MANAGERIAL ECONOMICS

LECTURE 6: BUNDLING

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Aims of this lecture

- How managers can use *bundling* to increase profit when customers have heterogeneous tastes
- How firms use *transfer pricing* to provide incentives to subsidiaries (and to shelter profit from taxes)

Bundling

Bundling

To offer several products or services as a package.

Simple bundling: no option to buy package components separately

Mixed bundling: either buy the bundle (less costly) or the separate components (costlier)

- Streaming or movie theatres
- Cable or satellite TV channels
- Restaurants: Fixed Menu or a la carte
- Sports: Seasonal or event tickets
- Quantity discounts
- Funeral services

Conditions for bundling

- **Negative correlation of demand:** Some customers have higher reservation prices for one item in the bundle and lower reservation prices for another item in the bundle; and another group of customers has the reverse preferences
- **Marginal costs** for production should be low

Advantages of bundling

- Bundling can increase the seller's profits as customers have varied tastes
- Bundling does not require knowledge of individual consumers' reservation prices, but only the **distribution** of consumers' reservation prices
- Bundling can come close to first-degree price discrimination when it is not otherwise possible, e.g., reservation prices cannot be determined or laws prohibit price discrimination

Strategies

Assume: Goods are independent and the value of a bundle to a buyer is equal to the sum of the reservation prices of the goods in the bundle.

Consider:

1. Separate pricing: Goods are not bundled.
   - Prices are set equal to profit-maximizing monopoly prices.
2. Pure bundling
   - Bundle price is set to maximize profit.
3. Mixed bundling
   - Bundle price and individual good prices are set to maximize profit.

Benchmark: No bundling

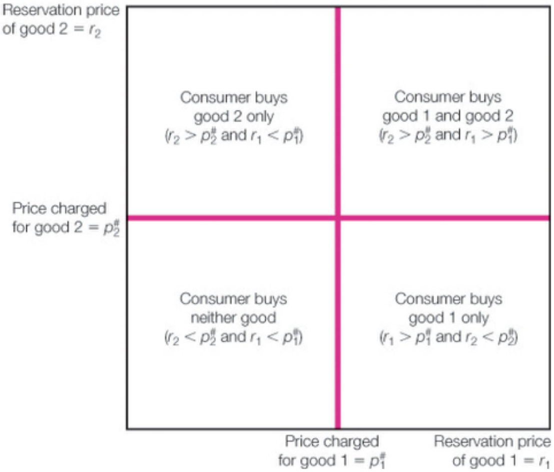
r_i = Reservation price of good i (aka willingness-to-pay, WTP)

p_i = Price charged for good i if sold separately from bundle
P_B = Price of bundle

With separate prices:

- If $r_1 < p_1$ and $r_2 < p_2$, then consumer buys neither good.
- If $r_1 > p_1$ and $r_2 < p_2$, then consumer buys only good 1.
- If $r_1 < p_1$ and $r_2 > p_2$, then consumer buys only good 2.
- If $r_1 > p_1$ and $r_2 > p_2$, then consumer buys both goods.

Pricing components separately

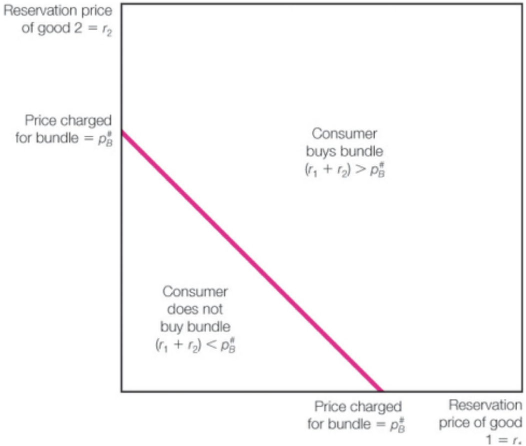


Notes: Each consumer decides to buy the two goods based on the reservation prices, r_1, r_2, and the goods' prices, p_1, p_2. See Allen et al., *Managerial Economics* (8th ed.), Figure 10.1, p360

