011) recommend an international tax regime which requires transfer prices reported by MNEs to tax authorities to be consistent with the transfer prices used

internally. The authors call such a transfer-pricing norm the performance related principle. We prefer to speak of a *one-book system* as this labeling better reveals the essence of the proposal.

We first demonstrate that the merits of a one-book system are closely tied to a form of management which is decentralized in the sense that it uses transfer pricing solely for equating demand and supply in the internal market for know-how. To show this, we maximize eq. (2) in K yielding

$$f' = \frac{R'_i - (t-w)R'_e}{1-t}. \quad (9)$$

Maximizing eq. (3) in K yields

$$F' + \frac{R'_i - (T-w)R'_e}{1-T} = C'. \quad (10)$$

The term $\frac{R'_i - (T-w)R'_e}{1-T}$ can be interpreted as the developing division's effective price fetched for supplied know-how, K^s . Similarly, $\frac{R'_i - (t-w)R'_e}{1-t}$ is the sharing division's effective cost of demanded know-how, K^d . The development of know-how is internally efficient if the sum of marginal productivities equals marginal cost. Obviously, such efficiency requires the equality of the effective price and cost of know-how, $\frac{R'_i - (T-w)R'_e}{1-T} = \frac{R'_i - (t-w)R'_e}{1-t}$, at $K^s = K^d$. At unequal tax rates such an equality is ensured only if a one-book system is installed, $P \equiv R'_i = R'_e$, and if no withholding tax is levied, $w = 0$. If this is the case, know-how supplied is paid its marginal product at the internally efficient level, $P = f'(K_i^*)$.

Proposition 6: If management is decentralized and if no withholding tax is levied on royalty payments, a one-book system sustains internal efficiency. The royalties paid equal the marginal product of know-how.

Proposition 6 replicates a key result of Desai and Dharmapala (2011). The replication clarifies the assumptions needed to sustain efficiency. Two of them require far-reaching steps of international policy coordination. The mentioned ban on withholding taxes within the European Union would have to be extended to the rest of the world. And MNEs would have

to be obliged to stick to a one-book system. Still, governments could consider agreeing on such measures. Governments cannot however enforce decentralized management. Such a judgment suggests taking a closer look at a one-book system when transfer pricing is assumed to be used by a centralized management to save on taxes. As shown by Nielsen (2014) in a model with rival costs of production the switch from a two-book system to a one-book system does not remove the ability to manipulate tax payments, only moderates it.

We make several simplifying assumptions. Pricing is linear, $R \equiv PK$, withholding taxes are not levied, and ownership rights are bundled. Furthermore, the managerial cost of centralization is assumed to increase quadratically in the difference between the chosen transfer price and the marginal product of know-how, $Z = z(P - f')^2 K/2$. The source of such cost is not modelled explicitly. One may, however, think of informational asymmetries between the MNE's headquarter and the divisions impeding internal efficiency. Maximizing joint profit

$$\pi + \Pi = (1 - t)[f - PK] + (1 - T)[F + PK - C] - z(P - f')^2 K/2 \quad (11)$$

in P yields $P = f' + (t - T)/z$. The optimal price exceeds the efficient one if the host country is a high-tax country. The host country's tax base is

$$b = \frac{g}{t} = f - PK = f - f'K - \frac{1}{z}(t - T)K. \quad (12)$$

As f is strictly concave, $0 < f - f'K < f$. Eq. (12) reveals that (weak) distributive equity is obtained only if the term with z is sufficiently small, i.e. if z is large. This means that the managerial cost of centralization must be sufficiently high if tax planning is to sustain an equitable distribution of the corporate tax base.

In order to analyze efficiency, the optimal price is plugged into eq. (11) which is then maximized in K yielding

$$(1 - T)[f' + F' - C'] = (T - t)f''K - \frac{1}{2z}(T - t)^2. \quad (13)$$

This first-order condition is compared with those derived in Section 4.2 for the two-book system. The comparison reveals that the effect that the managerial cost of centralization has on efficiency in a one-book system is ambiguous in the general case. Clear-cut results are derived only if the quadratic term in $T - t$ can be ignored because of some sufficiently large parameter z . If this is the case and if $T < t$, the right-hand side of eq. (13) is positive. This

means that optimal know-how falls short of the internally efficient quantity while the two-book system sustains internal efficiency. If the quadratic term can be ignored and if T exceeds t , the right-hand side of eq. (13) is negative. If f is isoelastic, say $f = K^\alpha$ with $\alpha < 1$, the right hand side of eq. (13) is less negative than the right hand side of eq. (6). This means again that the quantity of know-how resulting from eq. (13) remains below the quantity resulting from eq. (6).

Proposition 7: A one-book system sets incentives to centralize management. The welfare effects are ambiguous, in general. If, however, the managerial cost of centralization is sufficiently high, the following results are obtained:

- (i) The distribution of the tax base is weakly equitable.
- (ii) Developed know-how falls short of the quantity resulting in a two-book system.

