Aligning Profit Taxation with Value Creation\textsuperscript{1}

by

Wolfram F. Richter

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

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Abstract: The OECD seeks to align transfer pricing and profit taxation with value creation but fails to provide a clear definition. This paper argues that value creation requires international cooperation and that the profit tax base should therefore be allocated according to standards commonly considered as equitable when distributing the surplus of cooperation. The claim that current rules of international profit taxation are aligned with value creation is rejected. If anything, the OECD’s objective suggests a tax system in which profits are split between the involved jurisdictions. This result triggers the question of possible implementation which is discussed in some depth.

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Address: Wolfram F. Richter, TU Dortmund University, Department of Economics, 44221 Dortmund, Germany; Wolfram.Richter@tu-dortmund.de, phone: +49 231 755 3146.

\textsuperscript{1} There exist two related but obsolete papers written by the same author. One is titled “Taxing Intellectual Property in the Global Economy: A Plea for Regulated and Internationally Coordinated Profit Splitting” and can be found as CESifo WP 6564. The other is titled “Taxing Direct Sales of Digital Services: A Plea for Regulated and Internationally Coordinated Profit Splitting” and can be found as CESifo WP 7017.
1. Introduction

In 2013, OECD and G20 countries adopted a 15-point Action Plan to address base erosion and profit shifting (BEPS) in the taxation of multinational enterprises (MNEs). Among the fifteen Actions three were targeted to the objective to “align transfer pricing outcomes with value creation” (OECD, 2015). Despite the significance of the objective, a definition of “value creation” was not provided (Olbert et al., 2017). In a more recent study, the OECD (2018a) reveals a narrow understanding. Current rules are interpreted to mean that taxable value is only created through the economic activity of enterprises. User participation, public infrastructure, law enforcement and so forth are no acknowledged sources of value creation. A jurisdiction’s right of taxation is solely derived from the hosting of the taxed enterprise. There must be “nexus”. This is no longer undisputed, however, in its application to the digital economy (OECD, 2018a, 2019).

The international failure to clarify the concept of value creation has been used by various countries to stretch current standards of corporate income taxation and to invent new taxes with the alleged objective to address tax challenges raised by digitalization. Examples are given in Chap. 4 of OECD (2018a). The European Commission (2017, 2018), for instance, proposes to introduce a Digital Services Tax with the argument to tax services where the “main value” is claimed to be “created through user participation”. The ad-hoc character of the justification reveals the urgent need to clarify the meaning of value creation before it can be used in international tax policy.

The present paper contributes to clarification by drawing on cooperative game theory. It is argued that the design and enforcement of international taxation require the legal cooperation of jurisdictions. There would be no international value creation of MNEs if the countries in which the MNEs are active did not cooperate on legal issues. If this view is accepted, it, however, makes little sense to constrain the notion of value creation to the economic activity of enterprises. The ultimate source of value is international cooperation and the proceeds should be distributed according to standards commonly considered as fair and equitable when distributing the surplus of cooperation. At least, this should be the general rule to be overridden only in case of compelling reasons.

By drawing on cooperative game theory in general and on Shapley (1953) value theory, in particular, this paper argues that intercountry equity in taxation requires dividing the profit which an MNE earns in a foreign country between the countries involved. The existence of a permanent establishment should not be necessary for exercising the right of taxation. This
implication is a first indication that this paper’s terminological use of “profit splitting” differs from its traditional use. As a matter of fact, the use is much broader. Until recently, the OECD (2018b) has only accepted profit splitting as a method of transfer pricing in controlled transactions between affiliated companies when each one makes a “unique and valuable contribution”. In this paper, the companies need not be affiliated. The Shapley approach even suggests some further notable deviations from the current tax system. For instance, the prominent role of the residence and source principles in international taxation is questioned. Another implication is that expenditures made for the use of intellectual property should not be deductible under profit taxation which they presently are. All this shows that the implications for tax policy would be far-reaching if the OECD’s declared objective of aligning taxation with value creation were taken serious and given a consistent interpretation according to accepted principles of cooperative game theory.

The literature related to the present paper is sparse. As indicated, the notion of value creation is not firmly established in OECD publications. Olbert et al. (2017) speak of a “new paradigm” and a “new gold standard” and they criticize the OECD for introducing the concept without providing an agreed definition. Meantime, the OECD (2018a) has published an interim report on the tax challenges arising from digitalization which provides an in-depth analysis of value creation across different digitalized business models. However, an agreed definition is still missing. Olbert et al. (2019) make an attempt to conceptualize value creation within the existing framework of international taxation. Other than the present paper they find “no justification for introducing a new tax order for digital businesses.” Richter (2019) analyses the remote supply of digital business services and argues that profit splitting might result from tax competition between the countries exporting and importing such services.

The idea of drawing on cooperative game theory when pricing transfers is not new. The suggestion has before been made by Gonnet et al. (2007) and Vögele et al. (2008). These authors even mention Shapley-value theory as an appropriate framework when doing contribution analysis and applying the profit split method. However, they restrict the discussion to controlled transactions between affiliated enterprises which the present paper does not. Furthermore, they do not try to characterize the allocation of tax bases resulting from the application of Shapley-value theory.

The paper is structured as follows. Section 2 reinterprets Shapley’s axiomatic value theory in terms of the objective to align profit taxation with value creation. It is shown that aligning profit taxation with value creation suggests profit splitting. Section 3 contrasts the derived concept of profit splitting with current rules of taxation and with proposals made in the
literature for reforming these rules. Section 4 unfolds the implications of profit splitting when applied to profit earned on goods and services the production of which relies on inputs which are non-rival in use. Section 5 looks at questions of practical implementation. Section 6 deals with the case when production inputs are rival in use. Section 7 summarizes and concludes.