The mechanics

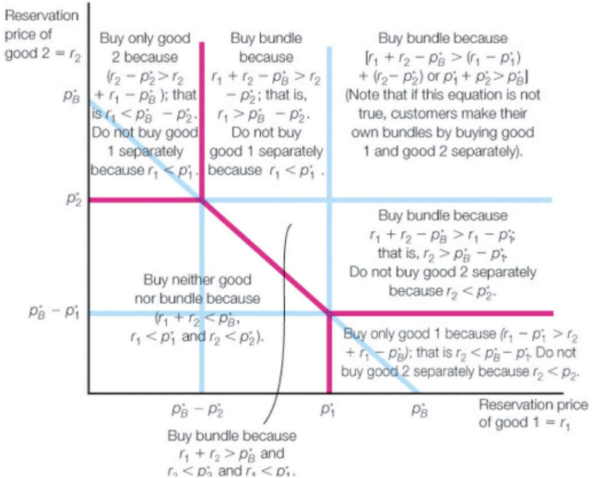
1. Pure Bundling:
   - ☐ If $(r_1 + r_2) < P_B$, then consumer does not buy the bundle.
   - ☐ If $(r_1 + r_2) > P_B$, then consumer buys the bundle.
2. Mixed Bundling:
   - ☐ Buy neither good nor bundle: $(r_1 + r_2) < P_B, r_1 < p_1$, and $r_2 < p_2$
   - ☐ Buy bundle: $(r_1 + r_2) > P_B$
   - ☐ Buy good 1 only: $r_1 > p_1, r_2 < p_2$, and $r_2 < (P_B - p_1)$
   - ☐ Buy good 2 only: $r_2 > p_2, r_1 < p_1$, and $r_1 < (P_B - p_2)$

Pure bundling



Notes: Each consumer decides to buy the bundle based on the sum of the reservation prices for the two components, $(r_1 + r_2)$, and the price of the bundle, p_B. See Allen et al., *Managerial Economics* (8th ed.), Figure 10.2, p360.

Mixed bundling



Notes: Each consumer decides to buy the bundle or the components separately based on the option that maximizes their consumer surplus. See Allen et al., *Managerial Economics* (8th ed.), Figure 10.3, p362

Dissecting this...

The sections of the previous diagram are determined by the relative values of reservation prices and the prices for the components and the bundle. The sections which are indicated by the faint blue lines collapse to four areas.

- Area 1, left bottom. Consumer buys neither good, nor the bundle: $r_1 < p_1$, $r_2 < p_2$, and $r_1 + r_2 < p_B$.
- Area 2, right bottom. Consumer buys only good 1: $r_1 > p_1$, $r_2 < p_2$, and $r_1 - p_1 > r_1 + r_2 - p_B$.
- Area 3, left top. Consumer buys only good 2: $r_1 < p_1$, $r_2 > p_2$, and $r_2 - p_2 > r_1 + r_2 - p_B$.
- Area 4, left top. Consumer buys only the bundle, either because the gains from buying the bundle are greater than buying the components separately or because the gains of additional buying the other good are greater than the costs.

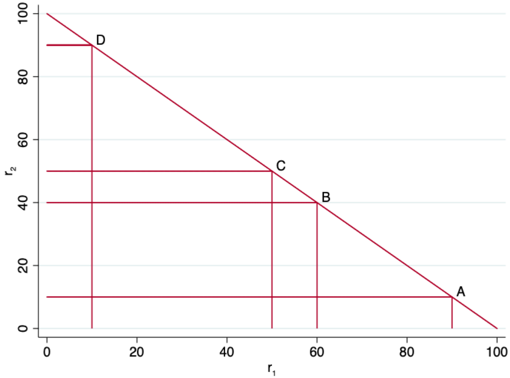
In practice, this is difficult to solve, see Hanson and Martin, 1990, *Management Science*.

Consider these four

Consumer	WTP Good 1	WTP Good 2	Price of bundle
A	90	10	100
B	60	40	100
C	50	50	100
D	10	90	100

Notes: Perfect negative correlation among consumer's reservation prices. All buyers value the bundle at the same value, €100. Assume cost of production are the same for good 1 and good2. Allen et al., *Managerial Economics* (8th ed.), Table 10.1, p363.

Perfectly negatively correlated reservation prices



Notes: Graphical representation of the four customers' reservation values. They are perfectly negatively correlated, but each values both goods at 100. Allen et al., *Managerial Economics* (8th ed.), Figure 10.4, p363.