6. Formula apportionment

The European Commission (2011, 2015) favors the introduction of a Common Consolidated Corporate Tax Base (CCCTB) which should be compulsory for MNEs. The Commission considers the CCCTB to be “an extremely effective tool for meeting the objectives of fairer and more efficient taxation” and for “tackling profit shifting and corporate tax abuse in the EU.” (European Commission, 2015, p. 7)

The consolidated tax base is defined as sales minus costs. In the simple model of the present paper, this is $B^c \equiv f(K) + F(K) - C(K)$. This base has to be split between the jurisdictions so that each of them can apply its own tax rate to its apportioned share. According to the Commission’s proposal of 2011 the apportioned shares are to be determined as an equally weighted average of the shares in labor, capital (assets), and sales. This is *formula apportionment*. As the present model does not differentiate between labor and capital it is suggestive to illustrate CCCTB by assigning a weight of $2/3$ to costs and a weight of $1/3$ to sales. The share of B^c apportioned to the home country then takes the simple form of

$$\lambda \equiv \frac{2}{3} + \frac{1}{3} \frac{F}{F+f}. \quad (14)$$

The remaining share, $b \equiv (1 - \lambda)B^c$, is apportioned to the host country. The first summand of 2/3 on the right-hand side of eq. (14) reflects the assumption that the cost of developing know-how falls on the home country.

An advantage of formula apportionment is that it is management neutral whenever royalties are not paid lump-sum. Divisions may maximize their own profits,

$$\Pi = F(K) - C(K) + R_i(K) - T\lambda B^c \text{ and } \pi = f(K) - R_i(K) - t(1 - \lambda)B^c ,$$

taking $R_i(K)$ as given. Or the MNE's headquarter may maximize $\Pi + \pi$. In both cases, optimal know-how results from solving

$$(1 - \tau)[f' + F' - C'] = (T - t)\frac{d\lambda}{dK}B^c \quad (15)$$

where $\tau \equiv \lambda T + (1 - \lambda)t$ denotes the weighted average tax rate.

Eq. (15) reveals that formula apportionment sustains internal efficiency if the splitting parameter λ does not vary with K (Wellisch, 2003). The right-hand side of eq. (15) vanishes in this case and $F' + f' = C'$ is implied. Constancy of λ does not represent an irrelevant case. In the present model, it holds when setting $F = p(K)\Phi, f = p(K)\phi$ so that $\lambda = \frac{\phi + 2\phi/3}{\phi + \Phi}$ which equals 5/6 when $\phi = \Phi$. Constancy should however not be expected in the general case. Quite to the contrary, it is a distinct feature of formula apportionment that the splitting parameter λ varies with varied factor costs and sales. MNEs will react to such variations by relocating factor costs to a low-tax country thereby reducing the effective tax. This incentive has been extensively discussed in the literature. (McLure, 1980; Eggert and Schjelderup, 2003; Wellisch, 2004) The present analysis allows one to highlight the specific effect that formula apportionment has on R&D activities. MNEs are incentivized to react less by some marginal shifting of R&D activities. They rather choose to relocate complete R&D activities. The incentive to relocate can be measured by the resulting decrease Δ in the MNE's aggregate tax payment. Subtracting the tax to be paid after relocating from the tax to be paid before relocating yields $\Delta = \frac{2}{3}(T - t)(f + F - C)$. The incentive to relocate increases in the tax gap and in the MNE's aggregate profit.

Proposition 8: The positive side of formula apportionment is management neutrality. The negative side is that it sets incentives to relocate complete R&D activities to low-tax countries. A measure of the incentive is $\Delta = \frac{2}{3}(T - t)(f + F - C)$.

Formula apportionment can be understood as the attempt to fairly divide the MNE's taxable profit among all those countries in which the MNE is active. As $0 < (1 - \lambda)B^c = \frac{1}{3}f - \frac{1}{3} \frac{f}{F+f}C < f/2$, the division is not only equitable in the weak sense but even in the sense of Shapley. However, the comparison with the Shapely value shows that two specific features of formula apportionment are debatable. One is the choice of weighting which is totally ad hoc. The other is the dependence on costs. The higher the cost incurred, the larger is the share of the consolidated tax base B^c allocated to this country. To be convincing, such a feature requires a monotone relationship between profit and cost. This is however not supported by empirical evidence. Quite to the contrary, in the digital economy the connection between the value of know-how and the cost of development is extremely loose.

7. Regulated profit splitting

Following Shapley, an equal split of the profit earned in the host country suggests itself as a kind of benchmark of distributive equity between the taxing countries. The benchmark draws attention to profit splitting with some arbitrary splitting parameter. Hence, let us analyze a regime in which some fixed share σ of the licensee's profit determined before royalty payments is allocated to the licensor in matters of taxation. We speak of *regulated profit splitting* (RPS) to stress the fact that σ is to be considered by the MNE as an exogenous parameter. The term profit splitting is meant to imply that σ is larger than zero and smaller than one. Profit splitting à la Shapley suggests setting $\frac{1}{2} < \sigma < 1$. We speak of *source taxation* if $\sigma = 0$ and we speak of *residence taxation* if $\sigma = 1$. The return to know-how is taxed at source in the former case and it is taxed in the licensor's country of residence in the latter case.