2. **Aligning profit taxation with value creation: An axiomatic approach**

The OECD seeks to align transfer pricing with value creation as the declared objective. A key problem of current standards of transfer pricing rules would be that “they can be misapplied so that they result in outcomes in which the allocation of profits is not aligned with the economic activity that produced the profits” (OECD 2015, p. 27). Unfortunately, the OECD has not exactly specified what it means that the allocation of profits is aligned with value creation. In this section, an axiomatic approach is used to fill the gap. The approach relies on two key assumptions. The first one is that profit and value can be set equal. The second one is that the ultimate source of international value creation lies in the interjurisdictional cooperation on legal issues such as market access, commercial law, taxation etc.

Let \( N = \{1, \ldots, n\} \) denote a collection of jurisdictions willing to cooperate on all relevant issues concerning profit taxation. The lower-case letter \( j \in N \) denotes a representative jurisdiction and the capital letter \( J \subseteq N \) denotes a subset of cooperating jurisdictions. Cooperation means that any MNE which is resident in one of the cooperating jurisdictions is allowed to carry out business in each cooperating jurisdiction and that the profit earned on such business is taxed according to a jointly agreed system of rules. The system which may reasonably be expected to be considered as fair and equitable is determined by way of axiomatization.

The object of axiomatization is the allocation of the (consolidated) profit an MNE earns when all jurisdictions cooperate. The proposed axiomatization allows for the fictitious case in which cooperation is constrained to a subset \( J \) of \( N \). Thus let \( \Pi(J) \) denote the MNE’s profit if its business were constrained to \( J \). \( \Pi = \{\Pi(J) | J \subseteq N\} \) is called a **profit pattern**. Mathematically speaking, it is a function mapping subsets of \( N \) to the real numbers, \( \mathbb{R} \). Let \( B = (B_1, \ldots, B_n) \in \mathbb{R}^n \) be an **allocation of tax bases**. In reduced form, a system of international profit taxation is a function assigning to each profit pattern a particular allocation of tax bases, \( B^\Pi = B(\Pi) \in \mathbb{R}^n \). The question to be answered by way of axiomatization is which properties (“desiderata” or “axioms”) the system should fulfill if it can reasonably be expected to be consented by the cooperating jurisdictions.
The first axiom is to account for the OECD’s declared objective that profit taxation should be aligned with value creation. In its weakest conceivable form this objective requires that a jurisdiction’s tax base should be zero if no profitable business is connected with this jurisdiction. In other words, the axiom stipulates no taxation without value creation:

\[ B_j^N = 0 \text{ if } \Pi(J \setminus j) = \Pi(J) \text{ for all constellations with } j \in J \subseteq N. \]

In this formula, \( J \setminus j \) is a short-form for the subset of jurisdictions obtained when removing \( j \) from \( J \). By similar misuse of notation, we shall write \( \Pi(1,2,\ldots) \) for \( \Pi(\{1,2,\ldots\}) \) further below.

Let us call \( \Pi(J) - \Pi(J \setminus j) \) the profit contributed by jurisdiction \( j \) when cooperating with the subset of jurisdictions \( J \setminus j \). According to axiom (i), the tax base of jurisdiction \( j \) should be zero if this jurisdiction’s profit contribution is never (strictly) positive.

The next two axioms (ii) and (iii) need no particular justification. It is difficult to argue against them. Axiom (ii) states that there should be no double taxation and that no profit should remain untaxed (“no white income”):

\[ \sum_{j=1}^{N} B_j^\Pi = \Pi(N) \text{ for all profit patterns } \Pi. \]

Axiom (iii) excludes (procedural) discrimination. No jurisdiction should be discriminated by the consented rules of taxation (“no discrimination”). The formal definition makes use of fictitious sequences \( \sigma: N \rightarrow N \) by which jurisdictions are thought to join the interjurisdictional cooperation. I.e., \( \sigma(j) \) is interpreted as the place in sequence \( \sigma \) by which \( j \) joins the cooperation of \( N \). In general, the profit contributed by \( j \) varies with \( \sigma \). Discrimination is excluded if the tax base allocated to jurisdiction \( j \) does not depend on the numbering in any particular sequence. To state this requirement in concise form, the following short-forms are used: \( \sigma(j) \equiv \{ \sigma(j): j \in J \} \), \( \sigma \Pi(J) \equiv \Pi(\sigma(J)) \) and \( \sigma B_j^\Pi \equiv B_{\sigma(j)}^\Pi \).

\[ \sigma B^\Pi = B_{\sigma}^\Pi \text{ for all sequences } \sigma \text{ and all profit patterns } \Pi. \]

The final axiom (iv) requires additivity of the assignment function, \( \Pi \mapsto B(\Pi) = B^\Pi \). It is best stated by using the following short-form: \( \Pi^1(J) + \Pi^2(J) \equiv (\Pi^1 + \Pi^2)(J) \). Additivity then requires

\[ B^{\Pi_1 + \Pi_2} = B^{\Pi_1} + B^{\Pi_2} \text{ for all profit patterns } \Pi_1, \Pi_2. \]

This is the axiom definitely requiring the most words of justification. And still, it is plausible and, above all, like axiom (i) closely related to the OECD’s objective to align profit taxation with value creation. Just consider the scenario in which an MNE extends its operations in a particular jurisdiction. All other jurisdictions are not affected by assumption. The wish to
align profit taxation with value creation suggests that only the tax base of this particular jurisdiction increases and not the tax bases of other jurisdictions. Additivity ensures this result.

**Theorem:** (Shapley, 1953): The only allocation of tax bases fulfilling axioms (i)-(iv) assigns to each jurisdiction $j$ the profit this jurisdiction contributes on average when joining the cooperation of all jurisdictions in a randomly chosen sequence.

