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SHAPLEY VALUE
Can Be Used as an Unspecified Method in Transfer Pricing

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AGENDA

I. Introduction - Shapley Value: A Fairer Way to Allocate Group Profits

II. Using Shapley Value to Attribute Value within the MNE Group

III. Why Shapley Value Should Be an Unspecified Method in Transfer Pricing Regulations

IV. Wrap-Up and Q&A

I. Shapley Value: A Fairer Way to Allocate Group Profits

Shapley Value - "for the theory of stable allocations and the practice of market design"

- Shapley Value is a solution concept in cooperative game theory.
  - Named in honor of Lloyd Shapley
  - Nobel Prize in Economics 2012

- Problem: A coalition of players cooperates and obtains a certain overall gain from that cooperation.
  - *How important is each player to the overall cooperation, and what payoff can each player reasonably expect?*

Useful Properties of Shapley Value

Assigns a unique distribution of the total surplus generated by a coalition of players in a cooperative game. Clear focus on business synergies from collaboration that add extra value to the players.

Takes account of (1) differences among players in their contributions to the coalition and (2) differences in their bargaining power when considering outside options.

Assesses the relative contribution of each player to the overall game and what payoff each player should reasonably expect from their respective contribution.

Example: Shapley Value in a Three-Player Game

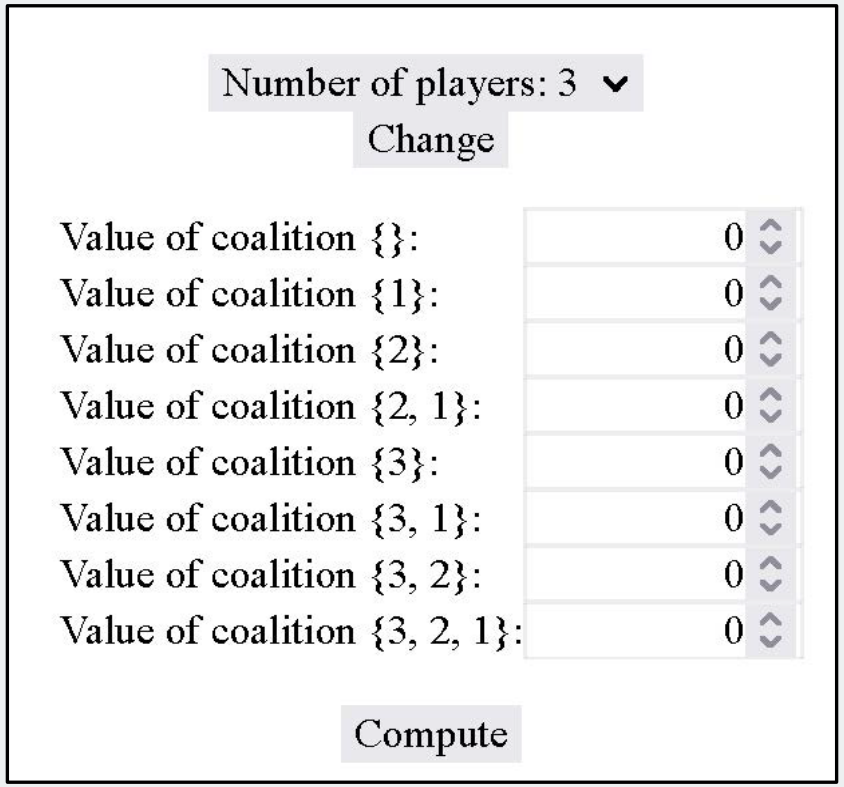
Example: Assume a three-player game. How should the total value be distributed among the players if they provide different contributions and differ in their bargaining power?

1. Calculate value to each player of playing alone or of playing with different sized coalitions

2. Take ordering into account by calculating, for each ordering, the marginal contribution each new player adds to the coalition