7.1 The case of bundled ownership rights

Our analysis of RPS starts with the scenario in which the development of know-how and the holding of IP are bundled. In this case the sharing division's profit after tax is

$$\pi \equiv f(K) - R_i(K) - t(1 - \sigma)f(K) \quad (16)$$

and the developing division's profit after tax is

$$\Pi \equiv F(K) - C(K) + R_i(K) - T[F(K) - C(K) + \sigma f(K)]. \quad (17)$$

Management neutrality holds. Divisions may maximize their own profits taking the non-lump-sum payment R_i as given or the MNE may maximize joint profits. In both cases, the optimal choice of know-how denoted by \bar{K}_σ^b is a solution of the same first-order condition:

$$(1 - T)[f' + F' - C'] = -(T - t)(1 - \sigma)f' \quad (18)$$

Implicit differentiation reveals that optimal know-how decreases in σ if, and only if, $T > t$. For this and the following statements see Appendix A. For $\sigma = 1$ eq. (18) implies $F' + f' = C'$. Residence taxation sustains internal efficiency as all returns to R&D are taxed at the same rate as the costs are deducted. Internal efficiency is not obtained when $\sigma < 1$. Optimal know-how exceeds the internally efficient level, $\bar{K}_\sigma^b > K_i^*$, if $T > t$ and it falls short of the internally efficient level if $T < t$. External efficiency requires a negative right-hand side of eq. (18) which only holds when the home country is the high-tax country, $T > t$. The development of know-how is then effectively subsidized. As there is no connection between $(T - t)(1 - \sigma)f'$ and $(1 - T)E'$ the subsidy can well be too weak or too strong in terms of external efficiency. For later reference, we note that the home country's tax base $F - C + \sigma f$ increases in σ for all values of σ if $T > t$ and for values of σ close to one only if $T < t$. Proposition 9 includes a comparison with results derived in Section 4.1.

Proposition 9: RPS is management neutral. If the developing division is the licensor of know-how, distributive equity is secured. The efficiency effects are as follows:

- (i) If home is a low-tax country, know-how is inefficiently low and less efficient than under the governing tax law. The home country's tax base increases in σ for sufficiently large values of σ .
- (ii) If home is a high-tax country, know-how exceeds the internally efficient quantity but falls short of the quantity developed under the governing tax law. The home country's tax base increases in σ .

7.2 The case of unbundled ownership rights

If it is possible to unbundle the development of R&D and the holding of IP, the MNE will be incentivized to locate R&D in the high-tax country and to shift the holding of IP to the low-tax country. The latter's tax base then is $b = f + \sigma(F - C) > f$ which is not compatible with distributive equity. Assume $T > t$ as the incentive to unbundle does not exist, otherwise. Maximizing the divisions' joint profit,

$$\pi + \Pi = f - t[f + \sigma(F - C)] + F - C - T(1 - \sigma)(F - C), \quad (19)$$

yields

$$(1 - \tau)[F' - C'] = -(1 - t)f' \quad (20)$$

where $\tau \equiv \sigma t + (1 - \sigma)T$ is the weighted average tax rate. Let \bar{K}_σ^u solve the first-order condition (20). \bar{K}_σ^u decreases in σ as is shown in Appendix A. As $\sigma = 1$ implies internal efficiency, we obtain $\bar{K}_\sigma^u > K_i^*$ for $\sigma < 1$. For later reference, we note that the home country's tax base $(1 - \sigma)(F - C)$ decreases in σ for σ close to one. Again, see Appendix A.

The incentive to unbundle can be measured by the resulting decrease Δ in the MNE's aggregate tax payment. Subtracting $t[f + \sigma(F - C)] + T(1 - \sigma)(F - C)$ from $t(1 - \sigma)f + T[F - C + \sigma f]$ yields $\Delta = \sigma(T - t)(f + F - C)$. The incentive to unbundle increases in σ , in the tax gap, and in the MNE's aggregate profit.

Proposition 10: If unbundling is feasible, the MNE is incentivized to shift the holding of IP to the low-tax country. The incentive to unbundle is measured by $\Delta = \sigma(T - t)(f + F - C)$. Optimal know-how exceeds the internally efficient quantity

and distribute equity is infringed. The home country's tax base decreases in σ for sufficiently large value of σ .

7.3 Implementing regulated profit splitting

If RPS is to be a realistic policy option, it has to offer convincing solutions in scenarios which are not just as simple as the one which has been analyzed so far. In this section, we choose to have a short look at less simple scenarios. In the first one we assume that know-how is developed in $n > 1$ home countries and that profit f is generated in one host country. As already mentioned in section 3.2, the Shapley value suggests a tax base b_n for the host country which is positive but not larger than $f/(n + 1)$. This suggestion could give reason to think about searching for a special splitting formula complying with the noted constraints. The point to be stressed is that any such splitting formula will have to depend on the number of cooperating countries. Even more, the division only sharing know-how has to be treated as an entity held jointly by all the divisions supplying know-how. This requires some form of unitary taxation as CCCTB does. Unitary taxation is however restricted to the sharing division's profit f . It does not extend to the MNE's profit $f + F - C$ as it does under CCCTB. In this respect, RPS is more like the Comparable Profits Method (CPM). It, however, deviates from the CPM in that it is no transactional transfer pricing method. No attempt is made to split the profit from some controlled transactions between associated divisions. The object of splitting is the sharing division's overall profit determined before royalty payments.