According to the theorem, there exists an allocation of tax bases which is uniquely determined by the axioms (i)-(iv).\(^2\) Let this allocation be called the *Shapley allocation* best illustrated by a simple example featuring remote supply. In this example the considered firm is not multinational in the sense that it holds a permanent establishment in a foreign jurisdiction. It produces in just one jurisdiction called home, $h$. However, it not only services home but also a foreign jurisdiction indexed by $a$ (“abroad”). The following profit pattern features the scenario:

$$\Pi(h, a) > \Pi(h) > 0 = \Pi(a).$$

To derive the Shapley allocation, the theorem suggests determining the profits contributed by $a$ when it either ranks first or second in joining cooperation. With a probability of one half, the foreign country $a$ ranks first. It is as if it cooperated with an empty set of jurisdictions or as if it stood alone. By assumption, $a$’s profit contribution is zero in such a case. With an equal probability of one half abroad ranks second. It is as if abroad cooperated with home and $a$’s profit contribution were $\Pi(h, a) - \Pi(h)$. Hence, in the simple setting of remote supply, Shapley theory suggests that $a$ is allocated one half of the profit contributed when cooperating with home. In mathematical terms, this means $B_{a}^{ll} = [\Pi(h, a) - \Pi(h)]/2$. The other half of $\Pi(h, a) - \Pi(h)$ adds to the base taxed by home when staying alone, $B_{h}^{ll} = [\Pi(h, a) - \Pi(h)]/2 + \Pi(h) = [\Pi(h, a) - \Pi(a)]/2 + \Pi(h)/2$.

For a formal proof of the theorem see Shapley (1953). In the simple case of remote supply the proof is straightforward. To see this, it is convenient to work with two auxiliary profit patterns, $\Pi^{1}, \Pi^{2}$:

\(^2\) As a matter of fact, the original axiomatization suggested by Shapley (1953) looks a bit different. It has later been modified by several authors and the one presented has been chosen because it is particularly appropriate for interpretation.
$$\Pi^1(h) = \Pi^1(a) \equiv 0, \Pi^1(h, a) \equiv \Pi(h, a) - \Pi(h) > 0$$ and
$$\Pi^2(h) = \Pi^2(h, a) \equiv \Pi(h) > 0 \equiv \Pi^2(a).$$

The profit pattern featuring remote supply is obtained by summing up the two auxiliary profit patterns, $\Pi \equiv \Pi^1 + \Pi^2$. Axiom (iii) implies
$$B^n_h = B^n_a = [\Pi(h, a) - \Pi(h)]/2.$$
Axiom (i) implies $B^n_a = 0$. By (ii), $B^n_h = \Pi(h)$. Finally, additivity implies
$$B^n_a = B^n_a + B^n_a = [\Pi(h, a) - \Pi(h)]/2, \quad (1)$$
$$B^n_h = B^n_h + B^n_h = [\Pi(h, a) - \Pi(h)]/2 + \Pi(h), \quad (2)$$
which was to be shown. □

The equations (1) and (2) suggest a particular form of profit splitting. The profit contribution earned abroad is to be fairly divided between home and abroad. The splitting does not extend to the profit earned in home. Intuitively speaking, home is allocated the right to tax one half of $\Pi(h, a) - \Pi(h)$ because it hosts the MNE and abroad is allocated the right to tax the other half because it provides the market with its profit potential. In Section 5 it will be shown how to generalize this particular concept of profit splitting in order to cope with more complex scenarios.

3. Profit splitting in taxation

There are noteworthy differences separating profit splitting à la Shapley from the current system of international corporate income taxation. The current system assigns undivided rights of taxation to jurisdictions. For example, land is taxed at source and labor is taxed in the country of residence. Equally, business profit is taxed in the country of residence unless business is carried through a permanent establishment in another country. In short, there is a clear tendency to assign taxing rights to just one country.

The difference between the Shapley allocation of tax bases and the current system becomes particularly apparent in the taxation of remote supplies. The current system assigns the right of taxing the profit earned on such supplies exclusively to the seller’s country of residence. The resulting allocation is $B^n_a = 0$ and $B^n_h = \Pi(h, a)$ which distinctly deviates from the Shapley allocation. Hence, one or more of the stated axioms must be violated by the current
system of international taxation. As a matter of fact, it is additivity which is systematically violated. To see this clearly, consider the scenario in which the vendor of remote supplies extends its operations abroad while keeping those at home fixed. Under additivity, the resulting increase in profit is exclusively allocated to a while it is allocated to home under the current system of taxation. Things would be different if the firm would hold a permanent establishment abroad. The current system then prescribes a switch in taxation from residence to source. The example demonstrates that the current system is far from aligning profit taxation with value creation in the sense formalized in the preceding section. The current system makes the allocation of tax bases distinctly dependent on the existence of an acknowledged nexus. The Shapley approach and the derived concept of intercountry tax equity do not provide any justification for connecting the right of taxation with nexus.

Whether an MNE holds a permanent establishment in a jurisdiction should not be the relevant question. The question should rather be whether the MNE’s aggregate profit would decline if the jurisdiction did not cooperate.

Not only is the relevance of nexus questioned by the Shapley approach. The interjurisdictional distribution of costs and revenues is equally considered irrelevant. The only relevant distribution is the distribution of profit contributions. The Shapley approach therefore contrasts even with the most prominent proposals which have been made for reforming the current system of international corporate income taxation such as the destination-based cash flow tax (DBCFT) promoted by Auerbach and Devereux (2018), the Common Consolidated Corporate Tax Base (CCCTB) promoted by the European Commission (2011, 2015), and its sales-based version recommended by Avi-Yonah (1993) and Avi-Yonah et al. (2009). All these proposals share the characteristic feature that revenues are treated as a key indicator for allocating the aggregate profit tax base. This differs from the Shapley approach in which revenues play no particular role. Profit contribution is all that matters. The revenue-based proposals are justified by referring to the objective of either sustaining global efficiency (Auerbach and Devereux) or constraining the profit shifting activity of MNEs (CCCTB, Avi-Yonah). The present analysis shows that it is difficult to justify a revenue-based proposal if aligning profit taxation with value creation is the agreed policy objective.

It is not that profit splitting played no role in the OECD world. The OECD (2018), however, accepts profit splitting only as a method of transfer pricing in controlled transactions between firms when each one makes a “unique and valuable contribution”. The definition justified in the present paper by the recourse to Shapley value theory is much broader. It refers to
uncontrolled transactions and assumes \textit{inter alia} that even providing the access to a foreign market is value creating.