Optimal separate prices

Consumer	Price 1	Cost/unit	Profit/unit	Number of units	Profit
A	90	1	89	1	89
B	60	1	59	2	118
C	**50**	1	49	3	**147**
D	10	1	9	4	36

Consumer	Price 2	Cost/unit	Profit/unit	Number of units	Profit
A	10	1	9	4	36
B	**40**	1	39	3	**117**
C	50	1	49	2	98
D	90	1	89	1	89

Notes: Notice that if the firm prices the goods separately, it is optimal to price them at $P_1 = 50$ and $P_2 = 40$. Profits are 264. Allen et al., *Managerial Economics* (8th ed.), Table 10.2, p364.

Optimal bundles

Consumer	Bundle price	Cost/bundle	Profit/bundle	Number sold	Profit
A, B, C, D	100	2	98	4	392

Consumer	Price 1	Cost/unit	Profit/unit	Number sold	Profit
None	90.01	1	89.01	0	0

Consumer	Price 2	Cost/unit	Profit/unit	Number sold	Profit
None	90.01	1	89.01	0	0

Notes: The optimal price for a pure bundle is $P_B = 100$, resulting in profits of 392. Allen et al., *Managerial Economics* (8th ed.), Tables 10.3 and 10.4, p364.

Optimal mixed bundles

Consumer	Bundle price	Cost/bundle	Profit/bundle	Number sold	Profit
A, B, C, D	100	2	98	4	392

Consumer	Price 1	Cost/unit	Profit/unit	Number sold	Profit
None	90.01	1	89.02	0	0

Consumer	Price 2	Cost/unit	Profit/unit	Number sold	Profit
None	90.01	1	89.02	0	0

Notes: The optimal mixed bundle prices are $P_B = 100$, $P_1 > 90$, and $P_2 > 90$. Profits are as in the pure bundle (no customer buys a separate component), 392. Allen et al., *Managerial Economics* (8th ed.), Table 10.4, p365.

Optimal mixed bundles when consumers buy a bundle and at least one good separately

Consumer	Bundle price	Cost/bundle	Profit/bundle	Number sold	Profit
B, C	100	2	98	2	196
Consumer	Price 1	Cost/unit	Profit/unit	Number sold	Profit
A	89.99	1	88.99	1	88.99
Consumer	Price 2	Cost/unit	Profit/unit	Number sold	Profit
D	89.99	1	88.99	1	88.99

Notes: The optimal prices in this situation are $P_B = 100$, $P_1 = 89.99$, and $P_2 = 89.99$. Profits are 379.98. Allen et al., *Managerial Economics* (8th ed.), Table 10.5, p365.

Different concepts

- **Extraction**: Setting the prices such that they ensure the (complete) extraction of consumer surplus, e.g., first price discrimination.
- **Exclusion**: Setting the prices such that they ensure that consumers who value the good less than the production costs do not buy it.
- **Inclusion**: Setting the prices such that they ensure that consumers who value the good more than the production costs do buy it.

Example: The importance of costs

Assume

- Perfect negative correlation among consumer reservation prices
- No variation in total bundle valuation; all value the bundle at €100
- Unit cost of production for each good = €11.

Optimal separate prices

Consumer	Price 1	Cost/bundle	Profit/unit	Number of units	Profit
A	90	11	79	1	79
B	60	11	49	2	98
C	**50**	11	39	3	**117**
D	10	11	-1	4	-4

Consumer	Price 2	Cost/bundle	Profit/unit	Number of units	Profit
A	10	11	-1	4	-4
B	**40**	11	29	3	**87**
C	50	11	39	2	78
D	90	11	79	1	79

Notes: Notice that—in this example!—that greater costs do not change the optimal prices. Allen et al., *Managerial Economics* (8th ed.), Table 10.6, p366.

Optimal pure bundles

Consumer	Bundle price	Cost/bundle	Profit/bundle	Number sold	Profit
A, B, C, D	100	22	78	4	312

Notes: Notice that—in this example!—that greater costs do not change the optimal price. Allen et al., *Managerial Economics* (8th ed.), Table 10.7, p367.