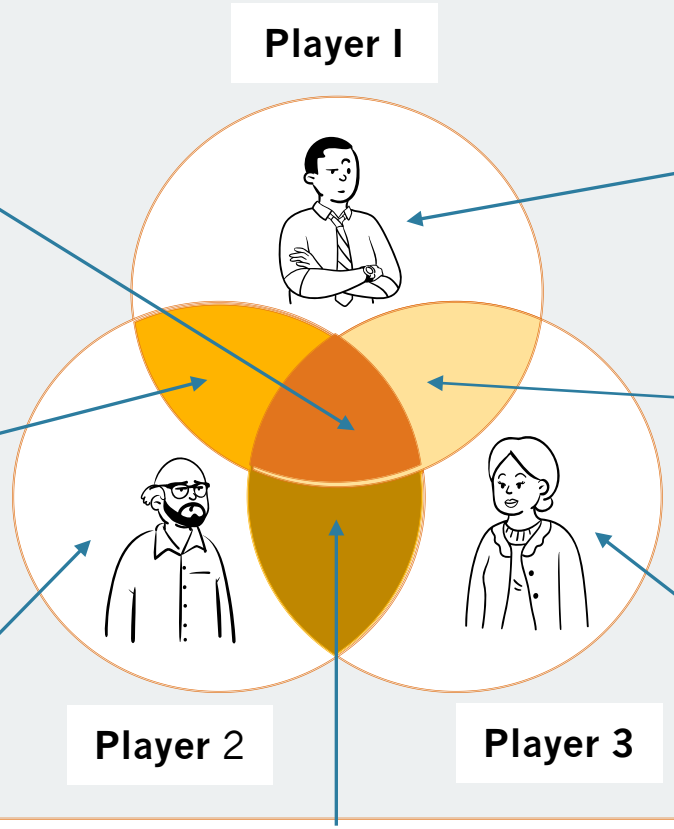
3. The average of the sum of each player's marginal contributions is his/her Shapley Value.

4. The Shapley Value formula allocates all consolidated profit earned together.



http://shapleyvalue.com

Intuition behind the Shapley Value



Synergies when **Player 1, Player 2 and Player 3 cooperate** (i.e., the pie that we observe)

What **Player I** could achieve **stand alone** (i.e., the outside option)

Synergies when **Player I & Player 2** work **together**

Synergies when **Player I & Player 3** work **together**

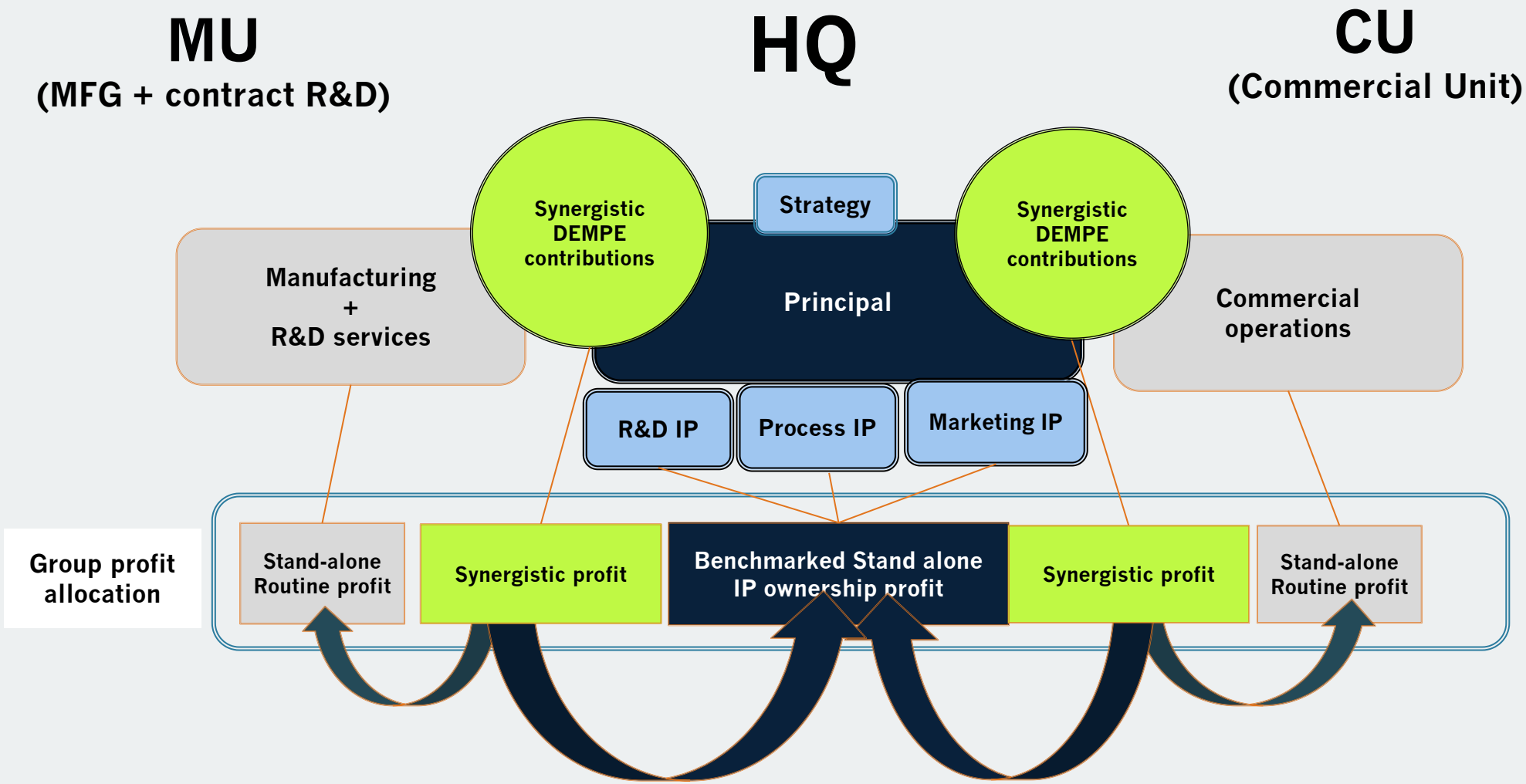
What **Player 2** could achieve **stand alone** (i.e., the outside option)

