Return on wood production by tree species in Finland

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IUFRO 125th Anniversary Congress
Managerial Economics and Accounting
18 Sept 2017, Freiburg

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Return **by tree species**, the next step in “return on roundwood production” studies in Finland

- The **objective** of the studies: to provide approximations for economic results in forestry and approximations for comparisons
- Previous studies
  - **Lausti, A. & Penttinen, M. 1998.** The Analysis of Return and Its Components of Non-industrial Private Forest Ownership by Forestry Board Districts in Finland
    - **New:** use of price, cost, harvest and forest inventory (growth and standing volume) data to produce aggregate return estimates for private forestry, components of return, 20 Forestry Board districts in Finland
    - **Results:** first estimates of return on roundwood production and its components in Finland, simplified return comparison to private housing
  - **Penttinen, M. & Lausti, A. 2004.** The Competitiveness and Return Components of NIPF Ownership in Finland
    - **New:** extension to and comparison with real estate and financial investments (private housing, offices, stocks, forest industry stocks)
    - **Results:** updated estimates of return, forestry correlates and is comparable only with private housing, whereas other financial investments outperform

Employed **formula and data** for the return on roundwood production calculation

$$\ln\left(\frac{1+0.05}{1}\right)=0.0488$$

- Returns ***r*** are based on natural logarithm (continously compounded return):
  - 34 ***y***early observations (1983-2016)
  - 6 roundwood ***a***ssortments (3 tree species, Norway spruce, Scots pine and Hardwoods, each with logs and pulpwood)
  - Stumpage ***P***rices, Standing ***V***olumes, ***I***ncrements, ***F***ellings, Net ***C***osts from forest statistics, forest inventory data is inter- and extrapolated

$$r_{y,NIPF} = LN\left(\frac{\sum_{a=1}^{6} P_{ya}(V_{y-1,a} + I_{ya} - F_{ya}) + \sum_{a=1}^{6} P_{ya} F_{ya} - C_{y}}{\sum_{a=1}^{6} P_{y-1,a}\, V_{y-1,a}}\right)$$

  - Calculations are made over all tree species and separately over each tree species: the data is from non-industrial private forests (NIPF)
  - We use deflator (cost-of-living index) to adjust prices in order to obtain **real returns**: rate of inflation is not of our interest