It is not more than a recent development that governments have agreed to examine profit splitting on a “without prejudice basis” as one of competing proposals to address the tax challenges arising from digitalization (OECD, 2019, p. 6). “Issues and options in connection with new profit allocation rules” are to be explored. One option explicitly mentioned is the “modified residual profit split method” which “would allocate to market jurisdictions a portion of an MNE group’s non-routine profit that reflects the value created in markets that is not recognised under the existing profit allocation rules” (OECD, 2019, p. 12). Notwithstanding this recent development, a puzzling question is why profit splitting has not been recognized before as a feasible profit allocation rule under the current tax system. Some tentative answers are as follows.

A first answer might be that current rules of international taxation are targeted at global production efficiency which favors residence taxation. The implicit assumption would be that efficiency could be considered a leading policy objective. Irrespective of whether this is a realistic hypothesis or not, it is disproved by the significant role which source taxation plays in the current system. More convincing answers to the puzzling question are as follows.

For instance, one might argue that there is no real need to achieve intercountry tax equity at the level of each \textit{particular} firm. Trade between countries is a reciprocal activity. Lacking intercountry tax equity in specific cases is overcome at the country level. If a country suffers disadvantages from undivided rights of taxation in some cases, it benefits in others. On balance, the undivided assignment of taxing rights allows achieving equity at the country level. This argument convinces even more in view of the informational problems which have to be solved when implementing profit splitting. If tax bases were defined in line with equations (1) and (2), one would have to determine the profit term $\Pi(h)$. This may not be straightforward as $\Pi(h)$ refers to the unobservable, counterfactual scenario of autarky. This objection can, however, be reversed. If profit splitting is seriously discussed in the context of digitalization, then this could have technological reasons. It might well be the case that the requirements for implementing profit splitting are more easily satisfied in the new economy than they are in the old economy.

To analyze this possibility in the following sections, three particular cases are studied more closely. The first one features production in the old economy. All inputs are rival in use so that the marginal cost of quantity is positive. An appropriate example would be food. Its
production relies on land, labor and capital which are all rival in use. For the sake of brevity the production where all inputs are rival in use is called rival production in what follows. The opposite is called non-rival production. In that case, all inputs are largely non-rival in use and the marginal cost of quantity is insignificant. An appropriate example is the production of digital services like the online placement of advertising. The cost of servicing additional customers is so low that it can be ignored (Commission Expert Group, 2014). The only significant cost comes from the development of service quality which is, however, fixed when producing quantity. Finally, there are mixed cases where the production of quantity relies on rival and non-rival inputs. Smartphones may serve as an appropriate example. Their production combines hardware which is rival in use with software which is non-rival in use. In what follows, it will be argued that the case for profit splitting is the strongest when production is non-rival. The discussion starts by unfolding the implications when the Shapley approach is applied to non-rival production.

4. Profit splitting when production of quantity is non-rival

If the marginal cost of quantity is zero for a service, the supplier must be able to exercise market power. Otherwise the service would not fetch a positive price allowing him or her to cover the fixed costs incurred by providing a service quality stimulating demand. Furthermore, the supplier must be able to restrict the use of the service by legal means such as trademarks or patents. I.e. the quality must be produced with particular knowhow which is patentable in some broad sense. In other words, the supplier must have acquired intellectual property or intangible assets before servicing the market. Terms like quality or (patentable) knowhow refer to the sphere of production whereas terms like intellectual property or intangible assets refer to the sphere of legal ownership. In what follows, all such notions are used interchangeably.

The focus is on an MNE having developed patented knowhow in a non-empty subset of the cooperating jurisdictions, $N$. It is assumed throughout that a patent is held in the same jurisdiction in which the underlying knowhow has been developed. The jurisdictions in which patents are held are called home and indexed by $h_j$ ($j = 1, \ldots, n$). The remaining jurisdictions are called abroad and indexed by $a_j$ ($j = 1, \ldots, m$). $H = \{h_j; j = 1, \ldots, n\}$ denotes the set of jurisdictions hosting patents while $A = \{a_j; j = 1, \ldots, m\}$ denotes the set of the remaining ones. Hence $N = H \cup A$. Shapley’s approach suggests focusing on a particular jurisdiction $j$ and determining the profit this jurisdiction contributes on average when cooperating with a
randomly selected set of other jurisdictions, \( J \setminus j \subseteq N \setminus j \). Obviously, two cases have to be analyzed separately. In one, \( j = h \) stands for a representative home jurisdiction and in the other, \( j = a \) stands for a representative foreign jurisdiction.

The first case to be looked at is \( j = h \). All patents held in home jurisdictions are assumed to be necessary for production. The Shapley approach to taxation then suggests treating all home jurisdictions equally, \( B_{h,j}^H = B_h^H \) for all \( j = 1, \ldots, n \). Differences in market size or differing costs in research and development do not provide relevant reasons for treating home jurisdictions differently. This statement may be unexpected, it, however, makes good sense once one thinks about it carefully. Even if a market is large, its size does not really matter if the servicing requires a patent the right of usage has not been acquired before. If this necessary patent is held in a small jurisdiction, the large one has no compelling reason to claim a higher share in the jointly created value. Both jurisdictions must cooperate when value is to be created. That is why the Shapley approach treats them equally.

**Proposition 1:**

(i) All jurisdictions in which patents are held are treated equally by the Shapley approach, \( B_{h,j}^H = B_h^H \) for all \( j = 1, \ldots, n \).