What **Player 3** could achieve **stand alone** (i.e., the outside option)

Synergies when **Player 2 & Player 3** work **together**

How to calculate Shapley Value: Determine the marginal contribution of each player to each possible coalition and average each player's marginal contribution across all possible coalitions to estimate that player's Value Creation to the group.

II. Using Shapley Value to Attribute Value within MNE Group



Economic Aspects to Consider for MNE Group

Stand-alone options of contributing entities in view of own capabilities, competitive market conditions, barriers to entry

Marginal DEMPE contributions & business synergies from collaborating with complementary companies

Observable market data & outcomes

Hypothetical Example: Estimated Coalition Values

Three players:
HQ: Headquarters as IP owner
MU: Manufacturing unit (+ contract R&D)
CU: Commercial unit

	Coalition	Lower Bounds	Synergies	Upper Bounds	Synergies
1	HQ	8.0%		10.0%	
2	MU (+ contract R&D)	2.0%		4.0%	
3	CU	2.0%		4.0%	
4	HQ, MU	14.0%	4.0%	22.0%	8.0%
5	HQ, CU	11.0%	1.0%	17.0%	3.0%
6	MU, CU	5.0%	1.0%	10.0%	2.0%
7	HQ, CU, MU	25.0%	13.0%	25.0%	7.0%

Consolidated value chain profit

Business & group synergies

Determined through stand-alone functional or IP benchmarking (e.g., CPM, TNMM, CUT)

In consideration of local market conditions and relative bargaining power, to be assessed through case-specific fact finding

Hypothetical Example: Shapley Value with Lower Bounds

MU

	Ordering	Set of players before MU	Coalition value before MU	Coalition value with MU	Marginal contribution of the MU
1	HQ, CU, **MU**	{HQ, CU}	11.0%	25.0%	14.0%
2	HQ, **MU**, CU	{HQ}	8.0%	14.0%	6.0%
3	CU, HQ, **MU**	{CU, HQ}	11.0%	25.0%	14.0%
4	CU, **MU**, HQ	{CU}	2.0%	5.0%	3.0%
5	**MU**, HQ, CU	0	0.0%	2.0%	2.0%
6	**MU**, CU, HQ	0	0.0%	2.0%	2.0%

MU Shapley value	**6.8%**

HQ

	Ordering	Set of players before HQ	Coalition value before HQ	Coalition value with HQ	Marginal contribution of the HQ
1	**HQ**, CU, MU	0	0.0%	8.0%	8.0%
2	**HQ**, MU, CU	0	0.0%	8.0%	8.0%
3	CU, **HQ**, MU	{CU}	2.0%	11.0%	9.0%
4	CU, MU, **HQ**	{CU, MU}	5.0%	25.0%	20.0%
5	MU, **HQ**, CU	{MU}	2.0%	14.0%	12.0%
6	MU, CU, **HQ**	{MU, CU}	5.0%	25.0%	20.0%