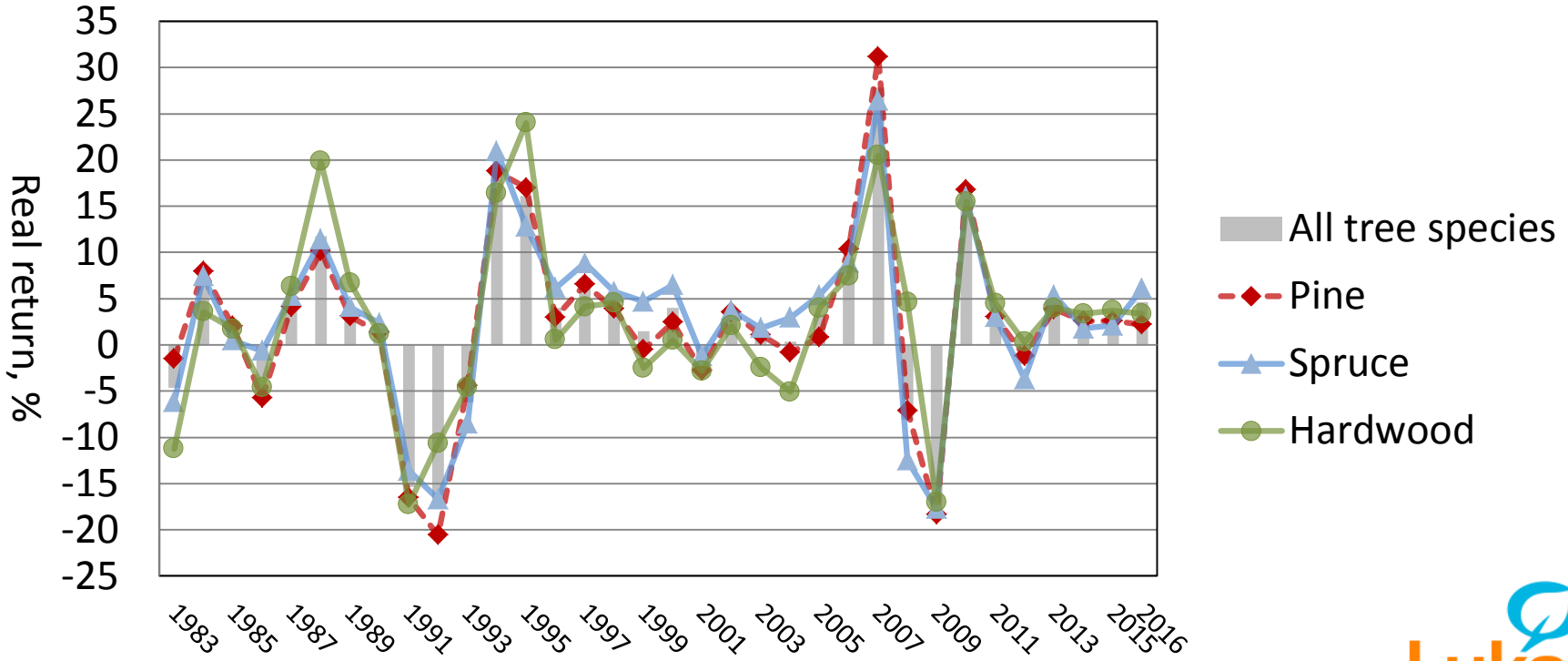
How we present the returns by tree species: **A split** into return components

- In formula, felling income does not have an impact on the total return calculation

$$r_{y,NIPF} = LN\left(\frac{\sum_{a=1}^{6} P_{ya}(V_{y-1,a} + I_{ya} - A_{ya}) + \sum_{a=1}^{6} P_{ya} F_{ya} - C_y}{\sum_{a=1}^{6} P_{y-1,a} V_{y-1,a}}\right)$$

- The total return on roundwood production depends only on three income components (stumpage prices, increment and costs) and value of standing volume as an asset
- Therefore a split into return components can be made for
  - Change in value of standing volume due to change in stumpage price
  - Value of increment
  - Net costs (silvicultural and forest improvement costs less public support)
- However, as fellings produce 'hard cash' and the needed price information, we may further split the value of increment into
  - Felling income
  - Value of net increment

A start with total return. Return on roundwood production by tree species in Finland 1983-2016