(ii) The tax base allocated to each of these jurisdictions exceeds an equal share of the profit earned when only home jurisdictions cooperate, \( B_h^H > \Pi(H)/n \). (3)

A formal proof goes as follows. Shapley’s theorem suggests focusing on profit contributions. The profit contributed by \( h \) is positive only if \( h \) cooperates with a set of jurisdictions including all remaining home jurisdictions, \( j \in H \setminus h \). As \( \Pi(H \cup J \setminus h) \) is zero for all \( J \subseteq A \), \( h \)’s profit contribution equals \( \Pi(H \cup J) \) which is the same value for all \( h \in H \). This proves statement (i). Assuming that business abroad is profitable, \( \Pi(H \cup J) \) must exceed \( \Pi(H) \) for all non-empty sets \( J \subseteq A \). If \( h \) is the last home jurisdiction which joins the cooperation of \( H \cup J \setminus h \), its profit contribution exceeds \( \Pi(H) \). The probability of the scenario in which \( h \) is the last home jurisdiction joining the cooperation of all other home jurisdictions equals \( 1/n \). Hence, \( B_h^H > \Pi(H)/n \). This is statement (ii).

Consider next a jurisdiction \( j = a \in A \) in which no patent is held. Such a jurisdiction only contributes positive profit when cooperating with a set of jurisdictions \( J \) including all home jurisdictions, \( H \subseteq J \). It has to be remembered that production is non-rival by assumption. The
only cost incurred comes from developing knowhow. As knowhow is not, however, developed in jurisdiction \( a \), the profit earned in that jurisdiction is revenue without cost, \( R^a > 0 \). This revenue does not, however, equal \( a \)’s profit contribution in the cooperation with \( J \). As shown in Appendix A, \( a \)’s profit contribution is positive but it may well be smaller than \( R^a \). The reason is that the expansion of business to jurisdiction \( a \) may impact the profit to be earned in jurisdictions \( J \setminus a \). Revenues from \( J \setminus a \) can go down when the market in \( a \) is serviced. Or sales in \( a \) may provide reason for the MNE to step up the costly development of knowhow in home jurisdictions. As a result,

\[
0 < \Pi(J) - \Pi(J \setminus a) \leq R^a \quad \text{when} \quad \subseteq J \subseteq H \cup A.
\]  

(4)

The difference between the revenues, \( R^a \), and the profit contributed by \( a \), i.e. \( \Pi(J) - \Pi(J \setminus a) \), is a \textit{business adjustment effect} on the distribution of profits, \( e^a = \epsilon^a(J \setminus a) \geq 0 \). It can be interpreted as an external effect exerted on the profit tax base of \( J \setminus a \) when the MNE adjusts its pricing strategy or the development of knowhow in reaction to expanded sales in jurisdiction \( a \).

According to Shapley’s theorem, \( a \)’s tax base \( B^H_a \) equals the profit jurisdiction \( a \) contributes \textit{on average} when cooperating with a randomly selected set of jurisdictions. As mentioned, a positive contribution can only be expected when \( a \) cooperates with a set of jurisdictions which includes all home jurisdictions. In Appendix B it is shown that the probability that \( a \) cooperates with such a set \( J \setminus a \), \( H \subseteq J \subseteq H \cup A \), equals \( 1/(n + 1) \) and that this probability is independent of the number \( m \) of elements in \( A \). Intuitively speaking, the reason is that \( n \) home jurisdictions plus jurisdiction \( a \) – i.e. \( n + 1 \) jurisdictions in total – must cooperate if a positive profit is to be contributed by \( a \). The number of jurisdictions counting as abroad is irrelevant.

\textit{Proposition 2}: The Shapley approach suggests that a jurisdiction \( a \) not used by an MNE for holding patents is allocated a positive tax base which does not exceed an equal share of the revenue which the MNE earns in \( a \) if that jurisdiction cooperates with all home jurisdictions:

\[
0 < B^H_a \leq R^a / (n + 1) .
\]

(5)

\( B^H_a \) is (strictly) positive as the servicing of jurisdiction \( a \) generates profitable business. The case that business in jurisdiction \( a \) is not profitable is not interesting and discarded by assumption.
The case in which all business adjustment effects on profit vanish, $\varepsilon^a = 0$, deserves special notice. Then

$$B_a^H = \frac{R^a}{(n + 1)},$$  \hspace{1cm} (6)

and $\Pi(H \cup J) = \Pi(H) + \sum_{a \in J} R^a$. Respecting Axiom (ii), one obtains

$$B_h^H = \frac{1}{n} \left[ \Pi(H \cup A) - \sum_{a \in A} B_a^H \right] = \frac{1}{n} \left[ \Pi(H) + \sum_{a \in A} (1 - \frac{1}{n+1}) R^a \right]$$

$$= \frac{1}{n} \Pi(H) + \frac{1}{n+1} \sum_{a \in A} R^a.$$ \hspace{1cm} (7)

According to eq. (7), home jurisdiction $h$ is allocated an equal share in all the profit contributions the generation of which requires the cooperation of $h$.

5. Implementing profit splitting when production is non-rival

Two reasons have been emphasized when trying to explain why the current system of international taxation does not rely on profit splitting and why it rather assigns undivided rights of taxation. One reason referred to the difficulty encountered when determining the profit contributed by a jurisdiction on average. The term, $\Pi(J) - \Pi(J \setminus j)$, is not directly observable, at least not in general. It is profit generated in a counterfactual situation. The other reason emphasized reciprocity in trade which renders the need dispensable to achieve intercountry tax equity at the firm level. Both reasons have to be qualified when production is non-rival as is a characteristic feature of the digital economy.

Implementing profit splitting raises no particular difficulty if all business adjustment effects on profit vanish, $\varepsilon^a = 0$. All items needed for allocating the profit tax base are then observable. The aggregate profit, $\Pi(H \cup A)$, is observable as are the revenues, $R^a$, in jurisdictions $a \in A$ and also $\Pi(H) = \Pi(H \cup A) - \sum_{a \in A} R^a$. This means that in scenarios characterized by $\varepsilon^a \equiv 0$ profit splitting raises no informational problem of implementation. All the information needed to determine the tax bases $B_j^H$, $j \in H \cup A$, in line with the equations (6) and (7) is observable, at least in principle.