HQ Shapley value	**12.8%**
CU Shapley value	**5.3%**
Total	**25.0%**

Profit margins in % of external sales

Estimate of Shapley Value with Upper Bounds and Comparison

MU

	Ordering	Set of players before MU	Coalition value before MU	Coalition value with MU	Marginal contribution of the MU
1	HQ, CU, **MU**	{HQ, CU}	17.0%	25.0%	8.0%
2	HQ, **MU**, CU	{HQ}	10.0%	22.0%	12.0%
3	CU, HQ, **MU**	{CU, HQ}	17.0%	25.0%	8.0%
4	CU, **MU**, HQ	{CU}	4.0%	10.0%	6.0%
5	**MU**, HQ, CU	0	0.0%	4.0%	4.0%
6	**MU**, CU, HQ	0	0.0%	4.0%	4.0%

Profit margins in % of external sales

	Upper Bounds	Lower Bounds
MU Shapley value	**7.0%**	**6.8%**

HQ

	Ordering	Set of players before HQ	Coalition value before HQ	Coalition value with HQ	Marginal contribution of the HQ
1	**HQ**, CU, MU	0	0.0%	10.0%	10.0%
2	**HQ**, MU, CU	0	0.0%	10.0%	10.0%
3	CU, **HQ**, MU	{CU}	4.0%	17.0%	13.0%
4	CU, MU, **HQ**	{CU, MU}	10.0%	25.0%	15.0%
5	MU, **HQ**, CU	{MU}	4.0%	22.0%	18.0%
6	MU, CU, **HQ**	{MU, CU}	10.0%	25.0%	15.0%

	Upper Bounds	Lower Bounds
HQ Shapley value	**13.5%**	**12.8%**
CU Shapley value	**4.5%**	**5.3%**
Total	**25.0%**	**25.0%**

Note: Difference in Shapley Values using Upper Bounds and Lower Bounds estimates is small

III. Why Shapley Value as Unspecified Method in TP Regulations

Robust Economic foundation for crucial quantitative findings		
Multi-sided analysis	Tailoring to specific market or business line conditions	validation and corroboration of profit split solutions

Tax audits: focus on quantitative-economic arguments, allowing for an informed and constructive discussion with tax authorities

Litigation and arbitration: Helping to resolve disputes in a principled manner in corroboration with traditional methods (e.g., adjustment of benchmarked CPM/TNMM margins in consideration of some local DEMPE contributions)

- **Shapley Value can help establish, support and defend a fair and robust profit allocation**

Post-BEPS Non-Routine Profit Allocation Considerations

Legal IP concept replaced by broader concept of **intangibles and entrepreneurial roles and risks**

Tension between legal ownership of intangibles and significant **DEMPE functions**

Distinction between routine and non-routine functions blurred

MNE theory suggests MNEs strive to maximize **cross-functional synergies to outcompete their peers**

Different entities within the MNE group can have **entrepreneurial roles and assume strategic risks**

At the legal entity level, bargaining power depends on:

- **available outside options (including status quo)**
- Entity's functional bundle, risks, and local market position

➢ **Shapley Value can also establish, support and defend a fair and robust profit allocation under the OECD *Transfer Pricing Guidelines***

IV. Wrap-Up and Q&A

Some Reading Materials on Shapley Value

COMMENTARY & ANALYSIS

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Shapley Value: A Fair Solution to the Value Creation Puzzle In Transfer Pricing?

by Verena Hahn, Yves Hervé, Salem Saljanin, and Lorraine Eden

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In this article, the authors show how the Shapley value can be used by transfer pricing professionals to implement the OECD's value creation approach when several legal entities make development, enhancement, maintenance, protection, and exploitation contributions to a multinational group's profit.

The views expressed in this article are the authors' and do not reflect those of NERA Economic Consulting, Texas A&M University, BBW Hochschule — University of Applied Sciences, or any other person or institution.

The 2017 OECD Transfer Pricing Guidelines for Multinational Enterprises and Tax Administrations recommend that transfer pricing outcomes be aligned with value creation. The value creation approach is, however, difficult to apply when multiple legal entities in different tax jurisdictions contribute jointly to the profits a multinational enterprise earns on its intangible assets. This article argues that the Shapley value can be used to determine an appropriate arm's-length attribution based on each entity's contributions to the group profit. It briefly discusses the OECD's value creation approach to implementing the arm's-length principle, provides a brief literature review of the Shapley value concept, and argues that the Shapley value can help implement the value creation approach. An empirical case study using the Shapley value to attribute a multinational group's profits from marketing intangibles to the group's legal entities provides support for those arguments.

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Comments? Questions? Thank-you!

To share additional comments and questions, contact us at:

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