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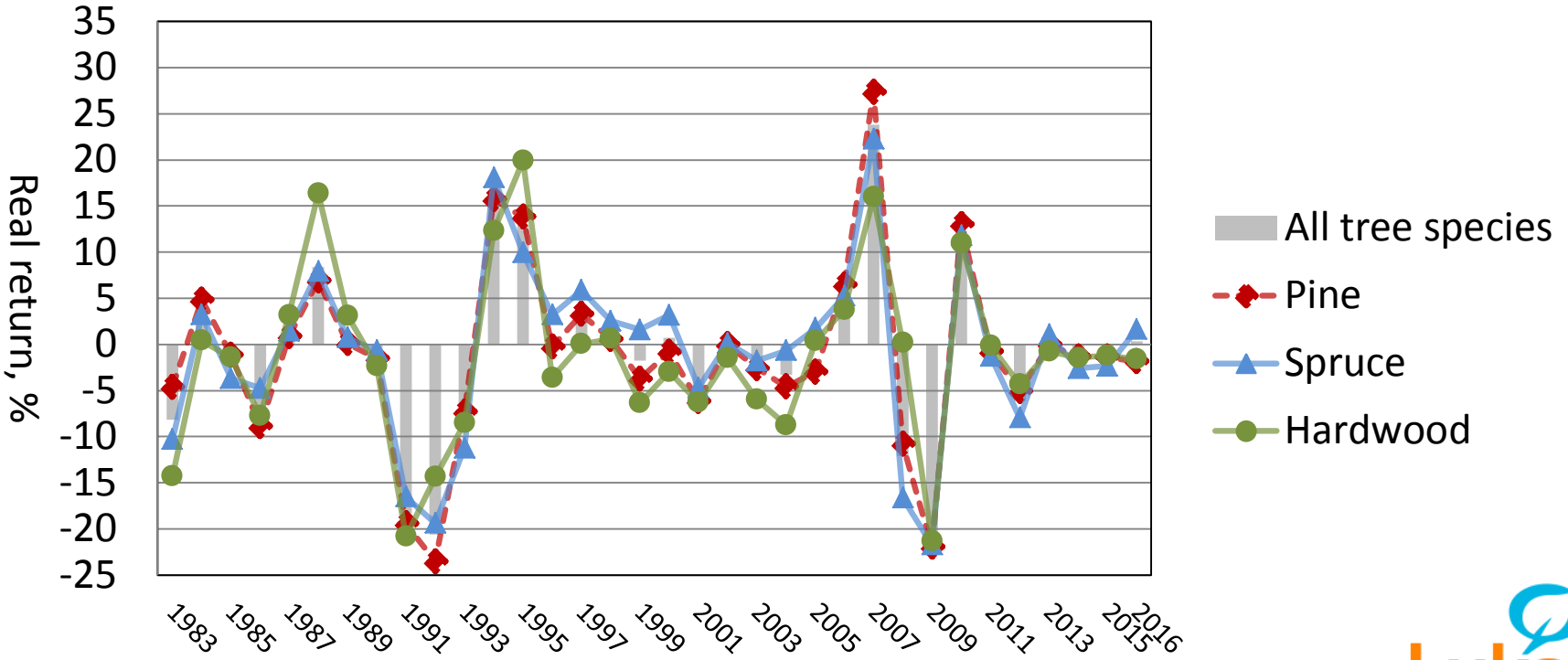
Return decomposition I. Impact of stumpage price on the value of standing volume 1983-2016