One might speculate that non-rival production is particularly prone for insignificant business adjustment effects. The informational problem of implementation would vanish in this case. A priori, the business adjustment effects on profit cannot, however, be expected to be insignificant even not when production is non-rival. If the effects are significant, the average profit contribution of $j$ stops to be observable. Under such circumstances, the only practical
finding derived from the Shapley approach is that each jurisdiction should have the right of taxing an equitable share of the profit which is only earned if this jurisdiction cooperates. Expressed as a formula, this means that a jurisdiction not hosting a patent should have the right to tax

\[ B_a^n = \beta R^a / (n + 1) \]

with some \( \beta \in (0,1] \). (8)

The problem with this formula is that purely normative reasoning does not allow justifying any particular choice of \( \beta \). This means that the international community of governments would have to negotiate over the choice of the splitting parameter \( \beta \) to be applied in profit taxation.

One might hope to pin down \( \beta \) by resorting to bargaining theory. However, bargaining theory cannot solve the problem of lacking observability. This is easily seen when applying Nash’s (1950) bargaining solution to the simple example of remote supply discussed before. In this case, the Nash bargaining solution does not differ from Shapley’s value. The problem of lacking observability would not be solved by switching from Shapley to Nash. Both solution concepts suggest assigning the same tax base \( B_a^n = [\Pi(h,a) - \Pi(h)] / 2 \) to abroad. No additional information about \( \beta \) is obtained. The implementation of formula (8) therefore fails whenever the business adjustment effect, \( \epsilon^a \), is positive but not observable.

The current system of international taxation seeks intercountry tax equity at the country level. The need to achieve equitable taxation at the level of an individual enterprise is denied. The implicit assumption is that each jurisdiction takes the role of home in some cases and the role of abroad in others. Profit is taxed in the MNE’s home country of residence except for the profit contributions earned by permanent establishments in foreign countries. Those latter profit contributions are taxed at source. The Shapley approach suggests interpreting the simultaneous application of residence and source taxation as an imperfect attempt to achieve intercountry equity at the country level. The attempt is imperfect as one cannot expect that the roles of residence and source are uniformly distributed between countries. E.g., intercountry tax equity has long been questioned by developing countries in their relation to the developed world and a new debate is fueled by the expansion of the digital economy.

The digital economy is characterized by economies of scale and scope and there are often network externalities. In addition, spillover effects in research and development (R&D) bring about regional concentration. The emergence of regionally concentrated natural monopolies fosters growth from which the whole world benefits. It would only harm global efficiency if the same kind of digital service were supplied by independent producers or if digital R&D
were spread evenly throughout the world. For this and other reasons, achieving balanced trade in digital services is neither efficient nor competitively sustainable.

Investments in the digital economy can be highly profitable. In 2018, seven out of the ten most valuable firms worldwide made their money with digital business. They either reside in the U.S. or in China. Concern is widespread in Europe that profits earned in the digital economy are not effectively and fairly taxed (European Commission, 2017). The perception of lacking fairness is strengthened by the practice of MNEs to avoid taxes by profit shifting. Against this background, profit splitting promises increased fairness. At least, it is a form of international taxation deserving careful consideration by policy makers. It is quite obvious that the incentive of profit shifting is decreased when the return earned on knowhow in a foreign country is not exclusively taxed by a single country but jointly by all countries involved. The exclusive taxation in a single country provides strong incentives to hold patents in those countries where tax rates are low and to shift costs of R&D to those countries where tax rates are high. Governments feel the need to react by granting all kinds of preferential tax provisions for R&D. E.g., costs of R&D are subsidized and patent boxes are introduced to alleviate the taxes on income earned with intangible assets. In other words, the current tax system triggers various types of tax competition. Profit splitting is, by nature, more resilient to such policies. The taxes saved when patents are migrated from a high-tax to a low-tax country are reduced when some part of profit continues to be taxed in the high-tax country. This is why one may hope that international negotiations over the splitting parameter $\beta$ might not be as antagonistic as international negotiations over taxation rights usually tend to be (Richter, 2019). When pleading for a particular value of $\beta$, governments have to trade off two opposing effects. A low value of $\beta$ secures a large share in the taxable profit earned with hosted patents. By contrast, a high value of $\beta$ reduces the incentive of resident MNEs to migrate patents to a foreign low-tax country. The tax savings are reduced as the share of profit taxed in the low-tax country decreases in $\beta$.

6. Profit splitting when production of quantity is rival

Shapley-value theory does not provide any a-priori reason for taxing different sources of profit differently. The approach rather suggests treating all sources equally and splitting profit irrespective of whether it is earned from non-rival or rival production. To illustrate the implications of splitting for rival production, the scenario where a good is produced with land only is considered next. As before, home and abroad are serviced from home.
Let $L_h$ denote the fixed land endowment of home and let $L_a$ be the land endowment abroad. The land rents earned when home and abroad stay in autarky are denoted by $\bar{w}_h$ and $\bar{w}_a$, respectively. If the jurisdictions cooperate, those rents change. Let the changed rents be denoted by $w_h$ and $w_a$, respectively. If land is in abundant supply in a particular country, the price goes up in that country, while the price goes down in the opposite case. As land is in fixed supply, all income from land is lump-sum. For the landowner earned rent is (accounting) profit and for the user of land the paid rent is an (opportunity) cost. The tax base assigned to home by Shapley-value theory equals

$$B_{h}^{Sh} \equiv \bar{w}_h L_h + \frac{1}{2} [(w_h - \bar{w}_h)L_h + (w_a - \bar{w}_a)L_a]$$

(9)

while the current tax system implies

$$B_{h}^{c} \equiv w_h L_h.$$  

(10)