Optimal mixed bundles

Consumer	Bundle price	Cost/bundle	Profit/bundle	Number sold	Profit
A, B, C, D	100	22	78	4	312

Consumer	Price 1	Cost/bundle	Profit/unit	Number sold	Profit
None	90.01	1	89.02	0	0

Consumer	Price 2	Cost/bundle	Profit/unit	Number sold	Profit
None	90.01	1	89.02	0	0

Notes: Notice that—in this example!—that greater costs do not change the optimal prices. Allen et al., *Managerial Economics* (8th ed.), Table 10.8, p367.

Optimal mixed bundles when consumers buy the bundle and at least one good separately

Consumer	Bundle price	Cost/bundle	Profit/bundle	Number sold	Profit
B, C	100	22	78	2	156
Consumer	Price 1	Cost/bundle	Profit/unit	Number sold	Profit
A	89.99	11	78.99	1	78.99
Consumer	Price 2	Cost/bundle	Profit/unit	Number sold	Profit
D	89.99	11	78.99	1	78.99

Notes: Notice that—in this example!—that greater costs do not change the optimal prices. **NB** that mixed bundling yields 313.98 in profits. Allen et al., *Managerial Economics* (8th ed.), Table 10.9, p368.

Comparisons

	Profits	
	Example 1	Example 2
Separate prices	264.00	204.00
Pure bundle	392.00	312.00
Mixed bundle	392.00	312.00
Mixed bundle+	379.98	313.98

Notes: “Mixed bundle +” refers to the situation where consumers buy the bundle and at least one consumer buys at least one component separately.
Allen et al., *Managerial Economics* (8th ed.), Table 10.9, p368.

Criteria for successful bundling

- **Credibility of the bundle:** When managers correctly anticipate which customers will purchase the bundle or the goods separately

- Extraction, exclusion, and inclusion are all satisfied by perfect price discrimination.
- Pricing separately will satisfy exclusion but will not result in complete extraction or inclusion.

Successful bundling

- **Pure bundling** may extract WTP completly, but if consumers' reservation prices do not correlate perfectly negatively, the extraction will be less than complete
- Pure bundling may fail full inclusion and exclusion
- The profit from **mixed bundling** is always greater or equal than that of pricing separately or pure bundling
- However, mixed bundling prices are difficult to find

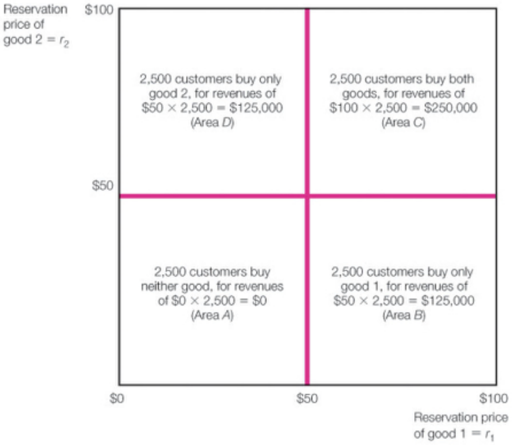
Correlation of reservation prices

- When costs are low: A pure bundle extracts entire consumer surplus.
- With greater costs: A mixed bundle is optimal.
- As costs increase: separate pricing becomes profit-maximizing.

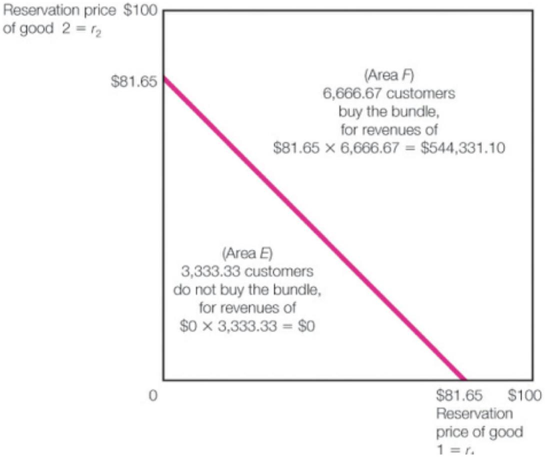
Negative correlation is not necessary for bundling to be optimal.
Assume 10,000 customers are uniformly distributed over their reservation prices:

- $r_1 \sim$ uniform$(0, 100)$
- $r_2 \sim$ uniform$(0, 100)$
- This implies corr$(r_1, r_2) = 0$!
- For simplicity, assume costs of production are 0.