This clarifying remark draws attention to questions surrounding the determination of taxable income. A particular issue is raised when licensed know-how is not the sole source of profit. Just for the sake of being more specific, let us assume that output $f = f(l)$ is a natural resource which has to be extracted at increasing cost $w(l)$. If supplied know-how K helps to reduce the cost $w(l) = w(l, K)$ of extraction, splitting the full profit $\pi(K) \equiv \max[f(l) - w(l, K)]$ does not seem appropriate. The share of profit attributable to the licensed know-how is $\pi(K) - \pi(0)$ and not more. The remaining share of profit, $\pi(0)$, is attributable to the scarcity of the resource which is ideally determined by applying arm's pricing methods. In practice, the separation may well raise problems. In theory, things are, however, clear. The rule should be that profit earned with a rival factor like a natural resource or land is allocated to the division using the factor and the determination has to rely on arm's length pricing

methods. Only the residual profit which cannot be explained by the use of rival factors is rightly attributed to know-how and subjected to RPS.

7.4 Regulated profit splitting with crediting?

One could think about combing RGS with crediting.⁵ In such a regime, the right of taxing profit earned with IP would principally be allocated to the country in which IP is held. The profit earned with licensed know-how in another country would, however, be split and the tax paid by the licensee in his country of residence would be credited against the licensor's liable tax. In the scenario in which the licensor is the developing division, the profit of the sharing division would be as in eq. (16). The developing division's profit would, however, differ from eq. (17). It would change to

$$\Pi \equiv F - C + R_i - T[f + F - C] + t(1 - \sigma)f. \quad (21)$$

The obvious appeal of RPS with crediting is that it does not only sustain distributive equity but also internal efficiency when ownership rights are bundled. The caveat is that the incentive to unbundle is strong. It is measured by $\Delta = (T - t)(f + F - C)$ which exceeds the level without crediting and also the level under the governing tax law. Unbundling would not, however, impede efficiency. Internal efficiency is equally sustained when ownership rights are unbundled. However, distributive equity can be jeopardized as is easily shown. With unbundling we obtain

$$g = t[f + F + C] - T(1 - \sigma)(F - C). \quad (22)$$

$g < tf$ requires $t < (1 - \sigma)T$ and $g > 0$ requires $tf > [(1 - \sigma)T - t](F - C)$. Hence, much depends on the individual case whether $0 < g < tf$ holds or not.

Proposition 11: If RPS is combined with crediting, internal efficiency is sustained. Distributive equity holds when ownership rights are bundled. The incentive to unbundle is measured by $\Delta = (T - t)(f + F - C)$.

⁵ This suggestion has been made by Ulrich Schreiber in a private communication.

8. The options of reform in comparison

The great strength of the governing tax law lies in management neutrality. A two-book system allows a MNE to minimize tax payments without compromising on management neutrality (Proposition 2). Some strength can even be claimed with regard to efficiency if the distortionary effect of the corporate income tax on capital is ignored. In this paper this distortion has been ignored not only for the sake of simplicity. In practice, MNEs have means such as internal debt finance which help to attenuate the distortion. And in theory, Auerbach and Devereux (2015) have made a proposal promising to eliminate the distortion completely. It therefore appears to be a defensible research strategy to ignore the distortionary effect which taxation has on capital when analyzing the taxation of IP. As shown, the governing tax law has some favorable efficiency effects in the development of know-how (Propositions 3 and 4). The development is either internally efficient or effectively subsidized. Effective subsidization results when the home country is a high-tax country and when ownership rights are bundled. It can be defended by the need to internalize local external effects exerted by the development of know-how. The great caveat to the governing tax law is distributive equity. The favorable efficiency effects are achieved at the cost of an extremely uneven distribution of taxable profit. The low-tax country tends to tax a larger share of the MNE's aggregate profit than can be justified by equity considerations. This is more and more the source of policy concerns.

Fuest and co-authors (2013) have recommended to extend source taxation and to impose a creditable withholding tax on royalty payments. The positive effect would be that distributive equity is restored in the scenario in which the host country is a high-tax country (Proposition 3). A withholding tax would however be no convincing solution for the scenarios in which the home country is the high-tax country. Either ownership rights are bundled with the result that sizable royalties liable to the withholding tax are not collected. Or ownership rights are unbundled and the realistic need of a withholding tax to be creditable up to the amount of tax due ("limited crediting") impedes an equitable distribution of taxable profit. A critical property of the withholding tax is that it is only levied on reported royalty payments.

Fuest and co-authors (2013) also discuss residence taxation. However, distributive equity is fundamentally violated if the returns to know-how are taxed exclusively in the country in which either the developer or the owner of property rights is resident. This is also a major caveat to the Destination-Based Cash-Flow Tax (DBCFT) proposed by Auerbach and

Devereux (2015). The DBCFT is equivalent to a tax on the pure profits received by domestic residents.