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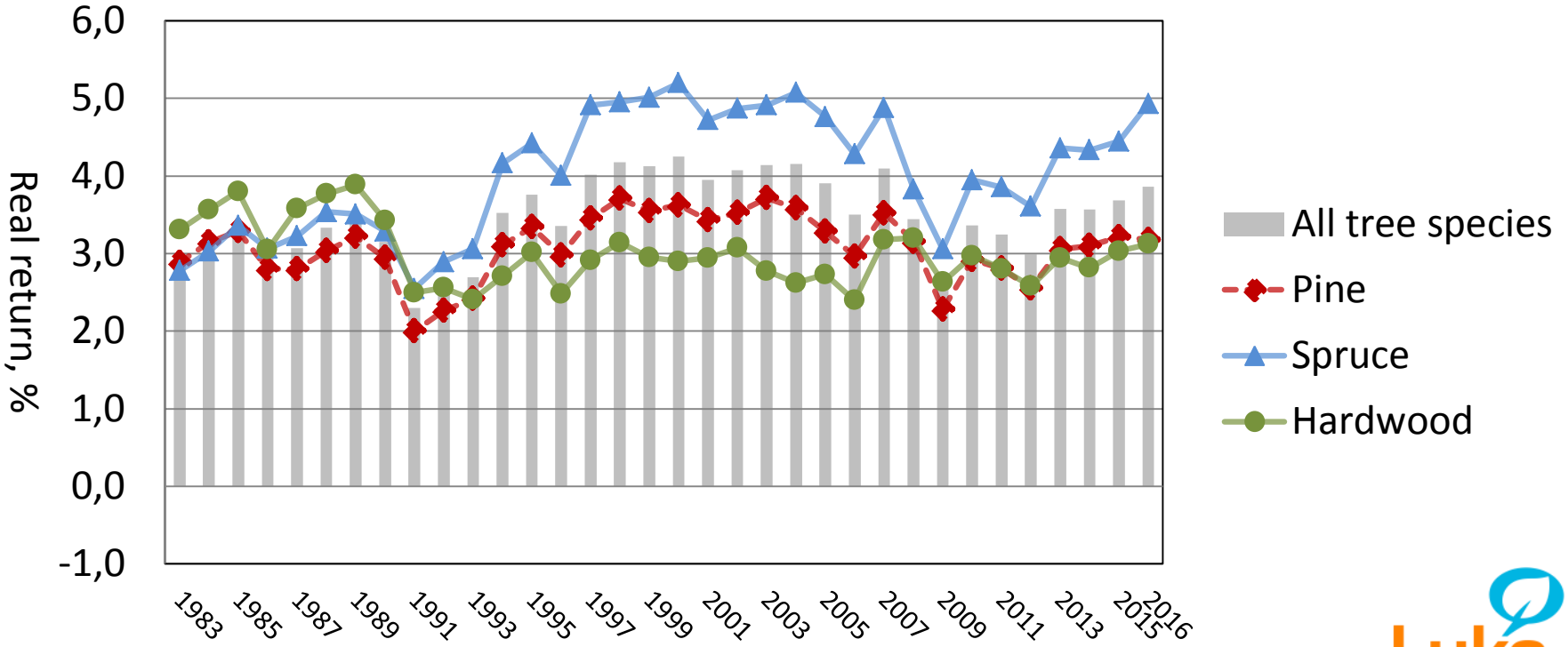