The Shapley allocation of tax bases may be considered as equitable in the sense that profit taxation is aligned with value creation. Such equity, however, has its cost. A first cost is informational. Taxation according to eq. (10) is obviously much simpler implemented than taxation according to eq. (9). The tax authority of home can implement the base (10) without relying on information which relates to the non-observable state of autarky, $\bar{w}_h$, or which must be supplied from abroad, $(w_a - \bar{w}_a)L_a$. Informational simplicity is a clear advantage. The need to achieve intercountry tax equity at the firm level is also less strong if goods are traded which are produced with rival inputs at constant returns to scale. Assuming trade in such goods to be balanced is not unrealistic. $B_{h}^{c}$ will exceed $B_{h}^{Sh}$ if profit is earned on a rival factor which is in abundant supply in home and the opposite will be the case if the factor is non-abundant. As a result, it is not clear whether a country gains on balance by moving to a Shapley allocation of profit-tax bases. An additional cost is incurred if the Shapley base apportionment is applied to rival factor income. An appropriate example is capital income. If home and abroad tax mobile capital at differing rates, there will be a cost in efficiency. The clear advantage of residence taxation is to avoid such allocational inefficiency. In summary, it is not clear whether the advantages exceed the disadvantages if the Shapley approach is extended to the taxation of income earned on rival factors of production. In what follows, it is assumed that the Shapley approach is not extended to such income.

Purely rival production and purely non-rival production are extreme cases. More relevant will be cases which are mixed in the sense that some factors are rival in use and others are non-rival. To cope with such mixed cases it is suggestive to reduce them to their pure components.
This is achieved by separating the profit contributions which are earned on rival factors from those earned on non-rival factors (“knowhow”). An unambiguous separation is theoretically possible if economic profit is interpreted as the return to knowhow. The implications are as follows.

Economic profit is defined as the balance of revenues, \( R \), and opportunity costs, \( C \). In the example with land sketched above economic profit is zero. Knowhow is no input and the rents, \( w_jL_j \) for \( j = h, a, \) have to be interpreted as the opportunity cost incurred when employing the rival factor land. The determination of opportunity costs relies on arm’s length pricing. The assumed existence of uncontrolled prices is certainly less problematic in the case of rival factor income than it is in the case of non-rival factor income. Knowhow is specific, by nature. In general, an uncontrolled price of the return will not exist. At most, the cost of development can be priced at arm’s length. By assumption, such cost is included in \( C \). Any royalties which may be paid for the right to use knowhow are no opportunity costs and hence not included in \( C \). They are treated as payments that should not be recognized in income tax assessment.

The discussion suggests the following allocation of taxing rights. (Accounting) profit attributable to rival factors of production is taxed in the jurisdiction incurring the opportunity cost of supply. This is very much in line with current rules. Land is taxed at source, labor is taxed in the supplier’s country of residence, and interest paid on debt is taxed in the lender’s country of residence. A discrepancy only exists for equity. Under current law, the return to equity is taxed where business is carried through and not necessarily where the supplier is resident. However, current law does not rely on separating the profit contributions earned on rival factors from those earned on knowhow. By contrast, the sketched approach would separate and it would apply profit splitting only to profit earned on knowhow.

7. Summary and conclusions

According to the OECD’s declared objective, profit taxation should be aligned with value creation. An agreed answer to the question of which activities create value is, however, not provided. In a publication of 2018, a narrow understanding is revealed (OECD, 2018a). Business activities are considered being the only source of value creation. The present paper argues that such a narrow understanding is unconvincing. The true source of value creation is the international cooperation of jurisdictions. An MNE earns taxable profit abroad only if the involved jurisdictions cooperate on legal issues such as market access, the rules of taxation,
and so forth. If this view is accepted and if profit taxation is to be aligned with value creation, then taxing rights should ideally be allocated according to standards commonly accepted as fair and equitable when distributing the surplus of cooperation. The Shapley value has been designed with the aim to determine an equitable distribution of the surplus generated by cooperation. This paper therefore applies Shapley-value theory to the question of how to apportion an MNE’s aggregate tax base among the jurisdictions in which the MNE is active. The axioms which uniquely characterize the Shapley value are interpreted and justified by reference to the objective to align profit taxation with value creation. Shapley-value theory is shown to imply that each jurisdiction is assigned the right to tax the profit that jurisdiction contributes on average when cooperating with a randomly selected subset of jurisdictions. This means that the profit contribution earned by an MNE in a particular jurisdiction should be split between all those jurisdictions whose cooperation is required for generating this profit. Hence, Shapley-value theory provides a firm normative framework for allocating an MNE’s profit tax base according to a rule not recognized by current international tax standards but certainly worth being considered “without prejudice” when addressing the tax challenges arising from digitalization (OECD, 2019, p. 6).

The theoretical implications of the Shapley approach for corporate income tax design have been unfolded in Sections 4 to 6 of this paper. The starting point is a classification of different sources of profit. (Accounting) profit can be the return to the employment of rival factors of production. Economic profit is, by contrast, assumed to be the exclusive return to non-rival factors in general, and patented knowhow, in particular. This assumption makes particular sense in connection with international corporate income taxation. The profitable exploitation of costly developed knowhow is considered to be the key driver of multinationalization in production. As stressed by Dunning (1979), the existence of knowhow is the primary reason why firms consider becoming multinational. By contrast, the wish to generate gains in the efficient use of rival factors of production cannot explain the emergence of MNEs. Therefore, it seems a defendable position to interpret economic profit as the return to patented knowhow.

To be clear, the profitable exploitation of knowhow is not claimed to be the only determinant of multinationalization but the complementary determinants captured by Dunning’s well-known OLI framework play no role in this paper’s analysis and are therefore disregarded.

In Section 6, it is argued that there are good reasons to restrict splitting to economic profit and not to extend splitting to income which has to be interpreted as the return to rival factors of production. This is so as the expected gains in intercountry tax equity derived from splitting the profit earned on rival inputs may well not be large enough to justify the increased cost of
information acquisition and the efficiency loss in the international allocation of those inputs. The return to rival factors should better be taxed only in the country incurring the opportunity cost. This is very much in line with current standards of international taxation. A discrepancy only exists with regard to equity capital. Under current law, the return to equity is taxed where business is carried through and not necessarily where the supplier of equity is resident.