In this paper, three options for reforming the governing tax law have been analyzed in detail. These options are: (i) a one-book system, (ii) the Common Consolidated Corporate Tax Base (CCCTB) with formula apportionment, and (iii) Regulated Profit Splitting (RPS). The option which at a closer look is least convincing is arguably the one-book system. The system does not sustain management neutrality. It has merits if MNEs stick to decentralized management (Proposition 6). Governments cannot, however, enforce decentralized management. The wish to minimize tax payments gives the MNEs an incentive to centralize. The effects on distributive equity and efficiency are ambiguous in general (Proposition 7). Distributive equity is secured only if the managerial cost of centralization is sufficiently high. As such costs are difficult to quantify, little can be said about the welfare effects of a one-book system. It is discarded in the subsequent discussion.

The remaining options – CCCTB and RPS – are management neutral as is the two-book system. With regard to distributive equity, there are reasons to prefer CCCTB over RPS and the latter over the governing tax law. This is so as the CCCTB is perfectly compatible with distributive equity while the alternatives are not so in each scenario analyzed. The alternatives are not compatible with distributive equity when unbundling cannot be stopped. RPS however ranks higher than the governing tax law as it secures distributive equity in all scenarios with bundled ownership rights. This is not the case under the governing tax law.

Efficiency considerations do not confirm this ranking. The caveat to CCCTB is that formula apportionment sets incentives to relocate complete R&D activities to low-tax countries (Proposition 8) while the alternatives set incentives to unbundle. As relocation affects the real economy while unbundling only government finances, CCCTB is ranked below the alternatives on efficiency grounds. A relocation of R&D is a serious threat to high-tax countries. The threat is not only to lose the activity as such but also the external benefits exerted by R&D. In what follows, we therefore discard CCCTB and we focus on the comparison of RPS with the governing tax law.

If home is a high-tax country, both RPS and the governing tax law sustain R&D at a quantity which reaches the internally efficient amount or even more. In view of the external benefits of R&D some overshooting may well enhance external efficiency. As the kind of effective

subsidization is not targeted, it is, however, difficult to say whether RPS or the governing tax law is to be preferred on efficiency grounds.

This is a bit different if home is a low-tax country. In this case, the governing tax law sustains internal efficiency (Proposition 3). By contrast, RPS without crediting sustains too little R&D and only the combination with crediting is able to sustain internal efficiency (Propositions 9 and 11). This might give reason to prefer the governing tax law. However, we like to argue the converse. We justify this by focusing on the scenario with $T > t$.

There is both a theoretical and an empirical reason to focus on the scenario in which the high-tax country is the one developing know-how. The theoretical reason is that the deductibility of costs provides an incentive to locate R&D activity in a high-tax country. *Ceteris paribus*, it diminishes expected tax payments. The empirical reason is that countries with strong R&D activity tend to be high-tax countries. The top recipients of royalty payments – notably the United States and Japan – are high-tax countries. (The top fifteen recipients of royalty payments in 2012 are listed in Dudar et al., 2015.) If we therefore discard the scenario characterized by $T < t$, no reason is left to prefer the governing tax law over RPS on efficiency grounds. More can be said when taking the perspective of the high-tax country's tax authority.

Revenue effects are largely in favor of RPS. (The comparison of revenue effects ignores behavioral reactions.) If ownership rights are bundled, revenue is $T[F - C]$ under the governing tax law. Under RPS without crediting the revenue increases to $T[F - C + \sigma f]$ and it increases even more to $T[f + F - C] - t(1 - \sigma)f = T[F - C + \sigma f] + (T - t)f$ when RGS is combined with crediting. The comparison is a bit ambiguous if ownership rights are unbundled. The revenue then is $w[F - C]$ under the governing tax law and it is $T(1 - \sigma)(F - C)$ under RPS with or without crediting. The governing tax law can therefore be more advantageous if w is large relative to $(1 - \sigma)T$.

The comparison of revenue effects draws attention to the incentive to unbundle ownership rights. The incentive is measured by $\Delta = (T - t)(F - C)$ under the governing tax law (Proposition 4). This incentive is even increased if RPS is instituted and combined with crediting (Proposition 11). It is, however, decreased if RPS is without crediting and if f is smaller than $(F - C)(1 - \sigma)/\sigma$. See Proposition 10. In Appendix B it is argued that the probability of unbundling decreases along with the incentive. It is shown that *expected* revenue is larger under RPS without crediting if f is smaller than $(F - C)(1 - \sigma)/\sigma$ and if

behavioral reactions are ignored. For $\sigma = 1/2$ the inequality means that more profit is earned at home than abroad.

Any plea in favor of RPS requires specifying σ . Equity considerations à la Shapley suggest setting $\sigma \geq 1/2$. A high-tax country hosting R&D, however, faces a trade-off when pleading for a specific value of σ . A large value is positive as it increases the home tax base $F - C + \sigma f$, if ownership rights remain bundled. It is, however, negative as it increases the incentive to unbundle, $\Delta = \sigma(T - t)(f + F - C)$.

Because of this trade-off, one might be optimistic that policy negotiations on the choice of σ are less contentious than other fundamental reforms of international taxation. However, much depends on the relevance of unbundling. If the migration of unbundled ownership rights can easily be stopped by means of an exit tax, high-tax countries with strong R&D activity unambiguously favor a high value of σ . The higher σ is, the larger is the share of the returns to own R&D which are earned abroad and taxed at home. High-tax countries have even reason to favor RPS with crediting as it further increases tax revenue. With regard to σ , low-tax countries with weak R&D activity have opposed interests. They favor a small value of σ if unbundling is effectively stopped. And they favor a large value in the scenario characterized by unbundling.