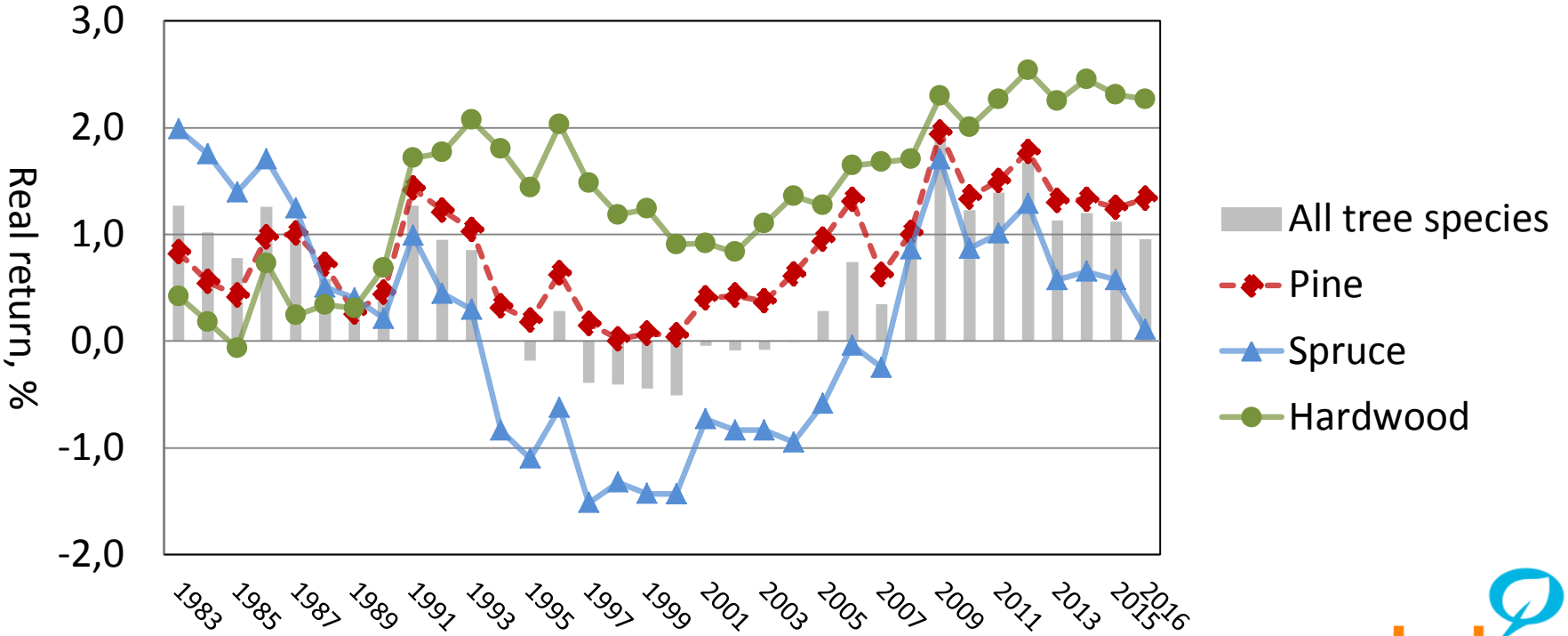
Return decomposition II. Felling incomes 1983-2016