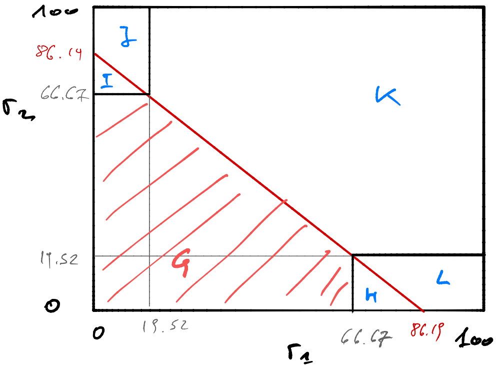
Optimal separate prices with uniformly distributed reservation prices



Optimal bundle price with uniformly distributed reservation prices



Optimal mixed bundle price with uniformly distributed reservation prices



Notes: The optimal mixed bundle prices in this example are $P_1 = P_2 = 66.67$ and $P_B = 86.19$. The conditions for areas G, H, I, J, L, and K are given in footnote 5 on p371. Profit is 549,201.See Allen et al., *Managerial Economics* (8th ed.), Figure 10.7, p372.

Unbundling

- A firm may always price its goods separately. If circumstances changes, it might be better to stop bundling and to price separately.
- (There is an elaborate example in the book, p377–381.)
- The important message from these exercises: To price optimally, you have (i) to consider your costs, and (ii) to consider the welfare a consumer obtains from a purchase.

Bundling as a preemptive entry strategy

- Bundling can be used to deter entry.
- A firm is producing two or more goods, but its rival is only producing one of them
- Bundling may deter entry: the bundle could be more attractive than the single offers from the rival firm

What did we learn about bundling?

- Pure bundling is profitable if demand of several goods is negatively correlated
- Market research: individual WTP is not needed
- Pure bundling: sum of different groups' WTP to set price optimally
- Bundling if MC are low
- Mixed bundling: optimal prices are difficult to find
- Bundling can be uses as a quantity discount or a deterrence to entry

Tying

Tying

A product requires a complementary product.

- The consumer needs to buy the complementary product from the same firm
- Examples: Toner for computer printer, spare parts for cars
- It is a type of bundling, here: for complementary products

Why would consumers accept tying?

- Monopoly: The brand name is protected
- Warranty: No guarantee if other firm's products are used
- Different prices for light/heavy use: e.g., printer expensive and toner cheap
- Gain market share: sell printer cheap, but price toner high
- Network effects: consumers have switching costs, e.g., from phone brand A to brand B

Example: Microsoft

Microsoft tied operating system with internet browser

- Antitrust case
  - abuse of monopoly power (90% market share)
  - Microsoft stated that the merging of Microsoft Windows and Internet Explorer was the result of innovation and competition
  - Internet Explorer vs. Netscape
  - In 2001, the US Dep. Of Justice reached an agreement with Microsoft to settle the case. The proposed settlement required Microsoft to share its application programming interfaces with third-party companies and appoint a panel of three people who will have full access to Microsoft's systems, records, and source code for five years in order to ensure compliance

Example: Hewlett Packard

HP tied printers with toner cartridges

- HP made half of its revenues with cartridges in 2002
- Possibility to refill old cartridges arose
- New chip in cartridges made it impossible to refill
- New EU law prohibits this

Transfer pricing

Transfer price

Payment to simulates a market price where no formal market exists

The purpose of transfer prices:

- Create an incentive to behave profit-maximizing or cost-minimizing
- Create a measure for performance
- Often found in firms with many subsidiaries

The workings of transfer pricing

Assume: A firm that consists of an upstream plant and a downstream monopolist

Distinguish two cases:

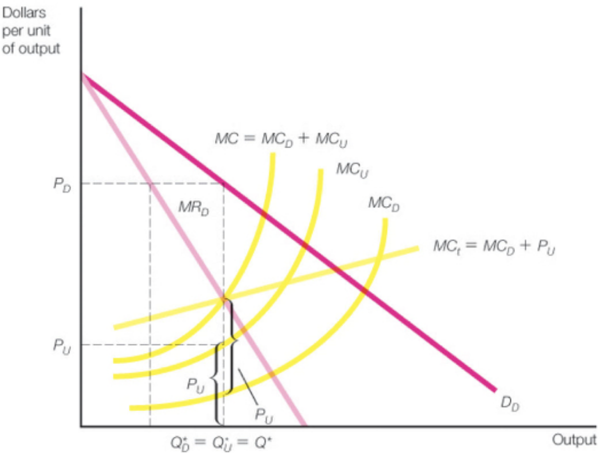
1. There is no external market for the product of the upstream division
2. There is an external market for the upstream product