9. Summary and concluding remarks

Pricing the transfer of IP is one of the challenging tasks in the field of international taxation. The task is challenging because an undisputed method of pricing does neither exist in theory nor in practice. MNEs take advantage of any leeway in pricing IP to minimize tax payments. Low effective tax rates and an unequal distribution of the tax base across countries are of increasing public concern worldwide. The development has triggered the OECD to launch its BEPS initiative. In our view, the Action Plan on BEPS is, however, no convincing answer to the question of pricing IP. The reason is that the OECD aims at taxing the returns to R&D in accordance with value creation. Because of lacking rivalry in use, the location in which value is created by R&D is, however, fundamentally ambiguous.

This paper discusses proposals made to overcome the problems raised by the governing tax law. It is argued that the return to levying a withholding tax on royalty payments as suggested by Fuest et al. (2013) does not solve the problems in all relevant scenarios. Neither does a

switch to a one-book system (Desai et al. 2011). A one-book system moderates tax planning without eliminating it. The welfare effects are ambiguous. A strict enforcement of residence taxation as is part of the proposal of Auerbach et al. (2015) fails to be fair from the perspective of the countries in which profit is earned with licensed know-how. On the other hand, residence taxation sustains global efficiency.

A trade-off between equity and efficiency is also reflected in the discussion of the two tax systems which are analyzed in this paper as alternatives to the governing tax law. The two systems are the CCCTB and RPS. It is argued that on equity grounds CCCTB dominates RPS and RPS dominates the governing tax law. On efficiency grounds the ranking is rather reversed. CCCTB is dominated by the governing tax law and RPS as the latter two regimes set no incentive to shift R&D to low-tax countries. A comparison of RPS with the governing tax law is difficult on efficiency grounds. If the high-tax country is the one hosting R&D, it is not clear which regime deserves to be given preference.

However, a high-tax country hosting R&D has reason to favor RPS with regard to revenue effects. When ownership rights are bundled more revenue is collected under RPS. When ownership rights are unbundled, only a large withholding tax rate could reverse this ranking.

A plea for RPS has to discuss the choice of the parameter by which the profit earned with licensed know-how is to be split for the purpose of taxation. It has been argued that an equal split is a kind of benchmark of distributive equity. Reasoning à la Shapley does not, however, confirm the perfect split without qualification. The qualification is that it may be justified to apportion more than half of the profit – though not all profit – to the country providing know-how. A high-tax country with strong R&D activity has reason to favor a high splitting parameter with regard to the revenue to be collected from taxation. If unbundling of ownership rights cannot be stopped, there are however opposing effects to be considered. Hence, one might be optimistic that policy negotiations on the choice of the splitting parameter are less contentious than other fundamental international tax reforms.

RPS is clearly no ideal solution to the problem of taxing R&D activities. It however deserves a closer consideration than it has so far received in the literature. RPS promises a more equitable distribution of taxable profit across countries. And the incentive to unbundle may diminish. That is the case if, for example, the profit earned with licensed know-how is lower abroad than at home, if the profit earned abroad is equally split, and if RPS is not combined with crediting.

One cannot finish such an analysis without stressing the theoretical nature of the obtained results. They rely on a whole array of simplifying assumptions suggesting caution when deriving policy recommendations. The following two sets of simplifying assumptions deserve to be stressed more than others. The first one relates to the paper's model of a MNE. The production of goods with input choices of capital and labor has not been modelled. The sole focus has been on the development of know-how. The specification of costs is ad hoc. This does not only hold for the cost of R&D. The same holds for the managerial cost of management. The second set of simplifying assumptions relates to taxation. The cost of R&D has been assumed to be tax deductible. In practice, this need not be the case. It is clearly not the case when R&D is financed with equity. Even if R&D only requires labor, incomplete tax deductibility may be a problem. This is so for the following reason. Know-how has to be developed by humans who tend to be highly skilled employees and who need to be incentivized and compensated for the effort caused by R&D activities. Equity-based forms of compensation are more and more used so that the non-deductibility of costs of R&D becomes an issue (Griffith and Miller, 2014). Finally, taxes have been modeled to only differ internationally with respect to rates. Preferential tax provisions for R&D such as patent boxes and cost subsidies which are widely granted in practice have not been modeled. For details of the practice see Evers et al., 2015. Future research will have to explore the implications of removing all such simplifications.

10. Appendix A

Implicit differentiation of eq. (18) yields

$$\frac{d}{d\sigma} \bar{K}_\sigma^b = \frac{(T-t)f'}{(1-T)[F''-C''+(1-\tau)f'']} < 0 \iff T > t$$

where $\tau \equiv (1-\sigma)t + \sigma T < 1$. By rearranging terms, eq. (18) can be written as

$$(1-T)[F' - C' + \sigma f'] = -(1-t)(1-\sigma)f'. \quad (18')$$

As the right-hand side of eq. (18') is negative for $\sigma < 1$, so is the bracketed expression on the right-hand side of the following equation:

$$\frac{d}{d\sigma} [F - C + \sigma f] = f + [F' - C' + \sigma f'] \frac{d}{d\sigma} \bar{K}_\sigma^b. \quad (23)$$

The right-hand side of eq. (23) is therefore positive for all values of σ when $T > t$. By contrast, when $T < t$, the right-hand side of eq. (23) is only positive for values of σ close to one.