Economic profit differs from accounting profit for various well-known reasons. The treatment of the return to equity as profit is just one reason. Another one is that royalties and other payments for the use of non-rival inputs are deductible items in tax accounting and that they should not be deductible items when determining economic profit. The opportunity cost of rival inputs is all which should be permitted as tax deduction when determining economic profit.

If the Shapley approach is applied to the taxation of economic profit, some noteworthy propositions are derived. A first one relates to the scenario in which an MNE holds one or more essential patents in more than just one jurisdiction. The approach suggests that all those jurisdictions should be allocated an identical share of the MNE’s aggregate profit tax base. Different market sizes and different costs of development should provide no reason to allocate different tax bases. The tax base allocated to the set of all patent hosting jurisdictions should, however, exceed the profit those jurisdictions would earn if they did not cooperate with those jurisdictions in which patents are not held. Instead, they should tax a share of the profit contribution earned with the MNE’s knowhow in jurisdictions in which patents are not held. On the other hand, a jurisdiction in which no patents are held should equally have the right to tax a share of the profit the MNE earns within that jurisdiction’s territory. Thus it is shown that the objective of aligning profit taxation with value creation suggests splitting the profit earned on patented knowhow between all those jurisdictions needed to generate that profit.

The weakness of the Shapley approach to international taxation is revealed when it comes to practical implementation of profit splitting. One would have to observe the effect on home profit being exerted when an MNE increases its production of knowhow in order to match business expansion abroad. If one reasonably assumes that such “external” effects are positive but not observable, the Shapley approach cannot be used to pin down a particular profit-splitting parameter. In the present paper, this parameter is modelled by $\beta \in (0,1]$. It is argued that governments would have to negotiate over the choice of $\beta$ to be applicable in international profit taxation. As governments have to trade off opposing effects when pleading for a particular value of $\beta$ one can, however, hope that such negotiations are not as
antagonistic as international negotiations over taxation rights usually are. No need to stress that this is a theoretical statement which like many others in this paper will have to be studied more intensively before it can be brought to bear in practical tax policy.

8. Appendices

Appendix A

Let $Q_h$ be the quantity of knowhow developed in home jurisdiction $h = 1, \ldots, n$. The development entails cost denoted by of $C_h(Q_h)$. Revenues are earned in each jurisdiction and denoted by of $R^j(Q_1, \ldots, Q_n)$ with $j \in H \cup A$. The revenue functions are monotone increasing and concave while the cost functions are monotone increasing and convex. Positive profit is earned only when all home jurisdictions cooperate.

\[
\Pi(H \cup J) = \max \{\sum_{j \in H \cup J} R^j(Q_1, \ldots, Q_n) - \sum_{h \in H} C_h(Q_h)\}
\]

\[
= \sum_{j \in H \cup J} R^j(Q_1^*, \ldots, Q_n^*) - \sum_{h \in H} C_h(Q_h^*)
\]

\[
\Pi(H \cup J \setminus a) = \max \{\sum_{j \in H \cup J \setminus a} R^j(Q_1, \ldots, Q_n) - \sum_{h \in H} C_h(Q_h)\}
\]

\[
= \sum_{j \in H \cup J \setminus a} R^j(Q_1^*, \ldots, Q_n^*) - \sum_{h \in H} C_h(Q_h^*)
\]

As $R^a$ is assumed to be positive, $\Pi(H \cup J)$ is strictly larger than $\Pi(H \cup J \setminus a)$.

A Taylor Series expansion yields

\[
0 < \Pi(H \cup J) - \Pi(H \cup J \setminus a) = R^a(Q_1^*, \ldots, Q_n^*) - \varepsilon^a
\]

with

\[
\varepsilon^a = \varepsilon^a(H \cup J \setminus a) = -\frac{1}{2} \sum_{j \in H \cup J \setminus a} \sum_{h,k \in H} (Q_h^* - Q_h^*)(R^j_{h,k} - C_h^*)(Q_k^* - Q_k^*)
\]

where subscripts of $R^j_{h,k}$ and the superscript of $C_h^*$ indicate (partial) derivatives. As revenue functions are concave and as cost functions are convex, the second-order term $\varepsilon^a$ is non-negative. First-order terms in eq. (11) cancel out.

Appendix B

Shapley’s theorem suggests analyzing sequences in which jurisdictions join cooperation one after the other. As the number of home jurisdictions is $n$ and as the number of foreign jurisdictions is $m$, there are $(n + m)!$ possible sequences. Only if jurisdiction $a \in A$
cooperates with a set of jurisdictions including all home jurisdictions, is the contributed profit positive. The claim is that this happens in \((n + m)!/(n + 1)\) sequences. In other words, the probability of joining a set of cooperating jurisdictions including all home jurisdictions in a randomly selected sequence is \(1/(n + 1)\). This is proved for fixed \(n\) and increasing \(m\) by induction.

The start is with \(m = 1\). There exist \(n!\) permutations of \(\{h_1, \ldots, h_n\}\) which are interpretable as sequences of arrival in the set of cooperation. As all \(h \in H\) have to arrive before \(a\) does if \(a\)’s profit contribution is to be positive, the probability of some positive contribution equals \(n!/(n + 1)! = 1/(n + 1)\).

Now assume that there are \((n + m)!/(n + 1)\) sequences of arrival of \(\{h_1, \ldots, h_n; a_1, \ldots, a_m\}\) such that \(a_1\) is preceded by all \(h \in H\). Select any such sequence and keep it fixed. If a further jurisdiction \(a_{m+1}\) is added to \(A\), there are \(n + m + 1\) ranks in the sequence where \(a_{m+1}\) can be included without destroying the property that \(a_1\) is preceded by all \(h \in H\). The probability that \(a_1\) contributes some positive profit therefore equals

\[
\frac{(n+m+1)!/(n+1)!}{(n+m+1)!} = \frac{1}{n+1}.
\]

9. References


OECD, 2015, OECD/G20 Base Erosion and Profit Shifting Project, Final Reports, Executive Summaries