Transfer pricing, no market price

If no market exists: the transfer price should be equal to the marginal cost at the optimal output of the upstream product division

- Downstream operation is subject to market discipline
- Managers need to ensure that profit-maximizing output is produced: $Q^* = Q_D(P) = Q_U(P)$
- Upstream division becomes a price taker although no market exists. It faces a price P_U, set by the downstream firm such that the optimal price P_U equals the marginal cost at the optimal output Q^*
- This has (may have) consequences on the within-firm profits

Transfer prices, no external market for transferred good



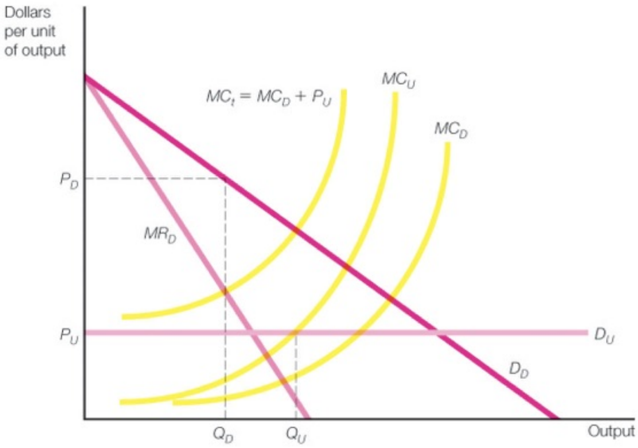
Notes: The optimal transfer price, P_U, is equal to MC at optimal output, Q^*. See Allen et al., *Managerial Economics* (8th ed.), Figure 10.9, p392.

Transfer pricing with a market price

If a market exists: the transfer price should be equal to the market price of the upstream product

1. Upstream firm produces quantity that is optimal given the outside market
   - ☐ If we assume perfect competition at the upstream market, prices are equal to marginal cost
2. Upstream firm produces too much output
   - ☐ Upstream firm may sell excess output at the market
   - ☐ Downstream firm may buy necessary input at the market

Transfer prices, with external market for transferred good



Notes: The optimal transfer price, P_U, is equal to the market price. See Allen et al., *Managerial Economics* (8th ed.), Figure 10.10, p393.

Japan's tax authority leans on foreign firms

Japan's tax authority claims that foreign companies avoid the country's high taxes by illegally shifting profit off their books in Japan

- The tax authority has filed claims against at least 50 multinationals totalling approximately $492.4 million in lost taxes
  - Among these firms: Coca-Cola, DaimlerChrysler, Procter & Gamble, Goodyear Tire and Rubber, Roche Holding AG
  - DaimlerChrysler recently paid Japan an extra $45.87 million for taxes allegedly owed in Japan that were shifted to Germany via transfer payments
- Japan keeps about 50% of yearly earnings compared to 41% in the US and 33% in UK
- Japan believes that some non-Japanese parent companies overcharge their Japanese subsidiaries

Transfer pricing, globally

Managers can use transfer pricing to shift profits between divisions to minimize tax liability:

- Decreases profit in high-tax countries
- Increases profit in low-tax countries

Assume there is no external market for the upstream product and that all profits are expressed in the same currency:

$\alpha =$ Tax rate in a downstream country

$\beta =$ Tax rate in an upstream country, where $\alpha > \beta$

Shifting profits from high to low tax countries

After-tax profit in the downstream country:

$(1-\alpha)(TR_D - TC_D - P_U Q_U)$

After-tax profit in the upstream country:

$(1-\beta)(P_U Q_U - TC_U)$

Total after-tax profit:

$(1-\alpha)(TR_D - TC_D) - (1-\beta)(TC_U) + (\alpha - \beta)(P_U Q_U)$

Increasing the transfer price (P_U) will increase after-tax profit.

On the importance of transfer prices

- Increased globalization
- Different taxes in different countries (tax havens)
- Greater scrutiny by tax authorities
- Inconsistent rules and laws in different tax jurisdictions