Eq. (20) implies $F' - C' < 0$. As $T > t$, implicit differentiation of eq. (20) yields

$$\frac{d}{d\sigma} \bar{K}_\sigma^u = -\frac{(T-t)[F'-C']}{(1-\tau)[F''-C'']+(1-t)f''} < 0. \text{ Hence,}$$

$$\frac{d}{d\sigma} (1-\sigma)(F-C) = -(F-C) + (1-\sigma)(F'-C') \frac{d}{d\sigma} \bar{K}_\sigma^u < 0 \text{ at } \sigma = 1.$$

11. Appendix B

Under the governing tax law, the MNE pays taxes $G_0^b = tf + T(F - C)$ when bundling and $G_0^u = t[f + F - C]$ when unbundling. Let p_0 be the probability that the MNE decides to unbundle under the governing tax law. Expected tax payment is $\bar{G}_0 = tf + [p_0 t + (1 - p_0)T](G - C)$.

Under regulated profit splitting, the MNE pays taxes $G_{RPS}^b = t(1 - \sigma)f + T(F - C + \sigma f)$ when bundling and $G_{RPS}^u = t[f + \sigma(F - C)] + T(1 - \sigma)(F - C)$ when unbundling. Let p_{RGS} be the probability that the MNE chooses to unbundle under RGS. Expected tax payment is $\bar{G}_{RGS} = tf + T(F - C) - [p_{RGS}(F - C) - (1 - p_{RGS})f]\sigma(T - t)$.

Assume $T > t$ and $f < \frac{1-\sigma}{\sigma}(F - C)$ with $\sigma \in (0,1)$. The incentive to unbundle is then stronger under the governing tax law. Hence, it is plausible to assume $p_0 > p_{RGS}$. Given these assumptions and ignoring behavioral reactions, the expected tax revenue is larger under RGS. This is shown by verifying the inequality on the right-hand side:

$$\bar{G}_{RGS} > \bar{G}_0 \Leftrightarrow p_0(T - t)(G - C) > [p_{RGS}(F - C) - (1 - p_{RGS})f]\sigma(T - t).$$

12. References

Alstadsaeter, Annette; Barrios, Salvador; Nicodeme, Gaetan; Skonieczna, Agnieszka M. (2015): Patent Boxes Design, Patents Location and Local R&D, European Commission, Working Paper N. 57-2015.

Auerbach, Alan J.; Devereux, Michael P. (2015): Cash-Flow Taxes in an International Setting, University of California Berkley and Oxford University, Discussion Paper

Avi-Yonah, Reuven S.; Clausing, Kimberly A.; Durst, Michael C. (2009): Allocation Business Profits for Tax Purposes: A Proposal to Adopt a Formulary Profit Split, *Florida Tax Review* 9, 497 – 553.

Beer, Sebastian; Loeprick, Jan (2015): Profit Shifting: Drivers of Transfer (Mis)Pricing and the Potential of Countermeasures, *International Tax and Public Finance* 22, 426–451.

Boos, Monica (2003): *International Transfer Pricing: The Valuation of Intangible Assets*, The Hague.

Bräutigam, Rainer; Spengel, Christoph; Streif, Frank (2015): Decline of CFC Rules and Rise of IP Boxes: How the ECJ Affects Tax Competition and Economic Distortions in Europe, ZEW Discussion Paper No. 15-055.

Commission Expert Group on Taxation of the Digital Economy (2014), Final Report, 28 May, Brussels.

Desai, Mihir A.; Dharmapala, Dhammika (2011): An Alternative Transfer Pricing Norm, Working Paper, Harvard Business School and University of Illinois at Urbana-Champaign.

Devereux, Michael P. (2004): Debating Proposed Reforms of the Taxation of Corporate Income in the European Union, *International Tax and Public Finance*, 71–89.

Dharmapala, Dhammika (2014): What Do We Know about Base Erosion and Profit Splitting? A review of the Empirical Literature, *Fiscal Studies* 35, 421–448.

Dischinger, Matthias; Riedel, Nadine (2011): Corporate Taxes, Profit Shifting and the Location of Intangibles within Multinational Firms, *Journal of Public Economics* 95, 691–707.

Dudar, Olena; Spengel, Christoph; Voget, Johannes (2015): The Impact of Taxes on Bilateral Royalty Flows, ZEW Discussion Paper No. 15-052.

Eggert, Wolfgang; Schjedelrup, Guttorm (2003): Symmetric Tax Competition under Formula Apportionment, *Journal of Public Economic Theory* 5, 439-446.

Enders, Dieter; Spengel, Christoph (2015): *International Company Taxation and Tax Planning*, eds., Kluwer Law International.

European Commission (2011): *Proposal for a Council Directive on a Common Consolidated Corporate Tax Base (CCCTB)*, Brussels, COM(2011) 121/4.

European Commission (2015): *A Fair and Efficient Corporate Tax System in the European Union: 5 Key Areas for Action*, Brussels, COM(2015) 302 final.