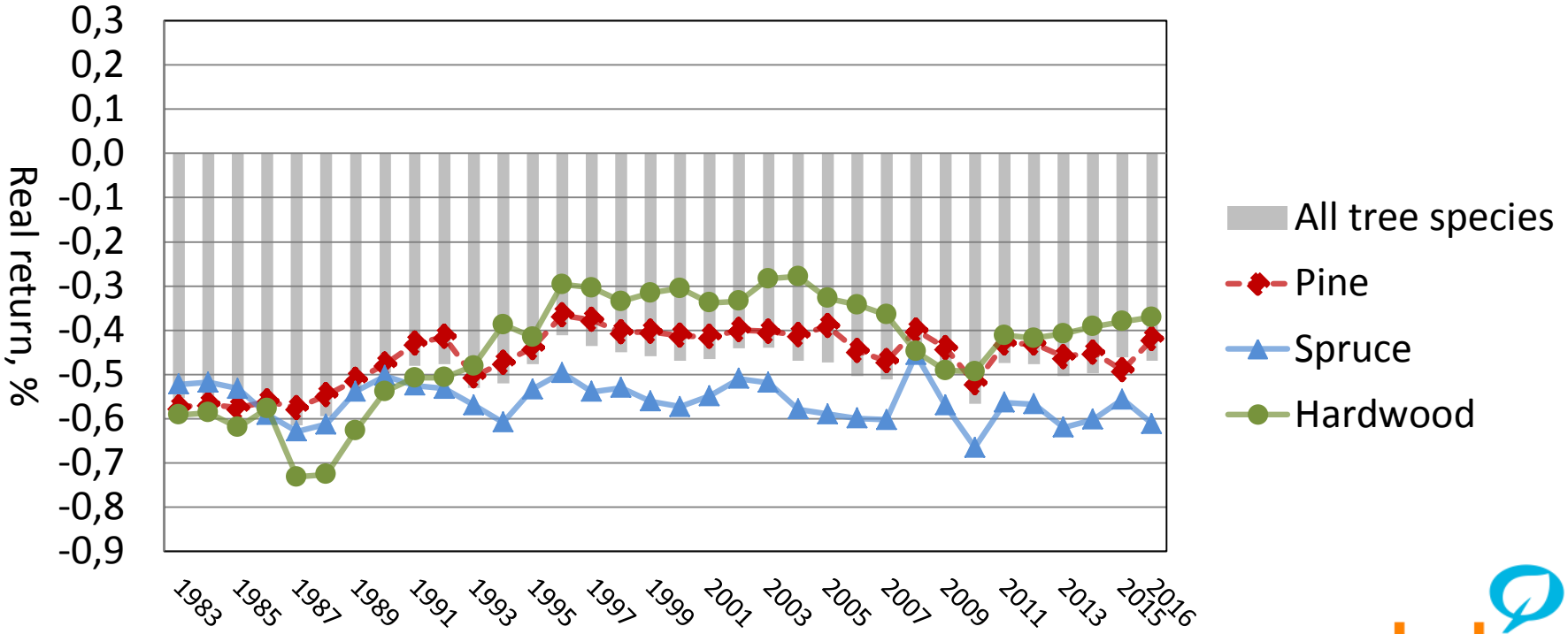


Return decomposition III. Value of net increment 1983-2016



Return decomposition IV. Net costs 1983-2016

(allocation to tree species according to felling incomes)



Back to total return. Long term averages by tree species: Norway spruce has outperformed

Because the standing volume valued with stumpage prices dominates the calculation (this value is 'reinvested' to next period), we employ geometric mean in long term averages

a) 1983-2016	Pine	Spruce	Hardwood	Total
Geometric mean	2.3 %	2.9 %	2.5 %	2.6 %
Standard deviation	9.99 %	9.52 %	9.40 %	9.50 %
b) 1983-1992				
Geometric mean	-1.6 %	-0.6 %	-0.4 %	-1.0 %
Standard deviation	10.04 %	9.03 %	10.82 %	9.47 %
c) 1993-2016				
Geometric mean	3.9 %	4.4 %	3.7 %	4.1 %
Standard deviation	9.72 %	9.52 %	8.70 %	9.28 %

Standard deviation indicates the risk related to specific return, used e.g. in Sharpe ratio

Ranking for tree species

a) 1983-2016
1. Spruce 2.9%
2. Hardwood 2.5%
3. Pine 2.3%

b) 1983-1992
1. Hardwood -0.4%
2. Spruce -0.6%
3. Pine -1.6%

c) 1993-2016
1. Spruce 4.4%
2. Pine 3.9%
3. Hardwood 3.7%

Some **assumptions** behind the approach and ***caveat auditor*** – starting points for further studies

- Some crucial assumptions
  - Stumpage prices from fellings can be employed both for income and asset valuation with respective harvested and standing volumes, i.e. we can ignore harvesting costs
  - Fellings and standing volumes can be valued equally
  - Land and expectation values can be excluded (impacts of buying and selling of forest land)
  - Net costs can be estimated, also by tree species
- *Caveat auditor**
  - Forest stand age class structure affects the analysis
  - Approach is best applicable for analyses, where all age classes of forest stands are (almost) equally present
  - Due to assumptions, results are not exact but rather magnitude estimates for roundwood production (in average forests in large areas)
  - The return decomposition is not exact but an approximation

*Beware, the receiver of message

Thank you!

Questions?

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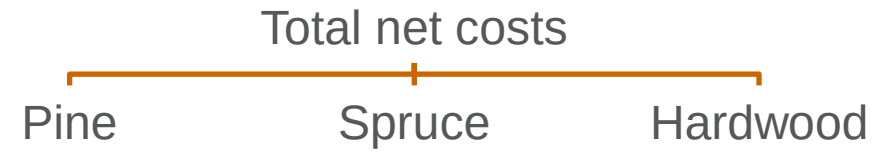
Some alternative principles for net cost allocation for tree species



Some alternative principles for cost allocation (long-term average)	Scots pine, %	Norway spruce, %	Hardwood (mainly silver birch), %	Total, %
Felling income	**40.2**	**49.1**	**10.6**	**100.0**
Standing volume	47.4	32.8	19.8	100.0

Probable ranking of costs by typical stands:

Spruce (mostly costly planting, dominates planting in Finland) **>** Pine (costly planting and natural regeneration) **>** Hardwood (naturally mixed in softwood stands, in Finland least magnitudes of costly planting and natural regeneneration)

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