Evers, Lisa; Spengel, Christoph (2014): *Effective Tax Rates under IP Tax Planning*, ZEW Discussion Paper No. 14-111.

Evers, Lisa; Miller, Helen; Spengel, Christoph (2015): *Intellectual Property Box Regimes: Effective Tax Rates and Tax Policy Considerations*, *International Tax and Public Finance* 22, 502-330.

Fuest, Clemens (2008): *The European Commission's Proposal for a Common Consolidated Corporate Tax Base*, *Oxford Review of Economic Policy* 24, 720-739.

Fuest, Clemens; Spengel, Christoph; Finke, Katharina; Heckemeyer, Jost; Nusser, Hannah (2013): *Profit Shifting and 'Aggressive' Tax Planning by Multinational Firms: Issues and Options for Reform*, *World Tax Journal* 5, 307-324.

Goldscheider, Robert; Jarosz, John; Mulhern, Carla (2005): *Use of the 25% rule in valuing intellectual property*, in: *Intellectual Property: Valuation, Exploitation, and Infringement Damages*, Smith, Gordon V.; Parr, Russell L., eds., John Wiley and Sons, 410-426.

Gonnet, Sébastien; Fris, Pim (2007): *Contribution Analyses under the Profit Split Method*, *International Tax Review*.

Griffith, Rachel; Miller, Helen; O'Connell, Martin (2014): *Ownership of Intellectual Property and Corporate Taxation*, *Journal of Public Economics* 112, 12-23.

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

Haufler, Andreas; Mardan, Mohammed (2014): *Cross-Border Loss Offset Can Fuel Tax Competition*, *Journal of Economic Behavior & Organization* 106, 42-61.

Heckemeyer, Jost H.; Overesch, Michael (2013): Multinationals' Profit Response to Tax Differentials: Effect Size and Shifting Channels, ZEW Discussion Paper 13-045.

Hiemann, Moritz; Reichelstein, Stefan (2012): Transfer Pricing in Multinational Corporations: An Integrated Management- and Tax Perspective, in: Fundamentals in International Transfer Pricing in Law and Economics, Schön, Wolfgang; Konrad, Kai A., eds., MPIS Studies in Tax Law and Public Finance 1, Berlin and Heidelberg, 3–18.

Johnson, Nicole Bastian (2006): Divisional Performance Measurement and Transfer Pricing for Intangible Assets, *Review of Accounting Studies* 11, 339–365.

Karkinsky, Tom; Riedel, Nadine (2012): Corporate Taxation and the Choice of Patent Location within Multinational Firms, *Journal of International Economics* 88, 176–185.

Knoppe, Helmut (1972): Die Besteuerung der Lizenz- und Know-how-Verträge, Berlin.

McLure, Charles E. (1980): The State Corporate Income Tax: Lambs in Wolves' Clothing, in: *The Economics of Taxation*, Aaron, Henry J.; Boskin, Michael J., eds., Brookings Institution, Washington DC, 327-336.

Luckhaupt, Hagen; Overesch, Michael; Schreiber, Ulrich (2012): The OECD Approach to Transfer Pricing: A Critical Assessment and Proposal, in: *Fundamentals in International Transfer Pricing in Law and Economics*, Schön, Wolfgang; Konrad, Kai A., eds., MPIS Studies in Tax Law and Public Finance 1, Berlin and Heidelberg, 91–121

Mutti, John; Grubert, Harry (2009): The Effect of Taxes on Royalties and the Migration of Intangible Assets Abroad, in: *International Trade in Services and Intangibles in the Era of Globalization*, Reinsdorf, Marshall; Slaughter, Matthew J., eds., University of Chicago Press, 111–137.

Nielsen, Soren Bo (2014): Transfer Pricing: Roles and Regimes, *Journal of World Economy/Revista de Economia Mundial* 37, 103–122.

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

Parr, Russell L. (2013): Intellectual Property: Valuation, Exploitation and Infringement Damages, Cumulative Supplement, 11th Edition.

Riedel, Nadine (2014): Quantifying International Tax Avoidance: A Review of the Academic Literature, Paper Prepared for the European Tax Policy Forum, Ruhr-University of Bochum, mimeo.

Russo, Raffaele (2007): Fundamentals of International Tax Planning, IBFD, Amsterdam.

San Martín, Marta; Saracho, Ana I. (2010): Royalty licensing, *Economics Letters* 107, 284–287.

Shapley, Lloyd S. (1967): The “Value of the Game” as a Tool in Theoretical Economics, RAND RM P-3658.

Vögele, Alexander; Gonnet, Sébastien; Gottschling, Bastian (2008): Transfer Prices Determined by Game Theory: 2 – Application to IP, *Tax Planning Transfer Pricing International Journal (BNA)*, 11/08.

Wellisch, Dietmar (2003): Internationale Verrechnungspreismethoden, Neutralität und die Gewinne multinationaler Unternehmen, *Journal of Economics and Statistics (Jahrbuecher fuer Nationaloekonomie und Statistik)* 223, 332–359 and 464–478.

Wellisch, Dietmar (2004): Taxation under Formula Apportionment – Tax Competition, Tax Incidence, and the Choice of Apportionment Factors, *Finanzarchiv* 60, 24-41.